

J. S. WILLIAMS.

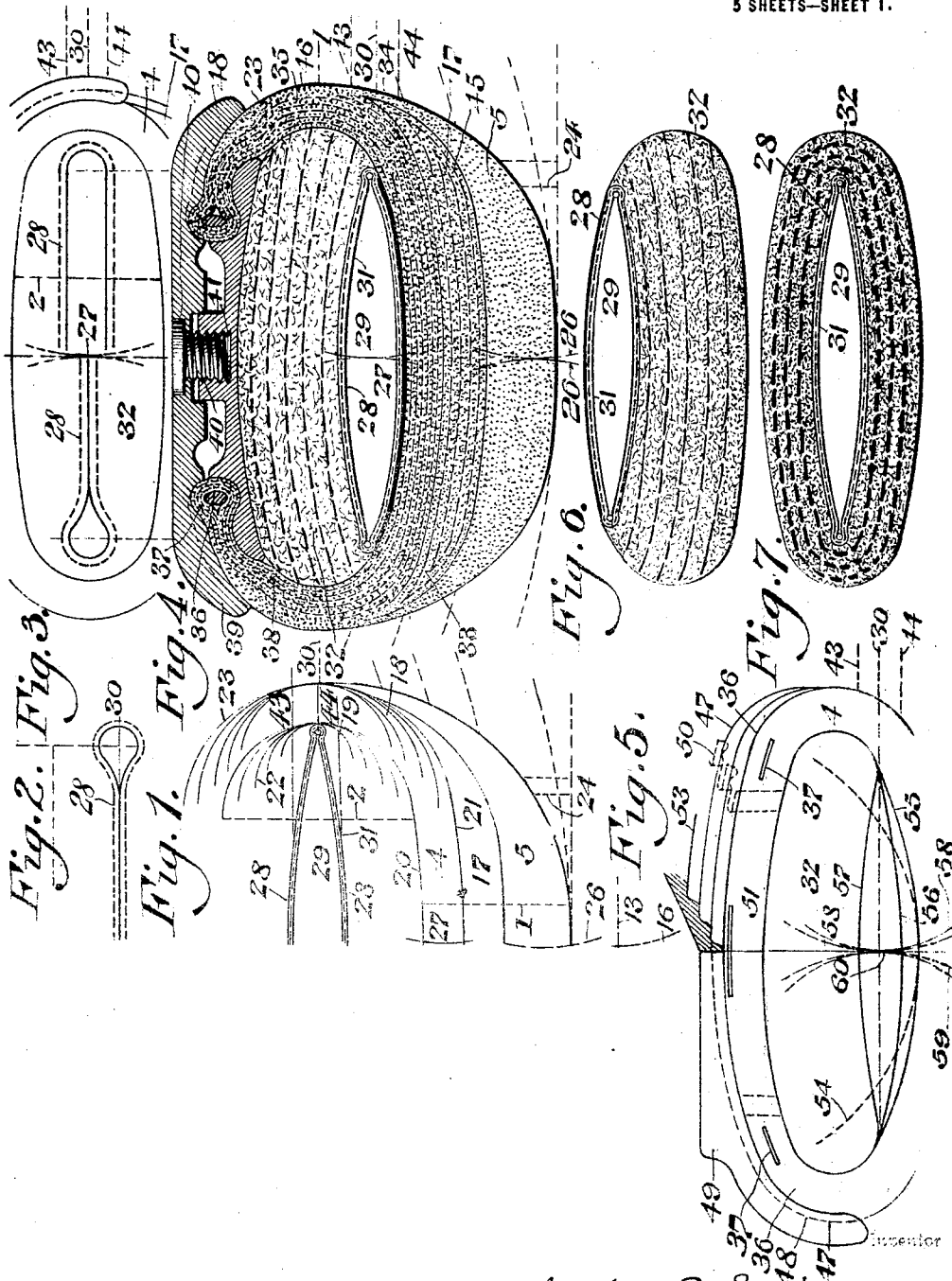
RESILIENT TIRE.

APPLICATION FILED JAN. 19, 1911. RENEWED MAR. 14, 1917.

1,250,405.

Patented Dec. 18, 1917.

5 SHEETS—SHEET 1.



Witnesses

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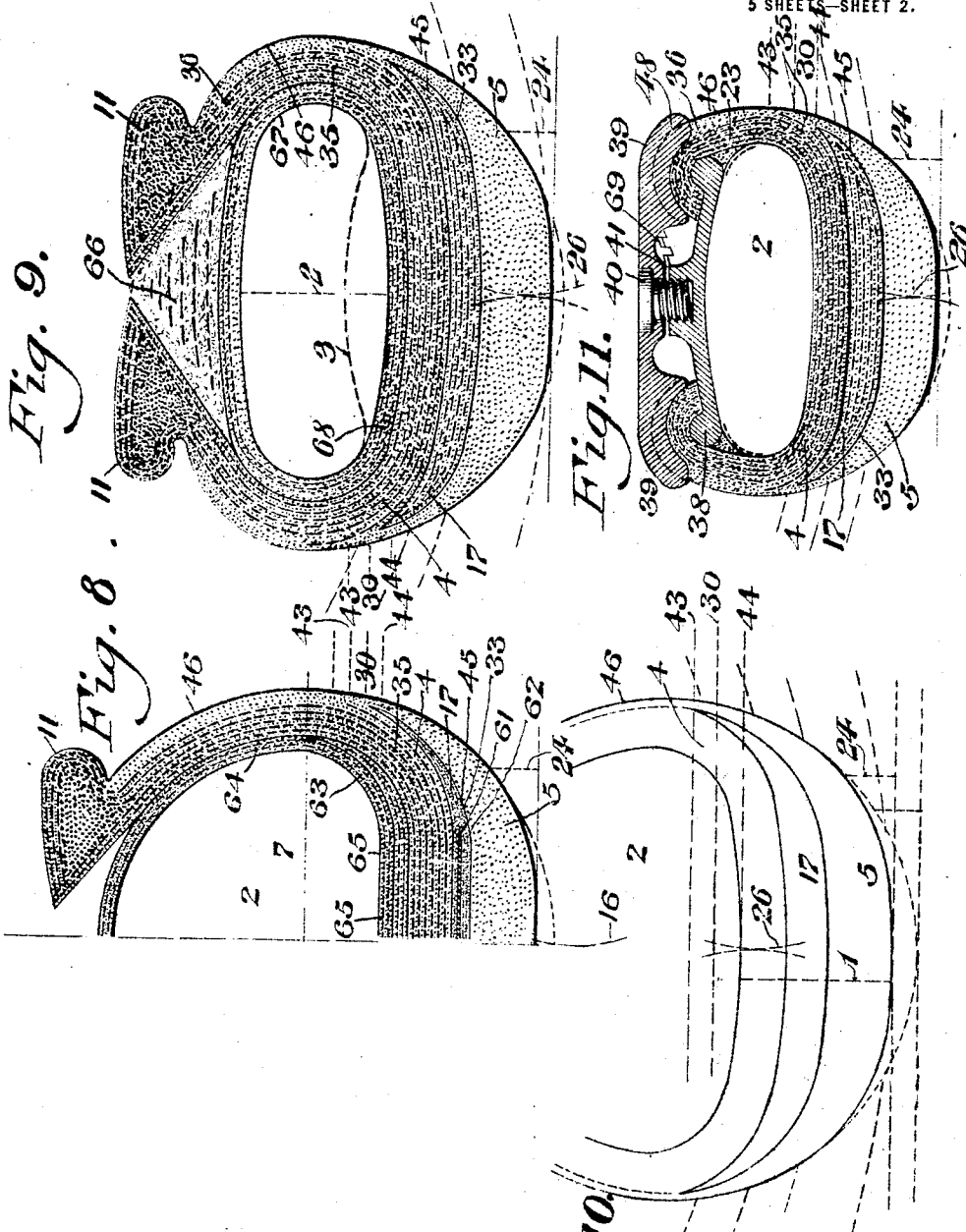
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Fig. 10.

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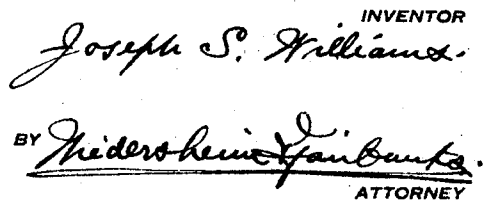
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5 SHEETS—SHEET 3.



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5 SHEETS—SHEET 4.

FIG. 15.

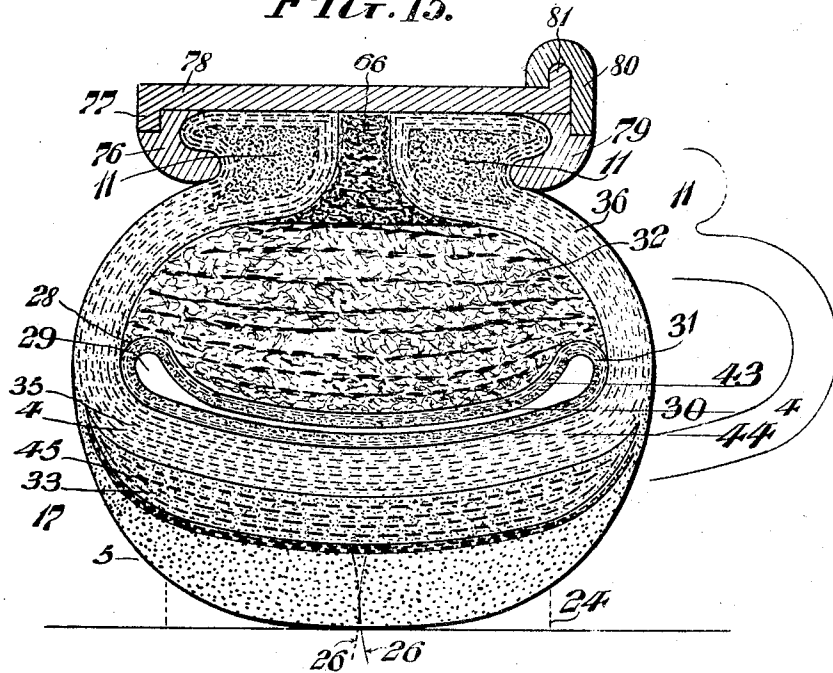
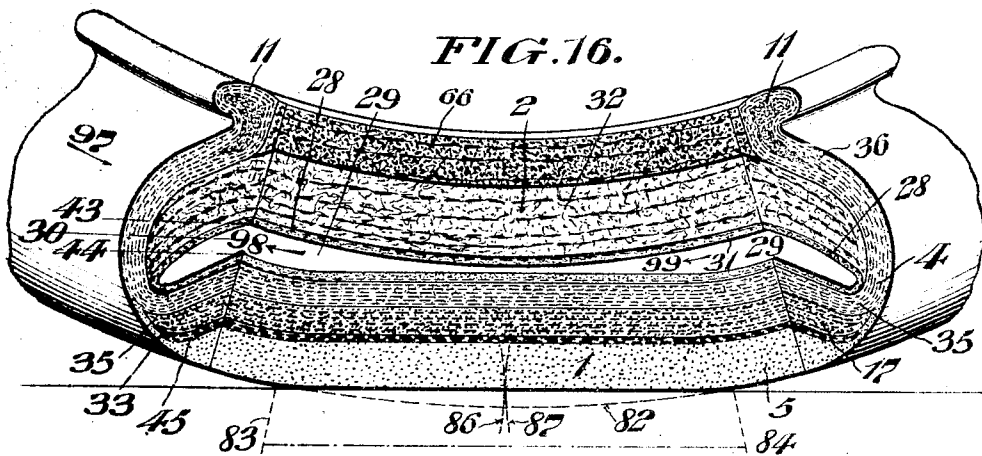


FIG. 16.



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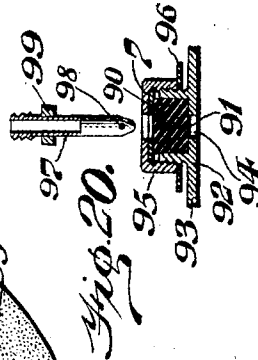
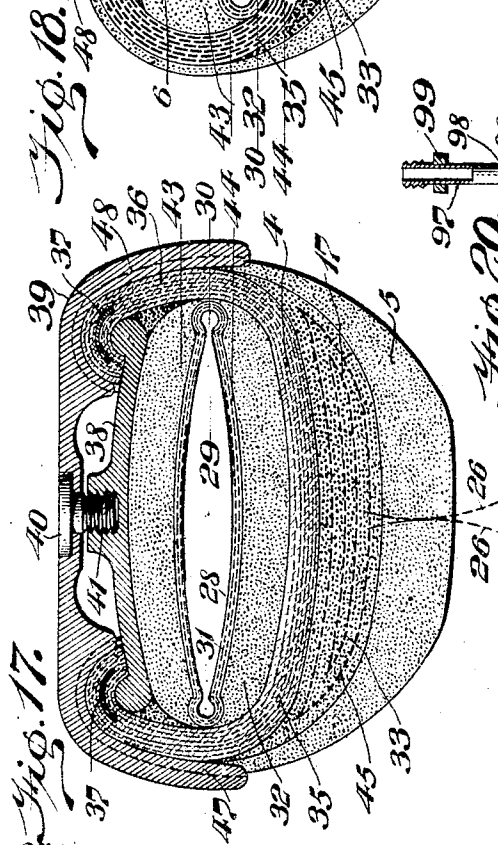
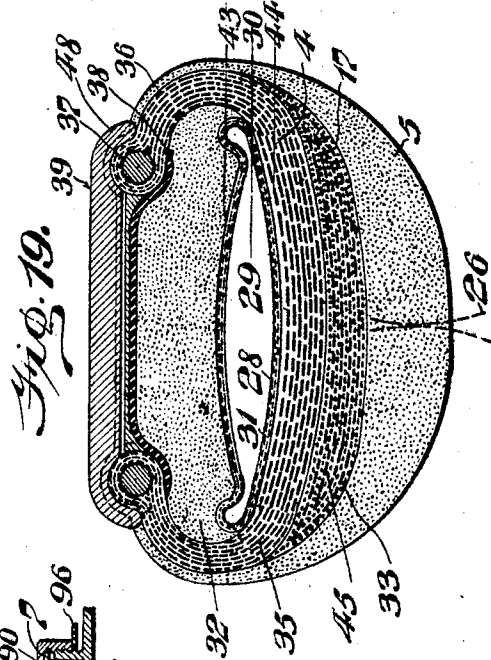
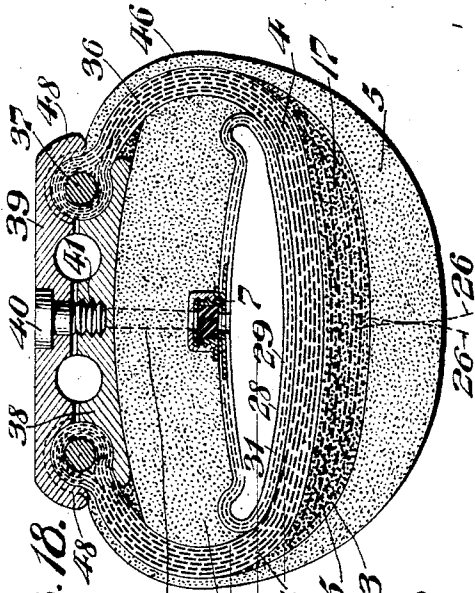
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5 SHEETS—SHEET 5.



Witnesses

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UNITED STATES PATENT OFFICE.

JOSEPH S. WILLIAMS, OF RIVERTON, NEW JERSEY.

RESILIENT TIRE.

1,250,405.

Specification of Letters Patent.

Patented Dec. 18, 1917.

Application filed January 19, 1911, Serial No. 603,552. Renewed March 14, 1917. Serial No. 154,868.

To all whom it may concern:

Be it known that I, JOSEPH S. WILLIAMS, a citizen of the United States, residing at Riverton, county of Burlington, State of New Jersey, have invented a new and useful Resilient Tire, of which the following is a specification.

The purpose of my invention in its broad and general scope is to provide a resilient tire construction with high standards of resistance to pressure, puncture and tread wear and with practically uniform areas of support and uniformity of flexure with altitude or range of deflection compensated or balanced in the transverse planes of the tire.

Other objects of my invention will be clearly understood from the detailed description of my invention.

My invention consists of a novel tire having its outer portion in the form of a flattened arch which is reinforced against circumferential distention, puncture and high internal pressure, with the outer part of the facing of tough elastic material with or without relatively hard wear and slip resistant material homogeneously embodied therein or as a facing element thereof, and the side extension of the arch construction being in uniform annular flexible connection or extension around the sides of the cushioning zone to the terminal seatings of the wheel equipment.

It further consists of novel means of cushioning and supporting the construction and resisting excessive strains and tread deflection.

It further consists of other novel features of construction, all as will be hereinafter fully set forth.

For the purpose of illustrating my invention I have shown in the accompanying drawings those embodiments thereof which are at present preferred by me, since the same will give in practice, satisfactory and reliable results, although it is to be understood that the various instrumentalities of which my invention consists can be variously arranged and organized and that my invention is not limited to the precise arrangement and organization of these instrumentalities as herein shown and described.

Figure 1 represents a diagrammatical view showing the lines of construction of a tire for carrying my invention into practice.

Fig. 2 represents a diagrammatical view

showing the lines of construction of the inner tube.

Fig. 3 represents a diagrammatical view showing the lines of construction of the cushion and a portion of the rim equipment.

Fig. 4 represents a sectional elevation of a tire embodying my invention.

Fig. 5 represents a diagrammatical view showing certain lines of construction.

Fig. 6 represents a sectional elevation of a fluid tight tube and cushion.

Fig. 7 represents a sectional elevation of a modified form of fluid tight tube and cushion embodying my invention.

Fig. 8 represents a sectional elevation of another embodiment of my invention.

Fig. 9 represents a sectional elevation of another embodiment of my invention.

Fig. 10 represents a diagrammatical view showing certain lines of construction and reinforcement.

Fig. 11 represents a sectional elevation of another embodiment of my invention.

Fig. 12 represents a perspective view partly in section of a tire embodying my invention.

Fig. 13 represents a sectional elevation of a portion of Fig. 12.

Fig. 14 represents a perspective view partly in section of a tire embodying my invention.

Fig. 15 represents a sectional elevation of a tire embodying my invention.

Fig. 16 represents a side elevation partly in perspective and partly in section of a tire embodying my invention.

Figs. 17, 18 and 19 represent sectional elevations of other embodiments of my invention.

Fig. 20 represents a sectional elevation showing means for inflating the inner tube.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings:

My present invention may be considered as comprising a compressive zone 1, a cushioning zone 2, and terminal extensions 3 united in rim equipment. The inner zone 1 includes an inner zone 4, the latter being provided with a zone 17, and the zone 1 also includes an outer zone 5. 9 designates the zone of reinforcement of the ordinary tire construction, having a tread 10 and terminals 11. The ordinary tread giving three-eighths of an inch deflection requires that

the base line be carried back to the line 31, see Fig. 2, and in so doing will elongate transversely, the difference between the length of the chord on line 13, and the arc 5 being approximately indicated by the arc 16. 18 and 19 designate lines of curvatures at the side from which extend lines 20 and 21. 22 and 23 indicate the extension of the element in zone 4. The line 24 indicates three- 10 eighths of an inch deflection in my novel tire as compared to the ordinary pneumatic type. 26 and 27 indicate approximate variations as compared with line 16.

28 designates an arched or elliptical construction provided with a fluid tight clearance space 29, so that the load is supported with slight variation of wheel diameter without the inner faces of 28 coming into contact on line 30. 31 designates reinforcements in the annular cushion 32, which serve to maintain the flattened curve or flattened elliptical formation. Lines 33 and 34 indicate ranges of resilient movements relatively to the line 30.

35 In the lines of construction seen in Fig. 5, 36 designates the terminals with reinforcements 37, and transversely grooved outer parts to cofit with grooves 48 of rim seating members 49. the terminals interlocking at 50, with the rim seating part 51, which is provided with transversely grooved inner faces 53 cofitting with the grooves 48. The port 51 with the cushion 32 can be bodily withdrawn or secured in equipment 35 with the other parts. 54 designates the arc of formation of a four and one-half inch circular tire, and 55 represents the arc of an elliptical formation with three-eighths of an inch flexure between the line 30 and the 40 outer line of the arc. 56 designates arc lines of construction in the outer zone and 57 designates the arc line of the outer periphery of the cushioning zone. 59 designates approximate variations of arc line 54, the arc line 55 defining the formation. 60 designates lines indicating approximate variations in zone 1, with arc lines 56 and 57 defining the formation.

The main difference between the lines of construction in Figs. 8 and 10 is that the zone 17 is shown as having a greater radial depth.

In Fig. 4 I have shown the elements of my construction with curved, or elliptical 55 forms with radial altitudes relative to transverse section lines of the construction in definite, compensating or balancing relationship to depth of normal deflection and in unit of structure with the rim equipments, 60 so that the deflection of the tread on longitudinal lines will be compensated on transverse lines through flexible curvations on the transverse section lines in the width of the tire.

65 The outer part, easing or shoe, comprises

the zones 4, 17 and 5 with the elements therein constructed in a unit of outer construction having practically uniform elliptical or flattened curved formation transversely across and through the field of the compressive zone of distributive tread with terminals extending from the zone 4 of such combination to the rim equipments. 70

The zone 4 is shown with tensile means of reinforcements to resist internal pressure and to maintain formation, for flexure and distributive support in the annular field of the transverse section lines of the construction. Such reinforcement consists of multiple layers of fabric 35 bonded together with 80 rubber or suitable material and given curved or elliptical formation on the transverse section lines of the tire in the width thereof, the altitude of the curvature radially in or through such construction being 85 in compensating or differentiating ratio to the depth of normal deflection.

The elements 35 are shown with defined curved or elliptical lines for purposes set forth across the compressive zone with a 90 continuity on arc lines of curvature at the sides around the sides of the cushioning zone 2 and inwardly to the terminals 36 provided with the annular reinforcements 37.

Such reinforced terminals 36 are shown 95 firmly gripped and held between the lateral extensions of the inner and transversely divided annulus 38 and the outer and transversely divided annulus 39 which are shown with cofitting and interlocking parts and 100 with a screw threaded member 40 passing through the annulus 39 in engagement with the threaded part 41 of the annulus 38 and thereby firmly securing the members 38 and 39 together. 105

The terminal parts of 39 are shown provided with transversely disposed grooves 48, as more clearly shown in other figures of the drawings to grip and retain the terminals and effectually prevent slip in the 110 seatings of constructions.

The cushioning zone 2 is shown with flattened arch or elliptical formation in the outer part as defined by the zone 4 and elements 35 which are shown with outward 115 curvature to negotiate flexure and distributive support for normal deflection in close proximity to line 30 in the annular field of the transverse planes as defined by lines 43 and 44. 120

The zone 17 is shown with multiple layers of tensile material 45 as additional reinforcement to the elements 35 against internal pressure and for maintenance of elliptical formation as defined by the zone 4 and 125 elements 35 and otherwise, and essentially as elements of reinforcement in the puncture proofing construction in zone 17, consisting of a homogeneous mixture of suitable rubber, rubber compounds or resilient bonding 130

material with mineral substances, such as carborundum, emery or equivalent material in a uniform state of subdivision, in uniform structural and bonded embodiment with the elements of the reinforcement 45 forming a flexible puncture proof element in vulcanized bonded union with and protecting and reinforcing the element 35 in the zone 4.

Zone 5 indicates the outer wearing part, or tread, consisting of a wear and slip resistant material, such as carborundum, emery, or the equivalent thereof in a graded state of division, in uniform embodiment and bond with suitable rubber, compounds of rubber, or flexible bonding material, as a flexible matrix yielding to deflection for distributive tread, with resistance to compression and elongation to about equalize, balance or to exceed the determined load supporting cushioning standard of the distributive tread.

Such elements of construction in the respective zones 4, 17 and 5 are combined in a vulcanized unit of structure and provide a flexible outer wearing construction of great stability, with high standards of resistance to internal pressure, with effectual resistance to puncture from without, and wear and slip in road use.

The elliptical or transversely disposed and reinforced formation of such construction is an important feature in providing for the use of such strongly reinforced construction, as by such means effective combinations of abrasive material and flexible bonded material, can be made and used with definite and suitable standards of tensility and resistance to compression, so as to free such combination of matter, or materials from the excessive stress and strains which would result with ordinary tubular tire construction.

The elements 35 of the zone 4 are shown with an outer protecting coating, or layers of rubber 46 as is usual, and otherwise with a layer of rubber 8 extending under sides of 39 and the transversely grooved parts 48 of the outer rim member 39 whereby the terminals 36 will not only be held in firm compressive engagement, but will be protected from weather and so as to compensate the slight transversely elongative action and inward movement of the elements 35 at such parts due to deflective and cushioning actions.

The cushioning zone 2 is shown equipped with the annular cushioning element 32 with elliptical formation in construction on transverse lines with flattened arch or elliptical formation having lines of curvature inward, and opposite the curvature, which is outward as defined by construction lines 4, 17 and 5 in the outer compressive zone.

The elliptical space, so formed and defined is shown equipped with the pressure proof fluid tight member 28 having an an-

nular clearance space 29 of elliptical formation conforming to the lines of construction as described.

The cushion 32 is shown in compressive engagement with the inner face of 35 of the zone 4 at the sides of the construction, from the line 30 on both sides and in compressive fitting engagement with the inner parts of the flexible inwardly projecting curved extensions of 35 to and along the inner supporting surface of 38.

Under this construction the cushion is designed to have a load supporting capacity per unit area of construction equal to or slightly exceeding the pneumatic pressure standard of the tire whereby the cushion will resist deflection in case of deflation, with slight variation in wheel diameter, and whereby the normal distributive tread and cushioning of tire construction will be balanced to action along the transverse planes between the curvatures on opposite sides of the line 30 throughout the range of normal deflection as defined by the lines 43 and 44 but I do not limit myself to such range as the spacement can be greater or less as desired.

The balance of such construction and variations in the compressive zone of deflection and distributive tread are approximately shown by lines 26 and 27.

In Fig. 6, the cushion 32 is shown with the member 28 on the inner transverse planes instead of on the outer face as shown in Fig. 5.

In Fig. 7 the cushion 32 is shown with the fluid tight member 28 in transverse planes of the body of the cushion 32.

The cushions as shown in Figs. 6 and 7 may be substituted for the cushion 32 as shown in Fig. 5 and if desired the cushion 32 and the member 28 may be omitted from the construction and a pneumatic or fluid tight insert of suitable type may be used, so that the construction as shown in Fig. 5 may be used with a fluid cushion only, or with cushioning elements 32 and 28 as may be desired.

In Fig. 8, the zones 4, 17, and 5 are shown with the tensile elements of reinforcement 35 in zone 4 consisting of multiple layers of fabric transversely disposed in the transverse planes across the outer compressive zone of distributive tread in part parallel with the lines 43 and 44 and with curvature to the sides into continuity with curvature of greater magnitude to terminal of the well known types for clencher rim equipments. Zone 17 is shown with an annular element of fabric 45 with mineralized flexible bonding and puncture proofing material 33 and an annular reinforcement 61 consisting of material with high standard of tensility, such as nickel, or vanadium steel or carbon steel and metal giving approximate, or equivalent tensile strength per unit of thick-

ness in depth thereof, whereby such reinforcement with a thickness, or depth radially of five to ten one hundredths of an inch will offer, but slight resistance to deflection, but
 5 provide tensile reinforcement to resist any internal pressure of tire construction and of puncture therethrough from without in road service. The annular member 61 is preferably incased in and combined with an en-
 10 velopment, of tough or soft rubber 62 with high standard of tensility, which is in turn combined with the fabric 45 whereby the elongation of 61 in the compressive zone of distributive tread will be compensated on
 15 circumferential lines.

Such construction in zone 17 will be effective in materially reinforcing 35 in zone 4 against internal pressure and for maintenance of transverse lines of formation and
 20 in protecting 35 and the cushioning zone 2 from injury and puncture, without injuriously affecting the flexure of 35 on the sides thereof in the planes and side curvatures thereof.

As a further reinforcement to construction the field or zone 5 of the compressive zone 1 is formed of abrasive wear and slip resisting material homogeneously embodied in a flexible matrix of suitable bonding material, or mixture as described with reference
 30 to Fig. 4 and otherwise as herein set forth.

The inner tube 63 is shown consisting of fabric 64 and rubber 65 with the fabric extending annularly and transversely across
 35 the field of the compressive zone in the transverse planes of construction in part parallel with lines 43 and 44 and with curvature therefrom to the sides and inwardly in conformity with the curvature of and in pressure engagement with the inner part of the
 40 outer zone 1 and side casing of zone 2.

The construction 63 is shown with additional reinforcement on the outer face and against zone 4.

This reinforcement is shown consisting of multiple layers of fabric 65 bonded together with mineralized rubber as in zone 17 and also in vulcanized bonded union with the
 50 cushioning zone 2 will be maintained in effective working construction.

In the construction as shown in the outer compressive zone 1 of Fig. 8 compensation for deflection in transverse planes will be
 55 through the flexing curvature from the terminals 11 to the sides and the side curvatures and the curvature inwardly therefrom in the transverse planes of the construction across the compressive field in the width of
 60 the tire.

In Fig. 11 a tire construction is shown with the element in zones 5, 17, and 4 with curvature therefrom inwardly, and otherwise as in Fig. 4, to terminals 11 of a well
 65 known type, as shown in Fig. 3.

The cushioning zone 2 on the inner, or opening part of the annular construction is shown closed with a seating member 66 fitting between and against the terminals 11 and forming therewith a seating for the
 70 cushioning elements of zone 2.

The cushioning zone 2 is equipped with a strongly reinforced pressure proof member forming a fluid tight lining construction 67 for retaining air or other fluid under pres-
 75 sure. This annular member 67 is formed with elliptical lines of curvature in transverse planes through the compressive zone of distributive tread along the inner faces of zone 4 and the outer face of 66. Such
 80 line of curvature corresponds with the curvatures of construction as defined by zone 4 in the outer construction and the cushion seating face of 66.

The fluid tight member 67 is shown with
 85 multiple layers of fabric 68 bonded together with rubber and otherwise lined with rubber to make the construction fluid tight and pressure proof in tire use with the areas of construction mainly in the transverse planes
 90 of the tire and inextensible circumferentially in the outer parts in the plane of the tire.

The reinforcement 68 is embodied in the construction 67 with lines of curvature as shown and with the material of 68 in the
 95 inner part of such construction next to zone 4 with length on circumferential lines corresponding to the circumferential lengths on the transverse lines of the curvature of construction, and otherwise with lengths as defined
 100 by side lines of curvatures and with length on the inner part of such construction to provide for requisite compression against the inner faces of the outer construction and the inner face 66. Such construction
 105 makes the member 67 outwardly non-extensible circumferentially.

The tire construction in Fig. 11 is designed to operate as pneumatic with a tube construction 67 or with a tube of suitable
 110 form not so reinforced or with a cushion equipment 32 and a tube 28, as described with reference to Figs. 3, 4 and others of the drawings.

In Fig. 11, the outer elements of tire construction in zone 4, 17 and 5 are shown similar to the construction seen in Figs. 4 and
 115 9, with slight variations, but with similar terminal and rim seating equipments as in Fig. 4.
 120

The annular and transversely divided members of rim and terminal seating equipments are shown with transversely cofitting and interlocking parts at 69.

In Fig. 12 an annular tire construction
 125 is shown with the elements in the respective zones in the transverse planes and crossing the field of the compressive zone of distributive tread as described with reference to other figures of the drawings.
 130

The elements in zones 5, 17, and 4 are shown combined in a unit of structure with tensile elements 35 defining and reinforcing the curvature lines of construction across the compressive zone 1, and extending across the outer faces 70 of 38 and around the ends, or sides of the member 38 with reinforcements 37 on the inner side between 38 and 39.

The outer faces 70 of 38 are shown near line 43 which represents the inner line of normal deflection of distributive tread and slightly less than one-half an inch from line 44 which represents the outer line of the arc, or curvature of the construction.

The cushioning zone 2 is thereby extended with curvature in the transverse planes across the entire face of 38 and outwardly to sufficient distance as represented by line 44 to provide for free radial movement of the elements in the outer compressive zone with the range of normal distributive tread action.

The faces 70 of the inner seatings on 38, of the terminals 36, reinforcements 37 and the parts of 39 clamping same, and the elements 35 across the face of such construction, and the outer compressive zone 1, with member 32 and insert 28, all operate in harmony in resisting excessive deflection and in maintaining positive wheel equipment and practically constant wheel diameter on or about the maximum transverse axis chord or planes of construction. Cushioning material 71 is shown at the sides 72 of 38 between the parts thereof and the terminal parts 36 of 35 and the elements supported thereby.

The transversely divided annular member 39 is shown with transverse corrugations 48 cofitting with oppositely formed corrugations 47 on the terminal parts 36.

The cushioning zone 2 is shown with a fluid tight member 28 and cushion 32 or a fluid tight cushioning insert, by which uniform radial support is obtained for distributive tread and by which excessive deflection will be resisted and supported by solid cushioning means operating between the outer face of 38 and the inner face of 35. Such cushion 42 may be omitted and a fluid tight member of suitable formation be used or one-half of the cushion may be used, but I prefer arrangements as shown or the equivalent thereof. I may however with possible advantage for some purposes use a curvature of construction with less depth or so that the outer faces 70 will be central or between the outer and inner lines of normal deflection whereby the member 35 would operate directly to resist excessive deflection.

A passage way 73 is shown for the stem of or the valve of inner fluid tight member, or tube 28.

The meeting ends of the transversely

divided annular member 39 are shown secured to the screwed parts 41 of member 38 by screw bolts 40 through the medium of which all parts are securely combined.

The member 39 with full tire equipment can be combined and secured in wheel equipment by any of the well known means.

In Fig. 13 the parts 39 and 38 are provided with transverse cofitting interlocking parts 74 and 75 respectively to maintain the same in proper relationship with rim equipments and elements of construction as seen by figures of reference similar to Fig. 12.

Fig. 14 shows an annular tire construction with hemispherical form in transverse section with the elements of tensile reinforcements in and across the compressive zone in zone 4 with inner face thereof approximately intermediate the diameter, or major axes of construction and the outer surface of the road wearing part.

The cushion 32 is shown in the cushioning zone 2 with elliptical clearance space between the outer part of 32 and the inner part of zone 4 for fluid tight annular member 28 whereby distributive tread with uniform radial support will be negotiated in the field as defined by 43 and 44, by deflection of the curvatures of construction in the outer or compressive zone inwardly and the deflection of the curvature lines of solid cushioning construction of the cushioning zone outwardly toward the chord lines of the respective curvatures of such construction balanced to negotiate a normal or determined standard of distributive tread support in such field and to resist and cushion excessive strains or deflection on or about the line 30 on the major chord or axis in transverse planes of such construction.

The cushion 32 and the fluid tight member 28 are shown in the cushioning zone 2 in state of deflation, or with the cushion 32 compensating displacement of the fluid by taking its place to provide cushioning support for the elements in the outer compressive zone 1.

Under such conditions the standard of compressibility of the cushion 32 per unit area thereof across the compressive zone, will be to balance the determined fluid pressure of the tire when compressed thereby to a determined depth for clearance and otherwise to provide uniform radial support for normal deflection of distributive tread in the compressive field having mobile means of support.

The tire construction and cushion 32 as shown in Fig. 15 has greater depth than required as a cushion of one inch to one and a quarter inches in radial depth will be adequate to provide a space for fluid and normal deflection of tread.

I prefer to employ lesser depth as shown by lines of construction in Fig. 17 and others

of drawings but slight variation of depth are not important features but the standard of cushioning and resistance to compression and ranges of compression relatively to tire pressures and load supporting standards are important and necessary features in providing reliable standards in a properly balanced tire construction.

The member 28 is equipped with valve equipment or means for inflating 28 with air or other fluid, elastic or incompressible, to provide a clearance space 29 for securing mobility of deflection and uniform support for distributive tread and otherwise uniform cushioning and support throughout.

Fig. 16 shows in longitudinal section and in perspective and transverse section the elements of construction as in Fig. 15 and as shown and herein described with reference to other figures of the drawings 32 in the cushioning zone under compression by fluid inflation of the fluid tight member 28 and supporting normal deflection of distributive tread. The wear and slip resisting elements in zone 5 are shown combined with reinforcing and puncture proofing elements in zone 17, and the tensile elements of reinforcement and tire support in zone 4 with terminal parts for rim equipment.

The dotted line 82 represents the arc line of the deflected distributive tread construction in the compressive zone 1.

The distance between lines 83 and 84 show the approximate length of normal distributive tread on half scale of a thirty-four inch wheel.

The lines 86 and 87 show approximate difference and variations between the chord and arc lines of distributive tread along circumferential lines in the compressive zone 2. The direction of movement of the tire body is shown by arms 97 and the relative movement of the fluid in 28 is represented by arrows 98 and 99.

The variations as represented by 86 and 87 average slightly less than three quarters of one per cent. per unit of length as represented by lines 83 and 84.

The variations in the compressive zone 1 on transverse lines of ordinary tubular pneumatic tire construction as shown in Fig. 1 are approximately ten times greater than circumferential lines as will be clearly seen by reference to the drawings. 27 in the several figures show the approximate variations with the flattened arch, or curvature.

In Fig. 17 the annular fluid tight member 28 is transversely disposed throughout the width of the cushioning zone 2 and centrally between the inner and outer parts of 32. The member 32 is also annularly and transversely disposed in the transverse planes of the tire with outwardly and inwardly flattened arched formation between the inner periphery of 35 and the outer face

of the seating member 38 and otherwise filling the annular and transversely disposed cushioning zone 2 as defined by 35 by like flattened arch or curvature across the compressive zone in the transverse planes of the tire and by flexing curvature therefrom at and around the sides to the lateral terminal parts of 38 and 39. The general arrangement of the elements otherwise are clearly shown by the figure of reference.

In Fig. 18 the annular fluid tight member 28 with a clearance space 29 as described herein is shown equipped with valve organism 7 as a simple and convenient type for use with cushion 32. 6 represents passage way through the cushion for valve stem, or means to open the valve and provide fluid tight connection between the clearance space 29 and the source of fluid supply.

Any suitable valve construction may be used for the purpose and such are intended to be applied to the inner fluid tight members of the cushioning zone of construction as herein illustrated without valve mechanism.

In Figs. 18 and 19 the several annular elements transversely disposed with flattened curvatures in the transverse planes of the tire and otherwise combined are shown as complete units of structure, for or in wheel equipment as will be seen from the figures of reference.

The elements 35 are shown with flattened curvature, or arch formation relatively to transverse section lines of the tire across the compressive zone 1 with easy flexing curvature to and around the sides of the annular and transversely disposed cushioning zone 2 to the back of the lateral extensions thereof with inward curvature in the plane of the tire to the sides of the rim equipments centrally disposed and inwardly to or over the several annular and transversely disposed elements of the unitary structure.

The annular elements in zone 17 have curvature, as in 35 with practically uniform depth on the radius of curvature, or on vertical lines throughout the major width of 35 in the transverse planes of tire and with somewhat tapering sides in curvature to the side elements of tread, in zone 5 where they have the same curvature of form transversely in the transverse planes of the tire as in zone 17 with practically uniform depth to the outer surface of the tread throughout the width of the annular central belt and otherwise with continuing curvature to the outer faces or side of the tire and somewhat tapering formation in curvature between the outer face of the tire and the inwardly described curvatures of 17 and 4 at the sides.

The width of annular active tread surface having uniformity of depth can be materially increased by decreasing the depth of the wearing part with uniformity on the

lines of curvature as defined by zones 4, 17 and 5 in the compressive zone 1.

In Fig. 20 the valve organism 7 as combined with 28 in Fig. 18 shows a member 90 of suitable rubber with slitted part 91 vertically therethrough the member being inclosed within the cylindrical chamber of the member 92 having an outer annular flange 93 and a bottom with a central hole 94 there-through.

The member 90 acts as fluid tight stopper forced into the chamber of 92, and the capping member 95 removably secured to member 92 serves to retain the stopper and valve member in fluid tight compressive engagement within the chamber of 92.

The member 95 also serves to compress the flexible material and fabric between the flange 93 and the washer 96. The capping member 95 is shown with a central hole immediately over the elongated slit both of which are opposite and over the central hole 92.

97 designates a tubular needle having preferably a conical end provided in proximity to such end with side apertures 98 in order that when the needle passes through the slit 91 there will be a free passage for the fluid. 99 designates a stop carried by the needle.

Particular attention is directed to the fact that in all the embodiments of my invention I provide an annular belt of material of substantially uniform depth throughout the greater portion of the transverse diameter of the zone of distributive tread, the lines of formation having the contour of a flattened arch, with flexure of curvature at the sides relatively to transverse section lines of the tire, such flexure forming elastic supports or pillars for the arch formation. The flattened arch formation is transversely disposed relatively to transverse section lines of the tire and the altitude of the arch from the transverse section lines or chord line 30 represents a portion of the amount of normal tread deflection and in most of the cases approximately one half except in Fig. 12 wherein the altitude represents substantially the total amount of normal tread deflection. I also provide in all the embodiments shown an annular belt of material in the zone 4 substantially inextensible circumferentially and practically uniformly flexible especially in the curvatures at the sides, with an annular belt of reinforcement in the zone 17 substantially parallel to the lines of construction of zone 4 and of substantially uniform depth throughout the transverse section lines of distributive tread with graduated curvature to the sides of the construction thereby imparting to the annular belt lying in zone 4 a high standard of resistance to internal pressure and to puncture and a comparatively low standard of compressi-

bility throughout the compressive zone. I also provide a traction tread the lines of formation of which preferably conform to the contour of the flattened arch construction thus providing a central belt of substantially uniform depth with graduated curvature to the sides and into union with the materials in zones 17 and 4. Such tread is preferably formed of tough, flexible, wear resistant material and may have embodied therein relatively hard wear and slip resistant material. The annular belts of material in zones 5, 17 and 5 are vulcanized into a unit of structure.

The annular belt of material in zone 4 extends with curvature around the sides of the cushioning zone 2 to the terminal seatings for rim equipment and the terminal seatings are preferably extended inwardly so as to flex outwardly in a radial direction with slight transverse elongation of the flexing curvatures of the sides which compensates for the difference between the altitude of the flattened arch formation and the total depth of tread deflection. The cushioning zone is annularly and transversely disposed and of substantially uniform depth with variations in curvature at the inner and outer periphery and in some cases at the sides. The cushioning zone is adapted to be used with an inner inflatable tube filling the space of the cushioning zone, or with an annular cushioning member filling the cushioning zone with clearance for transversely disposed inner tube with depth to provide for the normal tread deflection. The lines of formation of the cushioning member conform to the lines of the arch formation or the reverse thereof or both.

The lines of formation of the inner tube conform preferably on either the inner and outer periphery or both to the inner and outer arch formation with flexure at the side. The inner tube is outwardly circumferentially inextensible. Clearance space may be provided in the cushion, and in such case the load supporting capacity of the cushion per unit area equals or exceeds the pressure standard of the tire, or the tube may be inserted with sufficient clearance to insert the same, to compress the cushion mainly radially to provide the clearance for tread deflection, and in this case the compressibility of the cushion per unit area is such that when compressed to provide determined spacement for tread deflection the resistance to compression per unit area will equal the pressure standard of the tire.

The terminal seatings will depend upon the type of rim equipment with which the tire is to be used. Any type of valve mechanism may be employed to control the inflation or deflation of the tire, and either elastic or incompressible fluid may be used in the inner tube.

The resilient core forms an annularly and transversely disposed resilient truss preferably constructed of layers of fabric and rubber, which are preferably concentrically arranged, and the abutments of the truss are seated against the curved side walls of the flexible tension member and substantially fill the space therebetween. I also provide a fluid tight tube having a clearance space therein, which is preferably of elliptical formation. The circumferential inextensible member and the resilient truss cooperate to maintain substantially the same formation of the tire under load under both inflation and deflation of the fluid tight tube. It will also be evident that by the insertion of fluid under pressure the tension of the truss may be varied as desired.

It will now be apparent that I have devised a novel and useful construction of a resilient tire which embodies the features of advantage enumerated as desirable in the statement of the invention and the above description and while I have, in the present instance, shown and described a preferred embodiment thereof which has been found in practice to give satisfactory and reliable results, it is to be understood that the same is susceptible of modification in various particulars without departing from the spirit or scope of the invention or sacrificing any of its advantages.

Having thus described my invention what I claim as new and desire to secure by Letters Patent, is:—

1. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, and a resilient core in said core space, having resilient solid material abutting against said curved walls and filling the space therebetween and provided with clearance space to provide for the flexures of said member, under load.

2. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, and a resilient core in said core space having resilient solid material abutting against said curved walls and filling the space therebetween and provided with an elliptical shaped clearance space to provide for the flexures of said member under load.

3. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into

curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, and a resilient core in said core space forming an annularly and transversely disposed truss having resilient solid material abutting against said curved walls and filling the space therebetween and provided with a clearance space to provide for the flexures of said member under load.

4. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, a resilient core in said core space having resilient solid material abutting against said curved walls and filling the space therebetween and provided with a fluid tight clearance space to provide for the flexures of said member under load, and fluid under pressure in said clearance space.

5. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, and a core in said core space forming an annular and transversely disposed resilient truss with resilient abutments of solid material seated against said side walls and substantially filling the space therebetween to form a yielding support, and the core having substantially throughout the width of road contact of the tire means to provide for definite flexures of said member under load.

6. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, a resilient core in said core space, having resilient solid material abutting against said curved walls and filling the space therebetween and provided with a clearance space to provide for the flexures of said member under load.

7. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, and a resilient and flexible annular truss transversely disposed in said core space and formed of layers of rubber and tensile reinforcements which abut against said

curved side walls and substantially fill the space therebetween to form a resilient support for said member.

8. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, and a resilient and flexible annular truss in said core space and consisting of concentric layers of fabric and rubber, the curved walls of the member forming abutments for the truss and the space therebetween being substantially filled by the layers of fabric and rubber thereof to thereby form a yielding support for such side walls, said truss having a fluid tight clearance space adapted to receive fluid under pressure, and said truss cooperating with said member to maintain substantially the same conformation of the tire under load under inflation and deflation.
9. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, and an annularly and transversely disposed resilient truss in said core space having its abutments seated against said curved side walls and substantially filling the space therebetween, and a fluid tight tube in said core space adapted to receive fluid under pressure, said truss cooperating with said member to maintain substantially the same conformation of the tire under load under both inflation and deflation of said tube.

10. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to

the terminal portions of the side walls and contributing with said member to form a core space, an annularly and transversely disposed tension truss in said core space having its abutments engaging said curved side walls and substantially filling the space therebetween, and means to vary the tension of said truss.

11. A tire comprising a circumferentially inextensible flexible member the outer periphery of which is transversely disposed in flattened arch formation and merges into curved side walls, an inner support fixed to the terminal portions of the side walls and contributing with said member to form a core space, an annularly and transversely disposed tension truss in said core space having its abutments engaging said curved side walls and substantially filling the space therebetween, and means to vary the tension of said truss by fluid under pressure.

12. An annular tire body having embodied therein an annular and transversely disposed flexible and circumferentially inextensible tension member spanning the body with flattened arch formation relatively to the transverse section lines in the major width of said body, and continuing with relatively close curvatures about the sides to the seating or base portion of said body, and contributing to form an annular and transversely elongated core space across the body and flexible tension support thereabout, an annular and transversely elongated truss of flexible material spanning the width of the core with curved sides in resilient tension abutment against the inner faces of the curvatures of said member along and about the sides of said core space, a tread secured to and supported by said member, and means providing circumferential inextensibility in the seating part or base of said body.

JOSEPH S. WILLIAMS.

Witnesses:

H. S. FAIRBANKS,
C. D. McVAY.