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(71) Applicant: **PIRELLI TYRE S.P.A.** [IT/IT]; No. 25, Viale Piero e Alberto Pirelli, 20126 Milano (IT).

(72) Inventors: **MISANI, Pierangelo**; c/o Pirelli Tyre S.p.A., No. 25, Viale Piero e Alberto Pirelli, 20126 Milano (IT). **MARIANI, Mario**; c/o Pirelli Tyre S.p.A., No. 25, Viale Piero e Alberto Pirelli, 20126 Milano (IT). **MONZANI, Alessandro**; c/o PT. Evoluzione Tyres, Jalan Raya Purwadadi-Kalijati, Dusun Kaliangbawang RT17 RW08, Wanakerta, Purwadadi, Jawa Barat, 41261 Subang (ID).

(74) Agent: **FABIANO, Piero**; Fabiano, Franke & MGT Sagl, Riva Caccia 1D, 6900 Lugano (CH).

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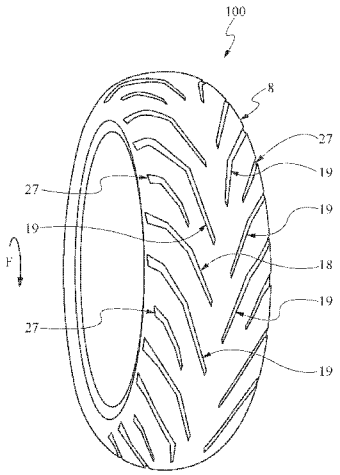


Fig. 1

(57) Abstract: Motorcycle tyre (100), comprising: - a carcass structure comprising at least two carcass plies radially superimposed, comprising a plurality of reinforcing elements parallel to one another and being mutually crossed; - a tread band (8) radially superimposed to the carcass plies, comprising a plurality of grooves (18,19,27) and presenting a void/solid ratio > 4%; - the first and the second grooves of a first and a second couple being arranged so as to form a central annular portion (s) across the equatorial plane presenting a void/solid ratio < 0,1%; - the first couple of first grooves (18) being arranged circumferentially alternated to the second couple of the second grooves (19); - the first (18) and the second grooves (19) extend axially away from the equatorial plane over at least 20% of the width L of the tread band (8); - at least a first segment (20,23) of each first (18) or second (19) grooves being arranged along a direction substantially corresponding to the direction of a reinforcing element of one of the first and second carcass ply.

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MOTORCYCLE TYRE

Field of the invention

The present invention refers to a motorcycle tyre. In particular, the present invention refers to a tyre targeted to be mounted on wheels of motorcycles with small/medium displacement (for example 150 – 250 cm^3), and/or with low and medium power (for example 40 -80 hp) generally used in geographic areas characterized by tropical hot climates and by road often being irregular and irregular.

Background art

The following documents describe some motorcycle tyres: US4112994 and EP 1 884377.

Summary of the invention

In these last years we are observing an endlessly increasing diffusion of motorcycles with small or medium displacement and/or with low-medium power in markets, so-called emerging, localized in tropical or sub-tropical geographic areas, with hot climates being characterized by abundant precipitations.

In these geographic areas the roads can be uneven and irregular, for example characterized by holes, hollow zones and protrusion.

For adapting to this exigence, to the tyres targeted to this use are normally required optimal qualities of drainage and strength also keeping into account the overload that motorcycles can be subjected to.

The applicant has observed that conventionally for resolving the issues of strength have been used tyres provided with a carcass structure provided with at least two carcass plies radially superimposed wherein the reinforcing elements of the radially inner ply are inclined opposite relative to the reinforcing elements of the above ply, the so-called carcass structure with crossed plies (“cross ply” or “X ply”).

The applicant has observed that in general the tyres provided with the aforementioned carcass structure have a high structural rigidity that results in a ground footprint which is long and narrow.

According to the applicant, an excessive length of the footprint zone is not convenient since it can cause local losses of contact pressure and/or an irregular wear.

Always according to the applicant a too narrow footprint area does not allow an adequate transmission on the ground of the traction torque prejudicing of the performances of the tyre mostly while running in straight stretch.

Furthermore, a footprint area too narrow tends to stress more the compound of the tread, worsening the behavior thereof.

Finally a footprint area too narrow tends to transmit the longitudinal stresses to the frame, that is a feature to avoid mostly for motorcycles with small and medium displacement wherein the transmission of the stresses to the frame is filtered and/or dampened substantially only by the flexibility of the fork.

For solving these drawbacks it is known to realize conventional tyres provided with many radial and/or longitudinal grooves, by the way reducing the contact between the compound and the tarmac, which is necessary where more performances in terms of grip and sporty driving are required.

While increasing the speed of the motorcycles even with low displacement and of the performances which are required to the tyre, it has, therefore, been necessary to realize a new type of structure able to guarantying performances.

Have therefore been introduced the radial tyres provided with a reinforcing structure known as belt specialized in containing the diameter of the tyre, while inflated and in operation, and in particular in containing the centrifugal forces.

The introduction of two structurer, radial carcass and belt, that even if collaborating are specialized in containing two different types of deformation, has allowed to increase the performances of thrust and resistance to the required increased speed.

The applicant has anyway observed that the tyres provided with radial carcass structure and belt structure can be not sufficiently robust in working conditions with uneven and irregular roads and/or with highly loaded motorcycles.

The applicant has furthermore observed that the tyres provided with radial carcass and belt can be of a complex production and not suitable to any type of production plant.

The applicant has considered of providing for tyres for motorcycles structurally simple that have optimal features of drainage and strength therefore suitable to be used also in conditions of use with uneven and irregular roads and highly loaded motorcycles and that at the same time do not present the drawbacks of the tyres provided with a conventional structure.

The applicant has furthermore considered to provide for tyres for motorcycle structurally simple that have optimal features of drainage and strength and at the same time of performances in terms of grip and tyre behavior so as to allow a more sporty driving.

The applicant has found that that problem can be solved by the use of a tyre provided with a conventional carcass structure and with a tread band with grooves, at least partially arranged according to the orientation of the reinforcing elements of the underlying carcass plies.

In a first aspect, the invention refers to a motorcycles tyre, comprising:

- a carcass structure comprising at least one first and at least one second carcass ply radially superimposed, each one made in elastomeric material and comprising a plurality of reinforcing elements arranged parallel to one another; said at least one first and a second carcass ply being mutually crossed so that the reinforcing elements of a first ply are inclined relative to the reinforcing elements of the second carcass ply and to the equatorial plane;
- a tread band externally outer to said carcass structure; said tread band comprising a plurality of grooves;
- said tread band presenting a solid/void ratio greater than of the 4%;
- said tread band comprising one module replicated along a direction di circumferential development of the tyre comprising:
- a first couple of first grooves, oppositely inclined relative to the equatorial plane of the tyre;
- a second couple pf second grooves oppositely inclined relative to the equatorial plane of the tyre;

- the first and the second grooves of the first and of the second couple being arranged so as to form a central annular portion across of the equatorial plane having a solid/void ratio less than 0,1%;
- the first couple of first grooves being arranged circumferentially alternated to the second couple of the second grooves;
- each first and second groove comprising a proximal end arranged in correspondence of the central annular portion in each first couple of first grooves the proximal ends are circumferentially staggered; in each second couple of second grooves the proximal ends are circumferentially staggered and circumferentially staggered relative to the proximal ends of the first couple of first grooves;
- the first and the second grooves extend axially away from equatorial plane over at least the 20% of the width L of the tread band;
- each one first or second groove of the first or of the second couple being arranged so as to have at least a first segment along a direction substantially corresponding to the direction of a reinforcing element of one between the first and the second carcass ply.

With direction substantially corresponding to another direction it is intended that the two directions are oriented the same and for an angle not exceeding 20°.

The applicant has observed that such an arrangement and shape of the first and of the second grooves generates a synergistic effect with the reinforcing elements of the underlying carcass plies suitable to increase the grip of the tyre without limiting the drainage and the strength thereof.

The applicant considers that such an enhancement is due to a better local interaction between the pattern tread with the stress and deformation status of the reinforcing elements of the of the overlying carcass plies.

The applicant has, in fact, found that the aforementioned interaction, in a determined and precise portion of the tread band, allows for having a rigid tyre in correspondence of the equatorial plane and a reduction of rigidity in a zone separated that allows for broaden the footprint area advantaging the performances and the ground grip, without in any case reduce the strength thereof.

The broadening of the footprint area allows for, in fact, increasing the forces which are transmitted to the ground: increasing in such a way also the braking and the tyre grip in bends.

The applicant has, anyway, observed that typically a broader contact surface is considered as involving as a drawback the worsening of the drainage capability of the tyre.

Typically in fact, it is considered that broad footprint areas can cause a worsening of the drainage since the lateral path of the water to be drained increases respective to tyres with narrower ground footprint.

Unexpectedly the solid/void ratio and the shape of the first and of the second grooves of the tyre according the present invention ensures in contrast optimal features of drainage also for vehicles used in tropical or sub-tropical geographic areas, with hot climates and being characterized by abundant precipitations.

With the expression “module of the pattern tread” it is meant a portion of tread pattern repeated equal to itself in a succession along the entire circumferential development of the tread band itself. The modules, even if maintaining the same pattern configuration, can present anyway different circumferential lengths.

With the expression “substantially straight segments”, are meant segments arranged according to straight lines for at least l’80% of their extension.

With the expression “substantially consecutive straight segments”, are meant two straight segments arranged directly one after the other, but also two substantially straight segments connected with a substantially curvilinear portion of extension smaller or equal to the minimal extension of the straight segments.

Furthermore, referring to the inclination of the grooves created in the tread band relative to the equatorial plane of the tyre, said inclination shall be meant for each point of the groove as referred to the angle (comprised between 0° and 90°) formed by a rotation performed starting from the equatorial plane up to the direction tangent to the groove passing for that point.

Furthermore the following definitions apply:

1. For “motorcycles tyre” it is meant a tyre having a high curvature ratio (typically greater than di 0.200), capable of reaching high angles of camber during the running in bends of the motorcycle.
2. For “radial angle” of positioning of a groove or of a segment thereof, given a straight section of the tyre, it is meant the angle between the equatorial plane of the tyre installed on the wheel of the motorcycle, not laying on the ground, and a radial plane passing through the median line of the groove and for the center of a circumference identified by three points: the point of intersection between equatorial plane and profile of the tyre; the points on the profile of the tyre of maximum chord.
3. For “equatorial plane” of the tyre it is meant a plane perpendicular to the rotation axis of the tyre and that subdivides the tyre in two equal parts.
4. For “circumferential” direction it is meant a direction generally oriented according to the rotation direction of the tyre, or in any case slight inclined relative to the rotation direction of the tyre.
5. For “solid/void ratio” it is meant the ratio between the total surface of the recesses of a determined portion of the pattern tread of the tyre (eventually of the whole pattern tread) and the total surface of the determined portion of pattern tread (eventually of the whole pattern tread).
6. For “curvature ratio” of the tyre it is meant the ratio between the distance comprised between the radially highest point of the tread band and the maximum chord of the tyre, and the maximum chord of the tyre itself, in a transversal section of the same.

The present invention, in one or more preferential aspects, can comprise one or more of the features hereinafter reported.

Preferably, in each one couple of first grooves, a first groove can be arranged for at least a first segment along a direction substantially corresponding to the direction of a reinforcing element of a first carcass ply and the resting first groove can be arranged for at least a first segment along a direction substantially corresponding to the direction of a reinforcing element of a second carcass ply.

Preferably, in each one couple of second grooves, a second groove is arranged for at least a first segment along a direction substantially corresponding to the direction of a reinforcing element of a first carcass ply and the resting second groove is arranged for at least a first segment along a direction substantially corresponding to the direction of a reinforcing element of a second carcass ply.

Advantageously, the first grooves of the first couple can comprise in axially away from the equatorial plane of the tyre at least two segments substantially straight and substantially consecutive wherein the first segment has an inclination with the equatorial plane suitable for forming an angle $\alpha 1 \leq 40°$.

Conveniently, the second grooves of the second couple of second grooves can comprise in axially away from the equatorial plane of the tyre at least two segments substantially straight and substantially consecutive wherein the first segment has an inclination with the equatorial plane suitable for forming an angle $\beta 1 \leq 40°$.

Preferably, the first segments of the first and of the second grooves are spaced from the equatorial plane and can extend in a radial zone of the tread band defined from radial angles comprised between +/-5° and +/-15°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-5° and +/-45, in the case of a tyre targeted to be installed on the front wheel of a motorcycle.

Conveniently, the first segments of the first and of the second grooves have inclination angles smaller respective to inclination angles of the second segments of the first and of the second grooves; the second segments presenting a length measured along their extension lower of the length of the first segments.

Advantageously, the first and the second grooves can comprise a third straight segment arranged consecutively to the second segment; said third segment presenting an angle of inclination greater than the inclination angle of the respective second segment.

Preferably, the first segments of the first groove, respectively of the second groove, have a proximal end spaced from the equatorial plane of a predetermined distance, the proximal ends of the first grooves and of the second grooves being suitable to be arranged in correspondence of the vertexes of a broken line arranged across of the equatorial plane.

The proximal ends of the first segments of the first and of the second grooves are the proximal ends of the first and of the second grooves. For proximal end of a groove or of an own segment it is meant the end of the groove itself or of its own segment least distant relative to the equatorial plane, according to a direction orthogonal to the equatorial plane.

Conveniently, each one proximal end of the first grooves and of the second grooves is spaced from the equatorial plane of a distance equal to at least the 5% of the width L of the tread band; and wherein the broken line comprises segments, having substantially opposed inclinations relative to the equatorial plane, in other words arranged substantially in a zig-zag way relative to the equatorial plane, the segments can be arranged along a direction substantially corresponding to the direction of a reinforcing element of a between the first and the second carcass ply.

Preferably, the proximal ends of the first segments of the first and of the second grooves are spaced from the equatorial plane and can extend in a radial zone of the tread band defined by radial angles comprised between +/-5° and +/-12°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-3° and +/-10 °, in the case of a tyre targeted to be installed on the front wheel of a motorcycle.

Preferably, the central annular portion s is defined by the proximal ends of a couple of first or second grooves and has a solid/void ratio equal to zero.

Advantageously, the reinforcing elements of the first ply can be arranged so as to form an angle γ_1 with the equatorial plane comprised in the range between 10° and 40°.

Preferably, the reinforcing elements of the second ply are arranged so as to form an angle γ_2 with the equatorial plane comprised in the range between 10° and 40°.

Conveniently, in one module, the second segment of a first groove of a first couple of first grooves angularly deviates from the direction of the reinforcing elements of the first ply at most for an angle less than 20° and the second segment of the first groove resting of the said first couple of first grooves angularly deviates from the direction of the reinforcing elements of the second ply at most for an angle less than 20°.

Preferably, in one module the third segment of a first groove of a first couple of first grooves angularly deviates from the direction of the reinforcing elements of the first ply at most for an angle of 80° and at least for an angle of 15° and the third segment of the first groove resting of the couple of first grooves angularly deviates from the direction of the reinforcing elements of the second ply at most for an angle of 80° and at least for an angle of 15°.

Conveniently, in one module the second segment of a second groove of a second couple of second grooves angularly deviates from the direction of the reinforcing elements of the first ply at most for an angle less than 20° and the second segment of the second groove resting of the said second couple angularly deviates from the direction of the reinforcing elements of the second ply at most for

an angle less than 20°.

Advantageously in one module the third segment of a second groove of a second couple of second grooves angularly deviates from the direction of the reinforcing elements of the first ply at most for an angle of 80° and at least for an angle of 15° and the third segment of the second groove resting of the couple angularly deviates from the direction of the reinforcing elements of the second ply at most for an angle of 80° and at least for an angle of 15°.

Conveniently, the first segments of the first and of the second grooves can have a length measured along their extension greater than 50 mm.

Advantageously, the third segments of the first and of the second grooves can have a length measured along their extension lower of the length of the second segments.

Preferably, the module comprises a couple of third grooves.

Conveniently, the third grooves can extend in a radial zone of the tread band defined by radial angles comprised between +/-35° and +/-60°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-25° and +/-40°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle.

Conveniently, the first and the second grooves do not have points of mutual intersection.

Advantageously, to the end of not to excessively weaken the structure of the tyre most of all in correspondence of the portion of the tread band suitable for entering in the footprint area while the

motorcycle runs in bends the third grooves do not have intersection points neither with the first nor with the second grooves.

Each one third groove has a free end close to the equatorial plane and a free end close to the edge of the tyre.

Preferably, in each module the third grooves have the proximal ends staggered between them in a circumferential direction and staggered relative to the proximal ends of the first and of the second grooves.

Conveniently, the third grooves can comprise in axially away from the equatorial plane of the tyre at least two segments substantially straight and substantially consecutive wherein the first segment has an inclination with the equatorial plane suitable for forming an angle □ ≤40°.

Advantageously, the third grooves extend themselves in axially away from the equatorial plane for at most the 5% of the width L of the tread band.

Preferably the tyre can comprise a third carcass ply made of elastomeric material and comprises a plurality of reinforcing elements arranged parallel one another; said third carcass ply being radially superimposed to the second carcass ply in such a way the reinforcing elements of the third ply are inclined respective to reinforcing elements of the second ply of the carcass, and respective to the equatorial plane.

Brief description of the figures

Further features and advantages of the invention will be defined by the following detailed description of some of its embodiments, provided as a non-limiting example, description that will be made referring to the annexed figures, wherein:

figure 1 shows the perspective view of a first example of a tyre according to the invention targeted to be installed on the rear wheel of a motorcycle;

figure 2 shows a portion of the tyre of figure 1 partially in section; and

figure 3 shows a plan view of the tread band of the tyre of Fig. 1;

figure 4 shows a plan view of the tread band of the tyre of Fig. 1, with respectively a portion of tread band and of a carcass ply being taken away.

Detailed description of the embodiments of the tyre.

In figure 1, with 100 is in its complex indicated a tyre for motorcycle wheels according to the present invention. It deals with a tyre preferably targeted to be used on a rear wheel of a motorcycle for a motorcycle with medium/small displacement for example 250cc.

Also referring to figure 1, in the tyre 100 is defined an equatorial plane X-X and a rotation axis (not shown in figure). A circumferential direction (shown in figures with the arrow F oriented in the sense of rotation of the tyre) and an axial direction perpendicular to the equatorial plane X-X are further defined.

The tyre 100 comprises a carcass structure 2 comprising at least one first 2a and a second carcass ply 2b, radially superimposed, each one made of elastomeric material and comprises a plurality of reinforcing elements 3 arranged parallel one another.

The first 2a and the second carcass ply 2b are used, by means of their opposite circumferential edges, they too being superimposed, to at least one annular reinforcing structure 9.

In particular, opposite lateral edges of the carcass plies 2a, 2b are turned up around reinforcement annular structures called beads 4.

On the axially outer perimeter of the beads 4 is applied a tapered elastomeric filling 5 that occupies

the space defined between the carcass plies 2a,2b and the corresponding turned up lateral edge of the carcass plies 2a, 2b.

As it is known, the zone of the tyre comprising the bead 4 and the filling 5 forma the bead, targeted to anchor the tyre on a corresponding mounting rim, not shown.

The carcass plies are radially superimposed in such a way the reinforcing elements 3 of a ply are inclined respective to reinforcing elements 3 of the carcass ply radially superimposed and respective to equatorial plane X-X.

Referring to embodiment shown in figure 2, the structure of carcass 2 has a first 2a and a second carcass ply 2b radially superimposed to the first carcass ply 2a.

In the first carcass ply 2athe reinforcing elements 3 are arranged so as to form an angle γ_1 with the equatorial plane X-X comprised in the range between 10° and 40°, preferably between 15° and 35°.

In the second carcass ply 2bthe reinforcing elements 3 are arranged so as to form an angle γ_2 with the equatorial plane X-X comprised in the range between 10° and 40°, preferably between 15° and 35° . The reinforcing elements 3 of the second ply 2b are arranged opposite respective to reinforcing elements 3 of the first carcass ply 2a, in other words have the same inclination width relative to the equatorial plane X-X but have opposite orientation.

Always referring to embodiment shown in figure 2the reinforcing elements 3 included in the carcass plies 2a.,2b comprise preferably textile cords, chosen among those usually adopted in the production of tyre carcasses, for example in nylon, rayon, PET, PEN, with single yarn of a diameter comprised between 0,35 mm and 1,5 mm.

Referring to embodiment shown in figures 1-3, it can be seen the tyre 100 in radially outer position to the carcass structure 2 does not have a belt structure.

Alternatively, in an embodiment not shown, the tyre 100 could present a belt structure.

According to this last embodiment, the belt structure can be constituted by at least two layers radially superimposed, each one constituted by an elastomeric material reinforced with cords arranged parallel one another. The layers are arranged in such a way that the cords of the first belt layer are

oriented obliquely relative to the equatorial plane X-X of the tyre, while the cords of the second layer, they also have obliquus orientation, but symmetrically crossed relative to the cords of the first layer (the so-called "crossed belt"). In such a case the cords of the belt structure are textile or metallic cords.

On the carcass structure 2 is circumferentially applied, in a radially outer position, a tread band 8 onto which, following an operation of molding performed in conjunction with the vulcanization of the tyre, longitudinal and/or transversal grooves, arranged so as to define a wanted pattern tread, are typically created.

The tyre 100 can comprise a couple of sidewalls laterally applied on opposite sides to said carcass structure 2.

The tyre 100 has a cross section characterized by a high transversal curvature.

In particular, the tyre 100 has a section height H measured, one equatorial plane, between the top of the tread band and the diameter of installation, defined by the reference line r, passing through the beads of the tyre.

The tyre 100 has furthermore a width C defined by the distance between the laterally opposed ends of the tread itself, and a curvature defined by the particular value of the ratio between the distance f of the top of the tread by the line passing through the extremities of the tread itself, measured on the equatorial plane of the tyre and the aforementioned width C. The ends of the tread can be formed with an edge.

For tyres with high curvature in the present description and in the following claims are meant tyres that have a curvature ratio f/C not lower than 0,2, preferably $f/C \geq 0,25$ for example 0,28. Preferably said curvature ratio f/C is not greater than 0,8, preferably $f/C \leq 0,5$.

Preferably the tyres have not particularly low sidewalls. In other words, for tyres with low sidewalls are meant tyres wherein the ratio between the height sidewalls and the overall height of the section measured between the top of the tread and the beads at the diameter level on the rim (H-f)/H is greater than 0,5, in any case lower than 0,8 for example 0,6.

The carcass structure 2 is typically covered on its internal walls by a sealing layer, or so-called "liner", essentially constituted by a layer of airproof elastomeric material, suitable for guarantying the sealing of the tyre itself once inflated.

On the tread band 8, as it is shown in figure 3, is recalled a pattern tread comprising a plurality of grooves.

To the end of guarantying an efficient drainage of the water and at the same time a suitable reduction of the rigidity of the structure of the tyre the grooves define in their total ensemble on the tread band a solid/void ratio greater than of the 4%.

The pattern tread comprises one module 14 replicated along a direction of circumferential development of the tyre. The module 14 is repeated at most thirteen times along the circumferential development of the tyre. Preferably at most ten times, for example eight times.

The module 14 has a couple of first grooves 18 oppositely inclined relative to the equatorial plane X-X and a second couple of second grooves 19 they also being oppositely inclined relative to the equatorial plane X-X of the tyre.

Always to the end of guarantying a suitable drainage and a sufficient synergistic interaction with the deformation layer of the reinforcing elements 3 of the underlying carcass plies 2a, 2b, the first 18 and the second 19 grooves have a considerable size. In particular, each one first 18 and second groove 19 extends axially away from the equatorial plane X-X for at least the 20% of the width L of the tread band 8.

As better shown in figure 3, the first 18 and the second 19 grooves of the first and of the second couple are arranged so as to form a central annular portion s across of the equatorial plane X-X that has a solid/void ratio less than' 0,1%.

The applicant has in fact found that, for this category of motorcycles, the drainage is performed in particular by the grooves arranged in a portion of the tread band which is central but spaced relative to the equatorial plane.

The applicant has furthermore found that a more central portion of the tread band across of the

equatorial plane provided with an appropriate rigidity for allowing suitable the traction torque during the running in straight stretch to be transmitted on the ground is convenient. The applicant has therefore found that in this portion of tread band, the grooves should not interact synergically with the underlying reinforcing elements 3 so as to not to excessively weaken the structure of the tyre in this area which is targeted to transmit on the ground the traction torque, mostly during the running in straight stretch.

Preferably to this end, the central annular portion s across of the equatorial plane X-X has a solid/void ratio substantially equal to zero.

The width l of the central annular portion s is at most equal to 0,1L, where L is the width of the tread band 8.

The central annular portion s can be identified as the lower distance, in axial direction, between two proximal ends 30,31 of the first couple of first grooves 18 or of the second couple of second grooves 19.

Referring to embodiment shown in figures it can be seen that the first couple of first grooves 18 is arranged circumferentially alternated to the second couple of the second grooves 19.

Preferably, the first grooves 18 of the first couple are circumferentially reciprocally staggered and the second grooves 19 of the second couple are reciprocally circumferentially staggered and staggered circumferentially relative to the first grooves 18 of the first couple.

The proximal ends 30,31 of the first grooves 18 and of the second grooves 19, axially inner, that is

to say closer to the equatorial plane X-X are arranged in correspondence of the vertexes of a broken line arranged across of the equatorial plane X-X.

The applicant has found that a similar arrangement of the proximal ends 30,31 of the first and of the second grooves in synergistic effect with the inclination of the reinforcing elements 3 of the first 2a and of the second carcass ply 2b allows for on one side to increase the footprint area of the tyre conferring it grip qualities mostly while running in straight stretch and on the other side to generate a containment effect of the deformation produced by the excessive structural deformation.

Preferably, the proximal ends 30,31 of the first grooves 18 and of the second grooves 19 can extend in a radial zone of the tread band defined from radial angles comprised between +/-5° and +/-12°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-3° and +/-10 °, in the case of a tyre targeted to be installed on the front wheel of a motorcycle

Referring to embodiment shown in figures 1-3, each one first groove 18 comprises in axially away from the equatorial plane X-X of the tyre three segments 20,21,22 substantially consecutive and straight.

In the case of tyre targeted to be installed on the rear wheel of a motorcycle as the one represented in figures 1-3, the first segment 20 has an inclination with the equatorial plane X-X suitable for forming an angle $\alpha 1 \leq 40°$, preferably greater than 10° for example equal to about 25°.

The second segment 21 has in contrast an inclination with respect to the equatorial plane X-X suitable for forming an angle $\alpha 2$ greater than of 20°, preferably less than 60°, for example equal to about 40°.

The third segment 22 has an inclination with the equatorial plane X-X suitable for forming an angle α3 greater than of 40°, preferably less than 90° , more preferably less than 70°for example equal to about 60°.

In other words moving axially away from the equatorial plane X-X along the first groove 18 it is observable a significant increase of the inclination of the first groove 18. The second segment 21 has in fact an inclination with the equatorial plane X-X greater than of the inclination of the first segment 20, while the third segment 22 has an inclination with the equatorial plane X-X greater than of the inclination of the second segment 21.

For conferring high drainage features, preferably the first segment 20 of the first grooves longitudinal 18 has a length measured along its extension greater than 4% respective to the circumferential development of the tyre. Preferably less than 12% of the circumferential development of the tyre.
In other words, the first segment 20 of the first grooves longitudinal 18 has a length measured along its extension greater than 50 mm.
The second segment 21, substantially straight, of the first grooves longitudinal 18 has, in contrast, a length measured along its extension which is smaller of the length of the first segment 20.
Preferably the second segment 21, substantially straight, of the first grooves longitudinal 18 has, a length measured along its extension less than 3% of the circumferential development of the tyre. Preferably, less than 2% of the circumferential development of the tyre.
Preferably, the second segment 21, substantially straight, has a length measured along its extension less than 40 mm, more preferably less than 30 mm.
In the embodiment shown in figure 3, the third segment 22, substantially straight, has an extension smaller than the extension of the second segment 21.
Such a choice of conformation of the third segment 22 allows for reducing the noise behaviour of the pattern tread without significantly influencing the drainage. Always referring to embodiment shown

in figures 1 and 3, the first segment 20 extends in a radial zone of the tread band 8 defined by radial angles comprised between +/-5° and +/-15°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-5° and +/-45°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle.

Referring to figures 1 and 3, the first segments 20 of the first grooves longitudinal 18 that are on the right of the equatorial plane X-X extend themselves in a radial zone of the tread band defined from radial angles comprised between +5° and +15°, while the first segments 20 of the first grooves longitudinal 18 that are on the left of the equatorial plane X-X extend themselves in a radial zone of the tread band 8 defined from radial angles comprised between -5° and -15°. The second segment 21 extends in a radial zone of the tread band 8 defined from radial angles comprised between +/-10° and +/-60°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-15° and +/-55°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle. Also in this case, with reference to figures 1 and 3, in the case of tyres targeted to be mounted on the rear wheel of a motorcycle, the second segments 21 of the first grooves 18 that are on the right of the equatorial plane X-X extend themselves in a radial zone of the tread band defined by angles of radials comprised between +10° and +60°, while the second segments 21 of the first grooves 18 that are on the left of the equatorial plane X-X extend themselves in a radial zone of the tread band defined from radial angles comprised between -10° and -60°.

Finally the third segment 22 extends in a radial zone of the annular lateral portion C defined from radial angles comprised +/-40° and +/-70°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle and between +/-45° and +/-70°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle. Referring to figure 3, therefore in the case of tyres targeted to be mounted on the rear wheel of a motorcycle the third segments 22 of the first grooves 18 that are on the right of the equatorial plane X-X extend themselves in a radial zone of the tread band 8 defined from radial angles comprised between +40° and +70°, while the third segments 22 of the first grooves

18 that are on the left of the equatorial plane X-X extend themselves in a radial zone of the tread band defined from radial angles comprised between -40° and -70°.

Always referring to embodiment shown in figure 3, each one second groove 19 comprises in axially away from the equatorial plane X-X of the tyre three segments 23,24,25 substantially consecutive and straight.

In the case of a tyre targeted to be installed on the rear wheel of a motorcycle as the one which is shown in figures 1-3, the first segment 23 has an inclination with the equatorial plane X-X suitable for forming an angle β1 ≤40°, preferably greater than di 5° for example equal to about 15°.

The second segment 24 has in contrast an inclination with the equatorial plane X-X suitable for forming an angle ß2 greater than of 15°, preferably less than 50°, for example equal to about 30°.

The third segment 25 has an inclination with the equatorial plane X-X suitable for forming an angle β3 greater than 30°, preferably less than 90°, more preferably less than 70°for example equal to about 60°.

In other words moving axially away from the equatorial plane X-X along the second groove 19 it can be observed a considerable reduction of the inclination of the second groove 19 itself. The second segment 24 has, in fact, an inclination with the equatorial plane X-X lower of the inclination of the first segment 23, while the third segment 25 has an inclination with the equatorial plane X-X lower of the inclination of the second segment 24.

Also in this case, in order to confer drainage features, preferably the first segment 23 of the second grooves 19 has a length measured along its extension greater than 4% of the circumferential development of the tyre. Preferably less than 12% of the circumferential development of the tyre.

In other words, the first segment 23 of the second grooves 19 has a length measured along its extension greater than 50 mm.

The second segment 24, substantially straight, of the second grooves longitudinal 19 has, in contrast, a length measured along its extension lower of the length of the second segment 20.

Preferably, the second segment 24, substantially straight, of the second grooves 19 has a length measured along its extension less than 3% of the circumferential development of the tyre. Preferably, less than 2% of the circumferential development of the tyre.

Preferably, the second segment 24, substantially straight, has a length measured along its extension less than 40 mm, more preferably less than 30 mm.

Nella embodiment shown in figure 3, the third segment 25, substantially straight, has an extension less than the extension of the second segment 24 in turn less than the extension of the first segment 23.

Such a choice of conformation of the third segment 25 allows for reducing the noise behaviour of the pattern tread without significantly affect the drainage features.

Always referring to embodiment shown in figures 1 and 3, the first segment 23 extends in a radial zone of the tread band 8 defined from radial angles comprised between +/-5° and +/-15°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-5° and +/-45°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle.

Referring to figures 1 and 3, the first segments 23 of the second grooves 19 that are on the right of the equatorial plane X-X extend themselves in a radial zone of the tread band 8 defined from radial angles comprised between +5° and +15°, while the first segments 23 of the second grooves 19 that are on the left of the equatorial plane X-X extend themselves in a radial zone of the tread band 8 defined from radial angles comprised between -5° and -15°.

Always referring to figures 1 and 3, the second segment 24 extends in a radial zone of the tread band 8 defined from radial angles comprised between +/-10° and +/-60°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-15° and +/-60°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle. Also in this case, referring to figures 1 and 3, in the case of tyres targeted to be mounted on the rear wheel of a motorcycle, the second segments 24 of the second grooves 19 that are on the right of the equatorial plane X-X extend themselves in a radial zone of the tread band defined from angles of radials comprised between

+10° and +60°, while the second segments 24 of the second grooves 19 that are on the left of the equatorial plane X-X extend themselves in a radial zone of the tread band defined from radial angles comprised between -10° and -60°.

Finally the third segment 25 extends in a radial zone of the tread band 8 defined from radial angles comprised between +/-20° and +/-70°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle and between +/-20° and +/-75°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle. Referring to figure 3, therefore in the case of tyres targeted to be mounted on the rear wheel of a motorcycle the third segments 25 of the second grooves 19 that are on the right of the equatorial plane X-X extend themselves in a radial zone of the portion of tread band defined by radial angles comprised between +20° and +70°, while the segments 25 of the second grooves 19 that are on the left of the equatorial plane X-X extend themselves in a radial zone of the tread band defined from radial angles comprised between -20° and -70°.

In the embodiment shown in figures 1-3 the first and the second grooves 18, 19 have a decreasing depth moving from the equatorial plane X-X toward the axially outer edges of the tyre, preferably the first and the second grooves longitudinal 18, 19 have a depth lower or equal to 8 mm.

According to an embodiment shown in figure 3, the first and the second grooves 18,19 have a width decreasing along the their extension, increasing moving from the first segment 20,23 in the direction of the edges of the tread band, that is to say from the first 20,23 to the third segment 22,25. Preferably, the first grooves longitudinal 18, 19 have a maximum width lower or equal to 15 mm preferably lower or equal to 12mm.

The applicant has observed that the aforementioned choices in terms of depth and width of the first and of the second grooves 18, 19 allow on one site to further enhance the drainage of the tyre and on the other side to enhance the structural rigidity of the tread band so helping the synergistic collaboration between the pattern of the tread band and the reinforcing elements 3 of the carcass plies 2a, 2b to the end of obtaining a broadened footprint area.

Always for guarantying optimal behaviors of drainage the module 14 comprises furthermore a couple of third grooves 27.

The third grooves 27 of each one couple of third grooves 27 are arranged opposite relative to the equatorial plane X-X and are staggered circumferentially.

Referring to embodiment shown in figures 1-3 it can be seen that the couple of third grooves 27 is arranged axially outer to the couple of second grooves 19 and internally to the couple of first grooves 18.

In detail, the third grooves 27 extend themselves in a radial zone of the tread band 8 defined from radial angles comprised between +/-10° and +/-75°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-20° and +/-75°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle.

Each one third groove 27 extends axially away from the equatorial plane X-X at most for 4% of the width L of the tread band 8.

Always referring to the embodiment shown in figure it can be seen the third grooves 27 comprise in axially away from the equatorial plane X-X of the tyre three segments 28,29,32 substantially straight, and substantially consecutive wherein the first segment 28 has an inclination with the equatorial plane X-X suitable for forming an angle $\Delta 1 \leq 40°$.

Always referring to embodiment shown in figures 1-3, it can be seen to the end of not to create point of excessive structural weakening, the third grooves 27 do not have intersection points neither with the first 18 nor with the second grooves 19.

The inclination of the third grooves decreases axially away from the equatorial plane X-X. The inclination of the second segment 29 of the third grooves is therefore greater than of the inclination of the first segment 28 and the inclination of the third segment 32 is greater than of the inclination of the second segment 29.

The second segment 29 has, in fact, an inclination with the equatorial plane X-X suitable for forming an angle $\Delta 2$ less than 60°, preferably greater than di 15°.

The third segment 32 has an inclination with the equatorial plane X-X suitable for forming an angle Δ3 less than 80°, preferably greater than 30°.

Always referring to embodiment shown in figures 1 and 3, it can be seen that preferably, in each module the third grooves have the proximal ends, that is to say those which are less distant from equatorial plane X-X or proximal thereto, staggered between one another in circumferential direction and staggered relative to the proximal ends 30,31 of the first 18 and of the second grooves 19.

According to an aspect of the present invention each one first 18 or second 19 groove of the first or of the second couple is arranged for at least the first segment 20,23 along a direction substantially corresponding to the direction of a reinforcing element 3 of a between the first 2a and the second 2b carcass ply.

In detail, relative to the embodiment shown in figures 1-3, in each one couple of first grooves 18, a first groove 18 is arranged for at least the first segment 20 along a direction substantially corresponding to the direction of a reinforcing element 3 of the first carcass ply 2a and the resting first groove 18 of the same couple is arranged for at least the first segment 20 along a direction substantially corresponding to the direction of a reinforcing element 3 of the second carcass ply 2b.

The same applies for the second couples of second grooves 19.

In other words, wherein in each one couple of second grooves 19, a second groove 19 is arranged for at least the first segment 23 along a direction substantially corresponding to the direction of a reinforcing element 3 of a first carcass ply 2a and the resting second groove 19 is arranged for at least the first segment 23 along a direction substantially corresponding with the directions of a reinforcing element 3 of a second carcass ply 2b.

In other words, the first 18 and the second 19 grooves arranged from one side of the equatorial plane X-X, for example the right side with reference to figure 3, have at least the respective first segments 20,23 arranged along directions which are substantially corresponding with the directions of the underlying reinforcing elements 3 of the first carcass ply 2a.

The first 18 and the second 19 grooves arranged on the other side of the equatorial plane X-X, for example the left side with reference to figure 3, have at least the respective first segments 20,23 arranged along direction which are substantially corresponding with the directions of the underlying reinforcing elements 3 of the second carcass ply 2b.

Always for keeping this substantial alignment between the direction of the first and second grooves 18,19 and the direction of the reinforcing elements 3 of the underlying carcass plies 2a,2b, in each module 14 the second segment 21 of a first groove 18 of a first couple of first grooves 18 angularly deviates from the direction of the reinforcing elements of the first ply 2a at most for an angle less than 20° and the second segment 21 of the first groove 18 resting of the first couple of first grooves 18 angularly deviates from the direction of the reinforcing elements 3 of the second ply 2b at most for an angle less than 20°.

Equivalently, for the second grooves 19, in each module 14 the second segment 24 of a second groove 19 of a second couple of second grooves 19 angularly deviates from the direction of the reinforcing elements 3 of the first ply 2a at most for an angle less than 20° and the second segment 24 of the second groove 19 resting of the second couple angularly deviates from the direction of the reinforcing elements 3 of the second ply 2b at most for an angle less than 20°.

The applicant has furthermore found in the portion of the tread band which is closer to the edges, it is no more necessary to keep the aforementioned alignment between the grooves and the reinforcing elements 3 of the underlying carcass plies, in contrast it is preferable that such an alignment is not present so as to confer the tyre rigidity and an appropriate response to the stresses that rise in leaning during a running in bend.

In other words, the applicant considers that while in the substantially most central portion of the tread band the cooperation provided by the substantial alignment between the direction of the first 18 and second grooves 19 and the reinforcing elements of the carcass plies 2a,2b allow the tyre to be less rigid advantaging the grip and the predictability of the tyre, mostly while running in straight stretch, moving away from the equatorial plane in direction of the of the edges it is important that the tread

band newly possesses rigidity, enhancing the response to the stresses that come while running in bends.

To this end, preferably in each module 14 the third segment 22 of a first groove 18 of a first couple of first grooves 18 angularly deviates from the direction of the reinforcing elements 3 of the first ply 2a at most for an angle of 80° and at least for an angle of 15° and the third segment of the first groove 18 resting of the same couple of first grooves 18 angularly deviates from the direction of the reinforcing elements 3 of the second ply 2b at most for an angle of 80° and at least for an angle of 15°.

Equivalently for the second grooves 19, in each module 14 the third segment 25 of a second groove 19 of a second couple of second grooves 19 angularly deviates from the direction of the reinforcing elements 3 of the first ply 2a at most for an angle of 80° and at least for an angle of 15° and the third segment 25 of the second groove 19 resting of the same couple angularly deviates from the direction of the reinforcing elements 3 of the second ply 2b at most for an angle of 80° and at least for an angle of 15°.

Examples

Different samples of the tyre according to an embodiment of the present invention and in particular having the tread of figure 1,3 and a carcass structure with crossed plies have been realized.

A couple of tyres according to the invention, respectively a front and a rear tyre (inv. 1), have been subjected to comparison tests with a couple of reference tyres P , model SPORT DEMON ™ that has a carcass structure with crossed plies and configures as the product targeted to the same market segment .

The front tyres, both according to the invention and the reference, had size 100/80- with a rim of 17" and inflation pressure 2,25 bar, while the rear tyres had size 130/70- with a rim 17" and inflation pressure 2,5 bar.

The tests have been performed with an environment temperature of 29°+/- 2°C.

The tests have been made providing a motorcycle Yamaha Fazer 250cc with the couples of tyres in comparison. In table 1 are reported the evaluations obtained by the couple of tyres according to the invention relative to the couple of reference tyres for the following parameters: stability in bends; front grip; rear grip; braking and traction; front drainage; rear drainage; front/rear balancing; trajectory keeping, predictability, controllability, safety feeling, driving neutrality.

To the end of evaluating those parameters, the tester simulated on track some typical manoeuvres. Hence, the tester evaluated the behaviour of the tyre according to the performance of the tyre during said manoeuver.

The results of these tests are expressed through the references greater, lower or equal referred to the couple of reference tyres.

The references produced in the subsequent table represent an average value among those obtained in a multiplicity of test sessions (5-6 tests, for example) and being provided by many testers.

Table 1

	Couple of reference P	**couple tyres Invention (INV1)**
Stability in bends	=	++
Front grip;	=	=
Rear grip;	=	=

braking and traction;	front	=	=
	rear	=	=
Front drainage	Straight stretch	=	+
	bends	=	+
Rear drainage ;	Stratight stretch	=	=
	bends	=	=
Drainage grip;		=	
Front/rear balancing;		=	=
Keeping of trajectory,	Constant speed	=	=
	acceleration	=	+
predictability,		=	+
controllability,		=	+
Safety feeling,		=	+
Driving neutrality.		=	+

The tyre according to the invention has a behaviour comparable or better with respect to the reference tyre on any of the evaluated features.

The present invention has been described in some embodiments. Different adaptations can be brought to the embodiment described in detail, in any case resting within the scope of protection provided by the following claims.

CLAIMS

1. Motorcycle tyre (100), comprising:

- a carcass structure (2) comprising at least one first (2a) and at least one second (2b) carcass ply, radially superimposed, each one made of elastomeric material and comprising a plurality of reinforcing elements (3) arranged parallel one another; said at least one first (2a) and a second (2b) carcass ply being mutually crossed in such a way the reinforcing elements of a first ply are inclined respective to reinforcing elements of the second carcass ply and to equatorial plane (X-X) of the tyre;

- a tread band (8) comprising a plurality of grooves (18,19,2) radially arranged externally to said carcass structure

- said tread band (8) presenting a solid/void ratio greater than of the' 4%;

- said tread band (8) comprises one module (14) replicated along a direction di circumferential development of the tyre comprising:

- a first couple of first grooves (18), oppositely inclined relative to the equatorial plane (X-X) of the tyre;

- a second couple of second grooves (19) oppositely inclined relative to the equatorial plane (X-X) of the tyre;

- the first and the second grooves of the first and of the second couple being arranged so as to form a central annular portion (s) across of the equatorial plane (X-X) presenting a solid/void ratio less

than 0,1%;

- each one first (18) and second groove (19) comprising a proximal end arranged in correspondence of the central annular portion (s); in each one first couple of first grooves (18) said proximal ends (30) are circumferentially staggered; in each one second couple of second grooves said proximal ends are staggered circumferentially and staggered circumferentially relative to the said proximal ends of the first couple of first grooves;

- the first couple of first grooves (18) being arranged circumferentially sequentially to the second couple of the second grooves (19);

- the first (18) and the second grooves (19) extend themselves in axially away from the equatorial plane (X-X) for at least the 20% of the width L of the tread band (8);

- each one first (18) or second (19) groove of the first or of the second couple being arranged for at least a first segment (20,22) along a direction substantially corresponding to the direction of a reinforcing element (3) of a between the first (2a) and the second (2b) carcass ply.

2. Motorcycles tyre according to claim 1, wherein in each one couple of first (18) grooves, a first groove (18) is arranged for at least a first segment (20) along a direction substantially corresponding to the direction of a reinforcing element (3) of a first carcass ply (2a) and the resting first groove (18) is arranged for at least a first segment (20) along a direction substantially corresponding to the direction of a reinforcing element (3) of a second carcass ply (2b).

3. Motorcycle tyre (100) according to claim 1 or 2, wherein in each one couple of second grooves (19), a second groove (19) is arranged for at least a first segment (23) along a direction substantially corresponding to the direction of a reinforcing element (3) of a first carcass ply (2a) and the resting second groove (19) is arranged for at least a first segment (23) along a direction substantially corresponding to the direction of a reinforcing element (3) of a second carcass ply (2b).

4. Motorcycles tyre according to any one of the claims from 1 to 3, wherein the first grooves (18) of the first couple comprise axially away from the equatorial plane (X-X) of the tyre at least two substantially straight and consecutive segments (20,21) wherein the first segment (20) has an inclination with the equatorial plane (X-X) suitable for forming an angle $\alpha 1 \leq 40°$.

5. Motorcycle tyre (100) according to any one of the claims from 1 a 4, wherein the second grooves (19) of the second couple of second grooves (19) comprise in axially away from the equatorial plane (X-X) of the tyre at least two substantially straight and substantially consecutive segments (23,24) wherein the first segment (23) has an inclination with the equatorial plane X-X suitable for forming an angle $\beta 1 \leq 40°$.

6. Motorcycle tyre (100) according to claim 1, wherein the first segments (20,23) of the first (18) and of the second (19) grooves are spaced from equatorial plane (X-X) and extend themselves in a radial zone of the tread band (8) defined by radial angles comprised between +/-5° and +/-15°, in the case of a tyre targeted to be installed on the rear wheel of a motorcycle, and between +/-5° and +/-45°, in the case of a tyre targeted to be installed on the front wheel of a motorcycle.

7. Motorcycle tyre (100) according to any one of claims from 5 or 6, wherein the first segments (20,23) of the first (18) and of the second (19) groove have inclination angles with the equatorial plane (X-X) which are smaller than respective inclination angles of the second segments (21,24) of

the first (18) and of the second (19) grooves; the second segments (21,24) presenting a length measured along the their extension lower of the length of the first segments (20,23).

8. Motorcycle tyre (100) according to any one of the preceding claims from 1 to 7, wherein said first (18) and said second (19) grooves comprise a third straight segment (22,25) arranged consecutively to the second segment (21,24); said third segment (22,25) presenting an angle of inclination with the equatorial plane (X-X) lower than the inclination angle of the respective second segment (21,24).

9. Motorcycle tyre (100) according to any one of the preceding claims from 1 to 8, wherein the first grooves (18) of the first couple are reciprocally circumferentially staggered and the second grooves (19) of the second couple are circumferentially reciprocally staggered and staggered circumferentially relative to the first grooves (18) of the first couple.

10. Motorcycle tyre (100) according to any one of the previous claims from 2 a 9, wherein said free end (30,31) are spaced from the equatorial plane (X-X) of a predetermined distance d, the proximal ends (30,31) of the first grooves (18) and of the second grooves (19) being arranged in correspondence of the vertexes of a broken line arranged across of the equatorial plane (X-X).

11. Motorcycle tyre (100) according to claim 10, wherein each one proximal end (30,31) of the first grooves (18) and of the second grooves (19) is spaced from the equatorial plane of a distance d equal to at least the 5% of the width L of the tread band (8); and wherein the said broken line comprises segments, arranged substantially at a zig-zag relative to the equatorial plane (X-X), said segments being arranged along a direction substantially corresponding to the direction of a reinforcing element (3) of a between the first (2a) and the second (2b) carcass ply.

12. Motorcycle tyre (100) according to any one of the preceding claims from 1 to 11, wherein the reinforcing elements (3) of the first ply (2a) are arranged so as to form an angle γ_1 with the equatorial plane (X-X) comprised in the range between 10° and 40°.

13. Motorcycle tyre (100) according to any one of the preceding claims from 1 to 11, wherein the reinforcing elements (3) of the second ply (2b) are arranged so as to form an angle γ_2 with the equatorial plane X-X comprised in the range between 10° and 40°.

14. Motorcycle tyre (100) according to any one of the preceding claims from 1 to 13, wherein in one module (14) the second segment (21) of a first groove (18) of a first couple of first grooves (18) angularly deviates from the direction of the reinforcing elements of the first ply (2a) at most for an angle less than 20° and the second segment (21) of the first groove (18) resting of the said first couple of first grooves (18) angularly deviates from the direction of the reinforcing elements (3) of the second ply (2b) at most for an angle less than 20°.

15. Motorcycle tyre (100) according to any one of the preceding claims from 8 a 14, wherein in one module (14) the third segment (22,25) of a first groove (18) of a first couple of first grooves (18) angularly deviates from the direction of the reinforcing elements (3) of the first ply (2a) at most for an angle of 80° and at least for an angle of 15° and the third segment of the first groove (18) resting of the said couple of first grooves (18) angularly deviates from the direction of the reinforcing elements (3) of the second ply (2b) at most for an angle of 80° and at least for an angle of 15°.

16. Motorcycle tyre (100) according to any one of the preceding claims from 1 to 15, wherein in one module (14) the second segment (24) of a second groove (19) of a second couple of second grooves (19) angularly deviates from the direction of the reinforcing elements (3) of the first ply (2a) at most for an angle less than 20° and the second segment (24) of the second groove (19) resting of the

said second couple angularly deviates from the direction of the reinforcing elements (3) of the second ply (2b) at most for an angle less than 20°.

17. Motorcycle tyre (100) according to any one of the preceding claims from 8 to 16, wherein in one module (14) the third segment (25) of a second groove (19) of a second couple of second grooves angularly deviates from the direction of the reinforcing elements (3) of the first ply (2a) at most for an angle of 80° and at least for an angle of 15° and the third segment (25) of the second groove (19) resting of the said couple angularly deviates from the direction of the reinforcing elements (3) of the second ply (2b) at most for an angle of 80° and at least for an angle of 15°.

18. Motorcycle tyre (100) according to any one of the preceding claims from 1 a 17, wherein the module (14) comprises a couple of third grooves (27).

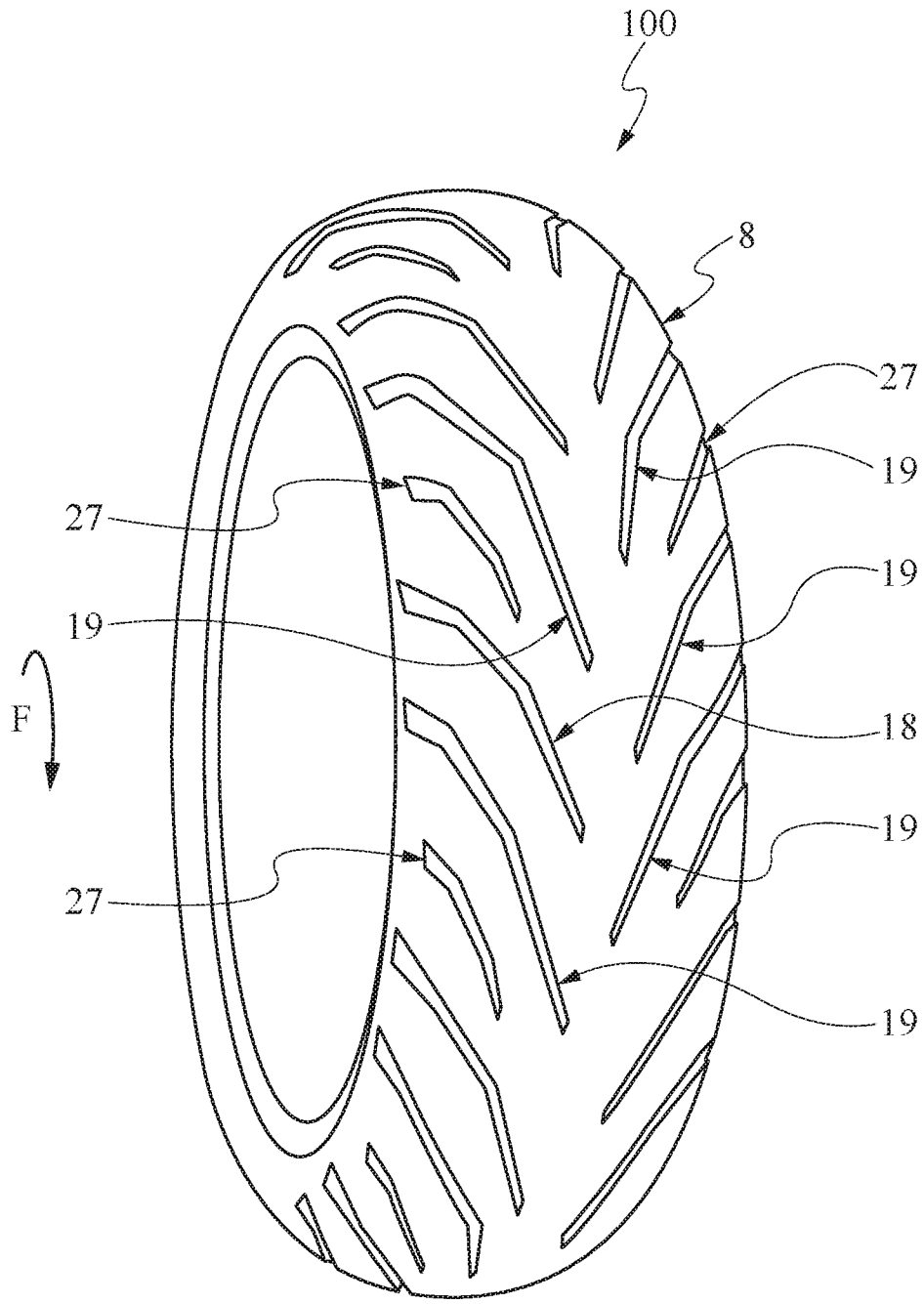


Fig. 1

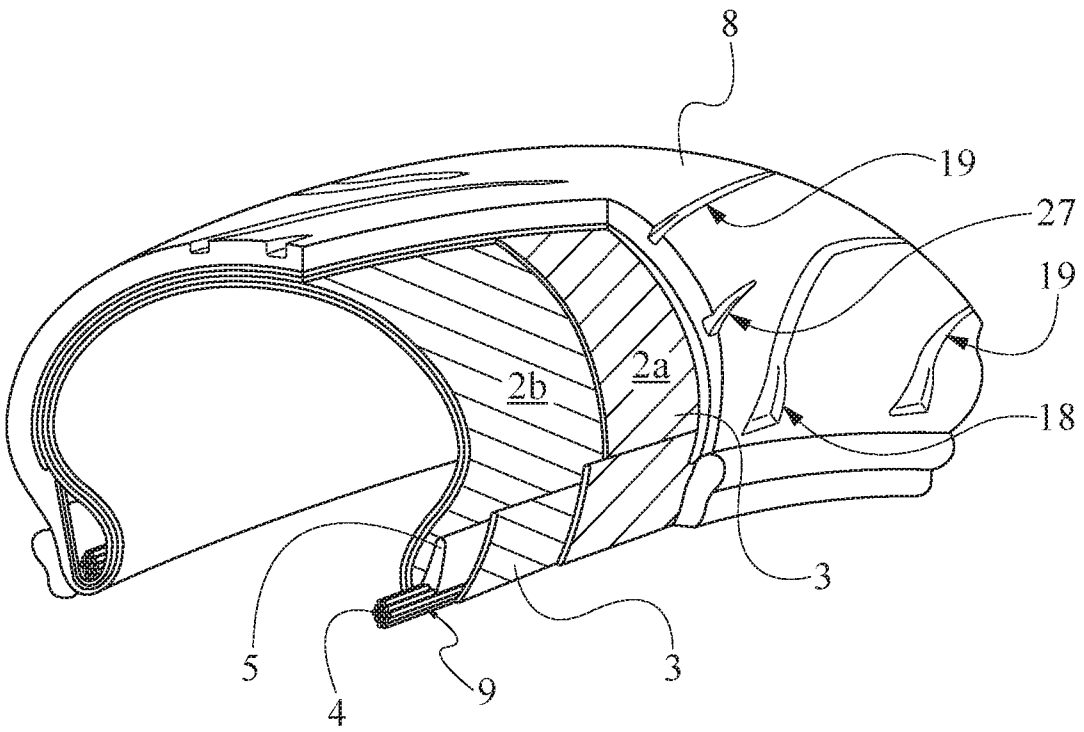


Fig. 2

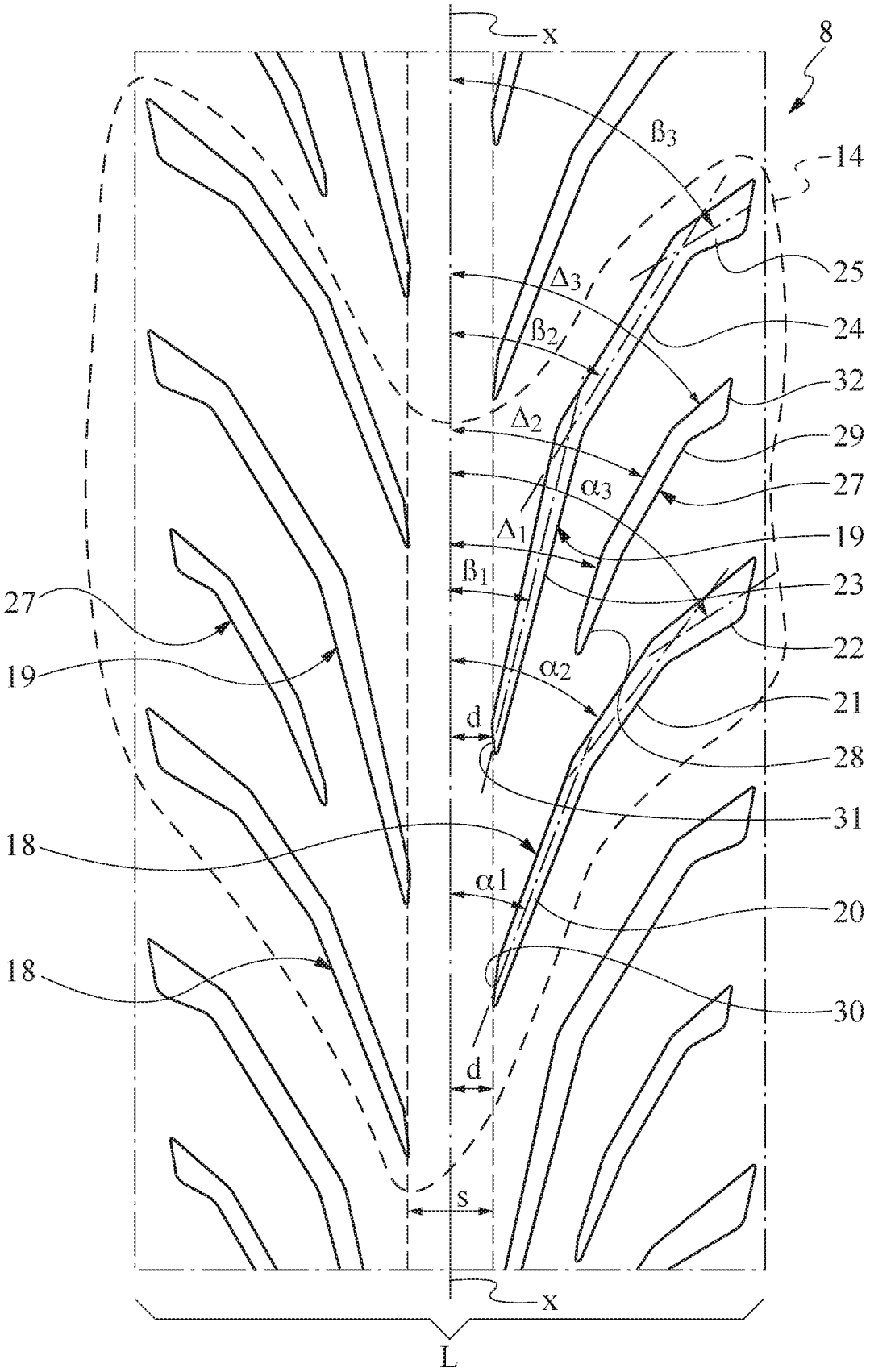

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Fig. 3

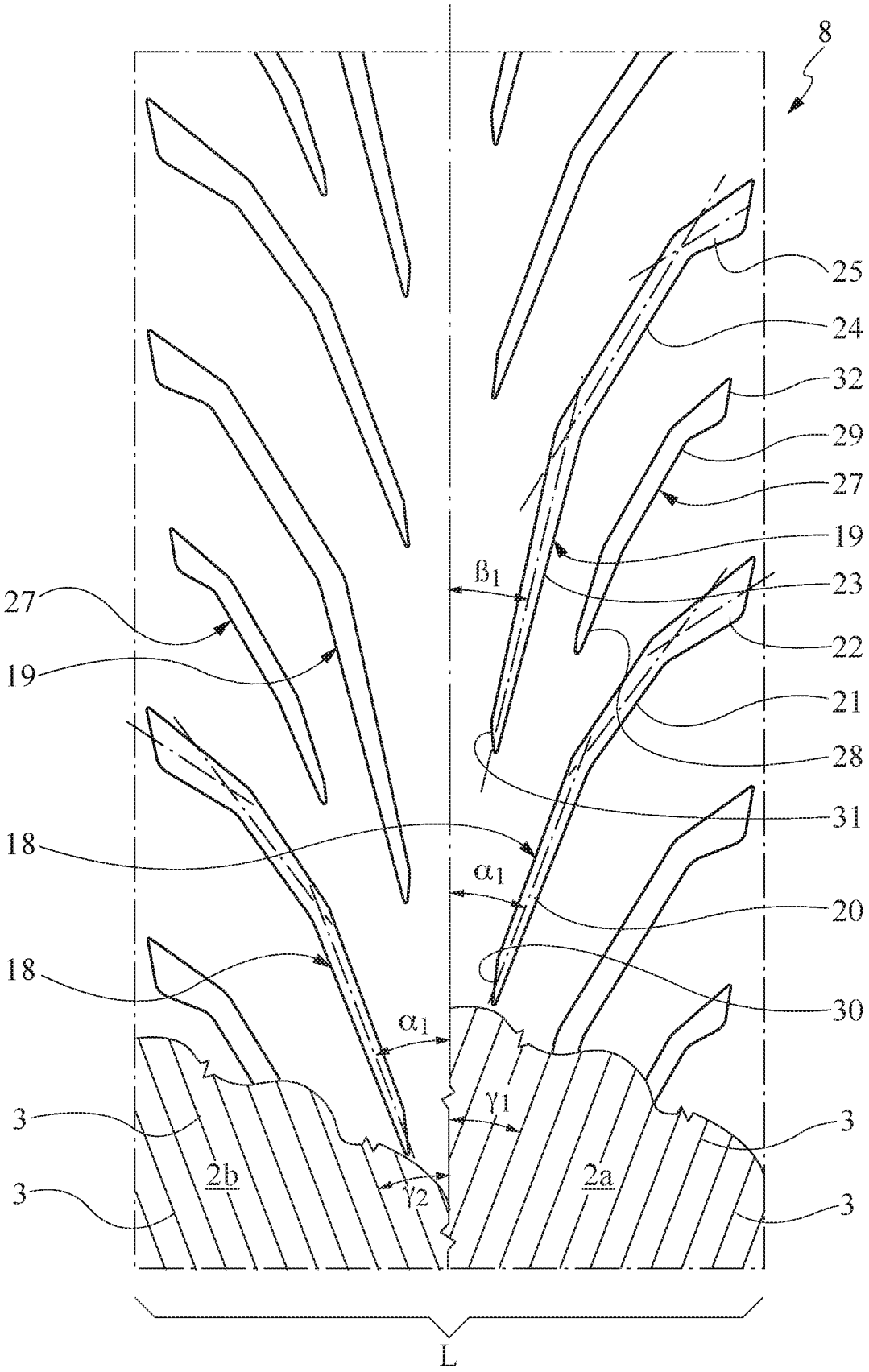

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Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/059834

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60C11/03 B60C9/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011/012980 A1 (PIRELLI [IT]; SCHIAVOLIN ANDREA [IT]; MARIANI MARIO [IT]; MISANI PIERA) 3 February 2011 (2011-02-03) claims 1,2; figures 1-3	1-18
A	US 4 112 994 A (MILLS ANTHONY MARK ET AL) 12 September 1978 (1978-09-12) claims 1-5; figures 3,4	1-18
A	WO 2010/073279 A1 (PIRELLI [IT]; MISANI PIERANGELO [IT]; MARIANI MARIO [IT]; SCHIAVOLIN A) 1 July 2010 (2010-07-01) figure 2	1-18

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 March 2016	21/03/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Buergo, Javier

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2015/059834

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011012980 A1	03-02-2011	CN 102470703 A	23-05-2012
		EP 2459396 A1	06-06-2012
		IT 1395004 B1	07-08-2012
		JP 5580895 B2	27-08-2014
		JP 2013500202 A	07-01-2013
		US 2012118456 A1	17-05-2012
		WO 2011012980 A1	03-02-2011
US 4112994 A	12-09-1978	AU 5949873 A	27-02-1975
		BE 804118 A1	17-12-1973
		DE 2343591 A1	07-03-1974
		FR 2242256 A1	28-03-1975
		GB 1438288 A	03-06-1976
		IE 38594 B1	26-04-1978
		JP S4992705 A	04-09-1974
		LU 68338 A1	12-11-1973
		NL 7311691 A	05-03-1974
		US 4112994 A	12-09-1978
WO 2010073279 A1	01-07-2010	BR PI0823374 A2	16-06-2015
		CN 102264556 A	30-11-2011
		EP 2373498 A1	12-10-2011
		JP 5583691 B2	03-09-2014
		JP 2012513928 A	21-06-2012
		US 2011253276 A1	20-10-2011
		WO 2010073279 A1	01-07-2010