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Tyre with beads having improved structure

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(56) Related Art
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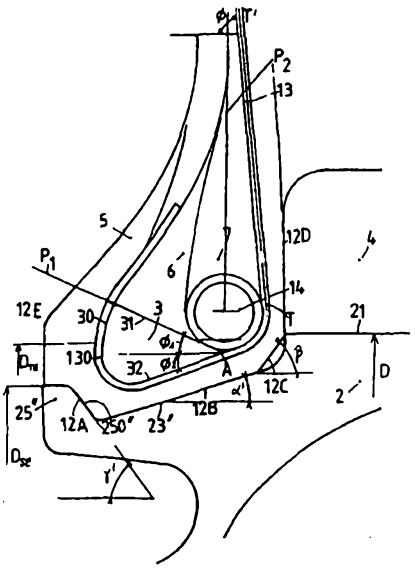
(54) Title: TYRE WITH BEADS HAVING IMPROVED STRUCTURE

(54) Titre: PNEUMATIQUE AVEC DES BOURRELETS DE STRUCTURE AMELIOREE

(57) Abstract

The invention concerns a tyre (1) with a radial body ply reinforcement comprising, viewed in meridian cross-section, at least a first bead (12), whereof the seat (12B) is inclined outwards, the bead (12) heel being axially inside and being reinforced by at least a reinforcing element (14), whereas the bead toe is axially outside and comprises a profile (3)of rubber mix in the form of a wedge delimited by two sides (31, 32), said mix having a Shore A hardness higher than the Shore A hardness level(s) of the rubber mixtures (7) and (6) radially above. The invention is characterised in that the radial body ply reinforcement (13) is wound in the bead around the annular element (14) from inside outwards to form a ply turn-up (130), whereof the end is located axially outside a straight line P¿2 ?perpendicular to the axis of rotation and passing through the centre of gravity of the meridian cross-section of the element (14), and axially inside and radially outside the straight line P_1 supporting the radially external side (31) of the profile (3).



(57) Abrégé

Pneumatique (1) à armature de carcasse radiale (13) comprenant, vu en section méridienne, au moins un premier bourrelet (12), dont le siège (12B) est incliné vers l'extérieur, le talon de bourrelet (12) étant axialement à l'intérieur et étant renforcé par au moins un élément de renforcement (14), alors que la pointe de bourrelet est axialement à l'extérieur et comprend un profilé (3) de mélange caoutchouteux sous forme de coin délimité par deux côtés (31, 32), ledit mélange ayant une dureté Shore A supérieure à la (aux) dureté(s) Shore A des mélanges caoutchouteux (7 et 6) radialement au-dessus, caractérisé en ce que l'armature de carcasse radiale (13) s'enroule dans le bourrelet autour dudit élément annulaire (14) en allant de l'intérieur à l'extérieur pour former un retournement (130), dont l'extrémité est localisée d'une part axialement à l'extérieur d'une droite P_2 perpendiculaire à l'axe de rotation et passant par le centre de gravité de la section méridienne de l'élément (14), et d'autre part axialement à l'intérieur et radialement à l'extérieur de la droite P_1 supportant le côté radialement externe (31) du profilé (3).

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TITLE: **TYRE HAVING BEADS OF IMPROVED STRUCTURE.**

ABSTRACT

A tyre (1) having a radial carcass reinforcement (13) comprising, viewed in meridian section, at least one first bead (12), the seat (12B) of which is inclined towards the outside, the bead heel (12) being axially to the inside and being reinforced by at least one reinforcement element (14), whereas the bead toe is axially to the outside, and comprises a profiled element (3) of rubber mix in the form of a wedge defined by two sides (31, 32), said mix having a Shore A hardness greater than the Shore A hardness(es) of the rubber mixes (7) and (6) radially above, characterised in that the radial carcass reinforcement (13) winds in the bead around said annular element (14) from the inside to the outside to form an upturn (130), the end of which is located on one hand axially to the outside of a straight line P_2 perpendicular to the axis of rotation and passing through the centre of gravity of the meridian section of the element (14), and on the other hand axially to the inside and radially to the outside of the straight line P_1 supporting the radially outer side (31) of the profiled element (3).

FIG. 1.

TYRE HAVING BEADS OF IMPROVED STRUCTURE

The present invention relates to a tyre intended to be mounted on a rim having at least one first frustoconical seat, the generatrix of which has an axially outer end which is closer to the axis of rotation than the axially inner end.

Such a tyre is described in Application WO 94/13498 by the Applicant. It comprises at least one first bead, which is intended to be mounted on said first rim seat which is inclined towards the outside, said first bead, of conventional axial width, which ends axially to the outside in a bead toe, having a bead seat, the generatrix of which has its axially outer end closer to the axis of rotation than its axially inner end, said generatrix being extended axially to the outside by an outer face defining the bead toe, said face forming with the axis of rotation an angle γ, which is open radially and axially towards the outside, of less than 90°. The radial carcass reinforcement of said tyre, which is anchored within each bead to at least one inextensible annular reinforcement element, has a meridian profile, when the tyre is mounted on its operating rim and inflated to its operating pressure, with a direction of curvature which is constant in the sidewalls and bead which ends in the toe and which is such that, in said bead, the tangent to the point of tangency of said profile with the inextensible annular element of said bead forms with the axis of rotation an angle ø which is open towards the outside of at least 70°.

The bead of such a tyre, and more particularly the structure of the hooking of the carcass reinforcement, may be variable. In international application WO 95/23073, the radial carcass reinforcement is anchored to the inextensible element by winding around said element from the heel to the toe of the bead to form an upturn extending into a profiled element of rubber mix in the form of a wedge defined by two sides starting from an apex A located beneath the section of the coated bead wire, the radially outer side forming, with a straight line parallel to the axis of rotation passing through said

apex A, an acute angle $ø_1$, which is open radially and axially towards the outside and is between 20° and 70°, and the radially inner side forming with said parallel line an acute angle $ø_2$, which is open radially towards the inside and is between 0° and 30°, and the rubber mix forming the profiled element, axially adjacent to the bead wire, having a Shore A hardness equal to at least 65 and greater than the Shore A hardness(es) of the rubber mixes axially and radially above the bead wire and the profiled element.

The combination of the meridian profile of the carcass reinforcement as described in the first international application cited with a hooking structure as described in the second international application cited makes it possible to obtain a very good compromise firstly between the properties of on-road behaviour of the tyre inflated to its recommended pressure, and secondly between said properties when it is inflated at reduced or even zero pressure, the beads of said tyre remaining perfectly in place when travelling in degraded mode owing to their above-described structure, which structure permits modification (increase) of the clamping of the bead toe on the mounting rim as a function of the tension of the carcass reinforcement, which makes it possible to have initial clamping on rim of low value, given that said clamping will increase when the tyre is inflated to its recommended pressure.

The preferred solution described in document WO 95/23073 is such that the carcass reinforcement upturn has a length such that it is in contact with the total perimeter of the profiled element or wedge; it thus forms the two, radially outer and inner, sides of the rubber profiled element and the side opposite the apex or centre of said profiled element, and the end thereof is located axially beyond the point of intersection of the two, outer and inner, sides. The part of the upturn immediately adjacent to the part which is wound about the bead wire can form firstly the radially outer side of the profiled element or wedge and then the side opposite the apex of said

profiled element, then finally the radially inner side of said profiled element, ending beyond the junction point of the two, outer and inner, sides. It may also first form the radially inner side of the profiled element or wedge, then the side opposite the apex of said profiled element, then finally the radially outer side of said profiled element, ending in the same manner as previously.

The above two structures are complicated and difficult to implement industrially, and are therefore expensive. Furthermore, under extremely severe loading conditions, the pressure exerted by the toe of the bead on the axially outer protrusion of the rim and the high temperature which said bead may reach are such that there may occur, at the end of its life, cracking in the rubber of the protective outer layer of the bead, which cracking is propagated along the upturn, reaching the radially inner face of the anchoring bead wire with destruction of said bead.

The object of the invention is to overcome the disadvantages above while retaining the excellent anti-unwedging or anti-unseating properties of the tyre in question.

The tyre having a radial carcass reinforcement, in accordance with the invention, comprises, viewed in meridian section, at least one first bead, the seat of which has a generatrix, the axially inner end of which lies on a circle of diameter greater than the diameter of the circle on which the axially outer end is located, the bead heel being axially to the inside and being reinforced by at least one inextensible, annular reinforcement element which is coated with rubber mix, while the toe of the bead is axially to the outside and comprises a profiled element of rubber mix in the form of a wedge which is defined by two sides starting from an apex A located beneath the section of the annular element, the radially outer side forming, with a straight line parallel to the axis of rotation passing through said apex A, an acute angle $\varnothing_1$, which is

open radially and axially towards the outside, and the radially inner side forming with said parallel line an acute angle $\varnothing_2$, which is open radially towards the inside, the rubber mix forming the profiled element, axially adjacent to the bead wire, having a Shore A hardness greater than the Shore A hardness(es) of the rubber mixes respectively radially above said annular element and the axially adjacent profiled element. It is characterised in that the radial carcass reinforcement of said tyre winds at least in the first bead around said annular element from the inside to the outside to form an upturn, the end of which is located on one hand axially to the outside of a straight line P_2 perpendicular to the axis of rotation and passing through the centre of gravity of the meridian section of the annular element and on the other hand axially to the inside and radially to the outside of the straight line P_1 supporting the radially outer side of the profiled element axially adjacent to said annular element.

The increase in the clamping of the bead toe on the mounting rim according to the tension of the carcass reinforcement will be greater if the profiled element of rubber mix in the form of a wedge and defined by the two sides starting from the apex A is reinforced by at least that part of the upturn of the carcass reinforcement which is immediately adjacent to that part of the carcass reinforcement which is wound around the annular bead reinforcement element, whether said part be in the profiled element or whether it forms at least one of its sides.

Advantageously, the radial carcass reinforcement of said tyre is wound, at least in the first bead, around said annular element from the inside to the outside to form an upturn, extending along the radially inner side of the profiled element in the form of a wedge, then along the side opposite the apex A, then covering axially and radially to the outside at least in part the profiled element radially above the profiled element in the form of a wedge.

Preferably, the tyre comprises a second bead, the seat of which is of the same configuration as the seat of the first bead, that is to say, a seat, the generatrix of which has an axially inner end on a circle of diameter greater than the diameter of the circle on which the axially outer end is located, or seat which is said to be inclined towards the outside.

Likewise, if "diameter of an inclined seat" refers to the diameter of the circle on which is located the end of its generatrix farthest from the axis of rotation, the tyre advantageously has two seats which are said to be inclined towards the outside and are of different diameters.

The meridian profile of the carcass reinforcement, when the tyre is mounted on its operating rim and inflated to its operating pressure, has a direction of curvature which is constant at least in the first bead and the sidewall which extends it radially, and the tangent TT' to the point of tangency T of said profile with the annular reinforcement element of said bead forms with the axis of rotation an angle ø which is open towards the outside of at least 70°.

The invention will be better understood with reference to the drawing attached to the description, which illustrates a non-limitative example of embodiment of a tyre according to the invention, and which, associated with a suitable rim, forms a high-performance tyre/rim assembly. In said drawing, the sole figure 1 is a diagram of a bead of a tyre according to the invention, mounted on the seat of its mounting rim.

The rim (2), on which the tyre (1) will be mounted, is formed mainly of two frustoconical seats, the generatrices of which form with the axis of rotation an angle α' which is open towards the inside of the tyre, of between 4° and 30° and in the example described equal to 14°, less than the angle of the corresponding generatrices of the

seats of the beads (12) of the tyre. Said seats thus have axially outer ends on circles of smaller diameters than those of the circles on which the axially inner ends are located. The seat (23"), which is located for example on the outer side of the vehicle, is extended axially to the outside by a protrusion or hump (25"), the inner face (250") of which forms with the axis of rotation an angle γ', the diameter D_{SE} of which is less than the internal diameter D_{TE} of the bead wire (14) for reinforcing the bead which is intended to be mounted on said seat, and the height h_1 of which, measured relative to the axially outer end of the rim seat (23"), is a height comparable to the height of the humps or protrusions used axially to the inside of conventional, standardised passenger-car rims.

On the side located on the outside of the vehicle, the rim seat (23") is connected to a cylindrical portion (21) on which a bearing support (4) for the tread will come to rest. The diameter of the cylindrical portion (21) is the nominal diameter D of the rim (2).

The contour of the bead (12), mounted on the seat (23"), comprises, axially to the inside, a wall (12D) substantially perpendicular to the axis of rotation, which wall will bear laterally on the axially outer face of the support ring (4). Said wall (12D) of the bead (12) is extended axially to the outside by a frustoconical generatrix (12C), which forms with a line parallel to the axis of rotation an angle β of 45° which is open axially towards the inside and radially towards the outside. Said generatrix (12C) is itself extended axially to the outside by a second frustoconical generatrix (12B) of the bead seat forming with the direction of the axis of rotation an angle α of 15°, which is open axially towards the inside and radially towards the outside. Said generatrix (12B) is said to be inclined towards the outside, its axially outer end being on a circle of diameter less than the diameter of the circle on which its axially inner end is located. A frustoconical generatrix (12A), extending the generatrix (12B) axially to the outside

and forming with the direction of the axis of rotation an angle of γ of 45°, which is open axially and radially towards the outside, finishes off the contour of the base of the bead (12). The wall (12E), which is curved in the example described and is of substantially perpendicular general orientation to the direction of the axis of rotation of the rim, completes the contour of the bead (12). Whereas the generatrix (12B) will bear on the rim seat (23"), which is inclined towards the outside, the generatrix (12A) will bear on the axially inner wall (250") of the protrusion or hump (25") of the rim (2), which is inclined by the angle γ', which is equal to the angle γ of the generatrix (12A). The portion of the bead adjacent to the wall (12D) and to the generatrix (12C), forms, viewed in meridian section, the heel of the bead (12). The portion of the bead adjacent to the generatrix (12B), to the generatrix (12A) and partially to the wall (12E) constitutes the toe of the bead (12). The heel of the bead (12) is reinforced by the anchoring bead wire (14) of the carcass reinforcement (13), which bead wire is coated with a rubber mix of high Shore A hardness. The toe of the bead (12) comprises a profiled element (3), arranged axially to the outside of the anchoring bead wire (14) of the carcass reinforcement (13). This profiled element (3) is in the shape of a substantially circular sector with an apex or centre A located radially beneath the bead wire (14), two sides or radii (31) and (32) starting from said apex A, and a third side (30), opposite the apex A. The radially outer side or radius (31) forms with a line parallel to the axis of rotation an angle $\varnothing_1$, which is open radially and axially towards the outside, of 45°, whereas the radially inner side or radius (32) forms with the same parallel line an angle $\varnothing_2$, which is open radially towards the inside and axially towards the outside, of 15°. This profiled element (3) is formed of a rubber mix having in the vulcanised state a Shore A hardness of 94.

The coated bead wire (14) is surmounted radially to the outside by a profiled element (7) of rubber mix of a Shore A hardness of 37. Radially to the outside of the profiled element (3) and axially to the outside of said profiled element (7) there is

arranged a third profiled element (6) of rubber mix having a Shore A hardness equal to that of the profiled element (7) and therefore significantly less than the hardness of the mix of the profiled element (3), which makes it possible, when the tension of the carcass reinforcement increases, to facilitate the axial displacement of the braided bead wire (14) towards the outside of the bead (12) and thus to create compression of the profiled element (3) and self-clamping of the toe of the bead on the mounting rim (2), whereas, in the case described, the initial clamping of the bead (12) on said rim is virtually zero, owing to the virtual equality of the angles α and α' and to the virtual equality of the largest diameters of the rim and bead seats. The bead (12) is finished off by the protector (5).

The carcass reinforcement (13) has a meridian profile, when the tyre is mounted on its operating rim and inflated to its operating pressure, which has a direction of curvature which is constant over its entire length, and is such that the tangents TT' to the points of tangency T of said profile with the coated bead wires (14) of the beads (12) form with the axis of rotation angles ϕ which are open axially and radially towards the outside and are equal to 80°. Said carcass reinforcement (13) is wound around the coated bead wire (14) from the heel to the toe of the bead (12), or from the inside to the outside, to form an upturn (130) which is substantially rectilinear and which extends along the radially inner side (32) of the profiled element (3), then along the side (30) opposite the apex A, then covering at least in part the axially and radially outer side of the profiled element (6) radially to the outside of the profiled element (3).

The end of the upturn (130) is located, on one hand axially to the inside and radially to the outside of a straight line P_1, said straight line P_1 being the straight line which supports the side (31) of the profiled element (3), and on the other hand axially to the outside of a straight line P_2, which is perpendicular to the axis of rotation and passes through the centre of gravity of the meridian section of the coated bead wire

(14). The carcass reinforcement upturn which is thus structured thus is of sufficient length to be able to have good strength with respect to the unwinding of the carcass reinforcement, while permitting a lesser propagation rate of the cracks which arise in the outer layer (5) of the bead (12).

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A tyre having a radial carcass reinforcement including, viewed in meridian section, at least one first bead, a seat which has a generatrix, an axially inner end of which lies on a circle of diameter greater than the diameter of a circle on which an axially outer end is located, a heel of said bead being axially to the inside and being reinforced by at least one inextensible, annular reinforcement element which is coated with rubber mix, whereas a bead toe is axially to the outside and comprises a profiled element of rubber mix in the form of a wedge defined by two sides starting from an apex A located beneath a section of the annular reinforcement element, the radially outer side forming, with a straight line parallel to the axis of rotation passing through said apex A, an acute angle $\varnothing_1$, which is open radially and axially towards the outside, and the radially inner side forming with said parallel line an acute angle $\varnothing_2$, which is open radially towards the inside, the rubber mix forming the profiled element, axially adjacent to the annular reinforcement element having a Shore A hardness greater than the Shore A hardness(es) of the rubber mixes radially above said annular reinforcement element and the axially adjacent profiled element, characterised in that the radial carcass reinforcement of said tyre winds at least in the first bead around said annular reinforcement element from the inside to the outside to form an upturn, the end of which is located on one hand axially to the outside of a straight line P_2 perpendicular to the axis of rotation and passing through the centre of gravity of the meridian section of the annular reinforcement element, and on the other hand axially to the inside and radially to the outside of the straight line P_1 supporting the radially outer side of the profiled element.

2. Tyre according to Claim 1, characterised in that the profiled element of rubber mix in the form of a wedge and defined by the two sides starting from the apex A is reinforced by at least that part of the upturn of the radial carcass reinforcement which is immediately adjacent to that part of the radial carcass reinforcement which is wound around the annular reinforcement element, whether said part be in the profiled element or whether it forms at least one of its said sides.

3. A tyre according to Claim 2, characterised in that the radial carcass reinforcement of said tyre is wound, at least in the first bead, around said annular element from the inside to the outside to form an upturn, extending along the radially inner side of the profiled element in the form of a wedge, then along a side opposite the apex A, then covering axially and radially to the outside at least in part a second profiled element radially above the profiled element in the form of a wedge.

4. A tyre according to Claim 1, characterised in that it comprises a second said bead, having a seat which is of the same configuration as the seat of the first bead, that is to say, a seat, the generatrix of which has an axially inner end on a circle of diameter greater than the diameter of the circle on which the axially outer end is located, or seat which is said to be inclined towards the outside.

5. A tyre according to Claim 1, characterised in that it has two said seats inclined towards the outside and of different diameters.

6. A tyre according to Claim 4, characterised in that the generatrices of the seats of the beads are extended axially to the outside by frustoconical generatrices, forming with the direction of the axis of rotation an angle γ, which is open axially and radially towards the outside, of 45°.

7. A tyre according to Claim 1, characterised in that the meridian profile of the radial carcass reinforcement, when the tyre is mounted on its operating rim and inflated to its operating pressure, has a direction of curvature which is constant in the sidewall and the first bead and the tangent TT' of which to the point of tangency T of said profile with the annular reinforcement element of said bead forms with the axis of rotation an angle ø which is open towards the outside of at least 70°.

DATED this 19th day of September 2002

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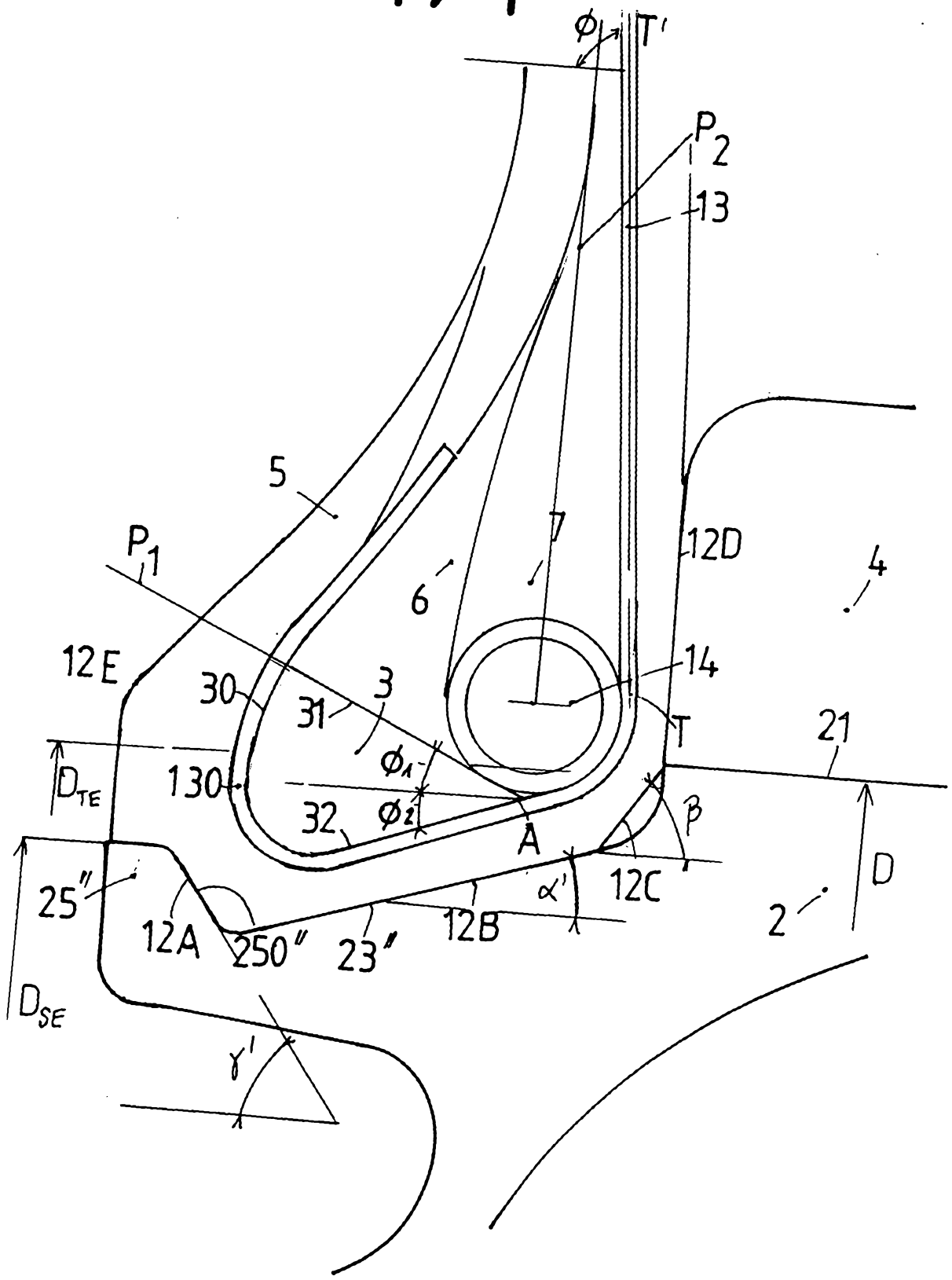
T'
P2
13
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P1
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130
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12C
D
25"
12A
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12B
2
DSE

FIG 1