



(51) International Patent Classification:
B60C 11/12 (2006.01)

(21) International Application Number:
PCT/JP2019/049980

(22) International Filing Date:
20 December 2019 (20.12.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2018-237898 20 December 2018 (20.12.2018) JP

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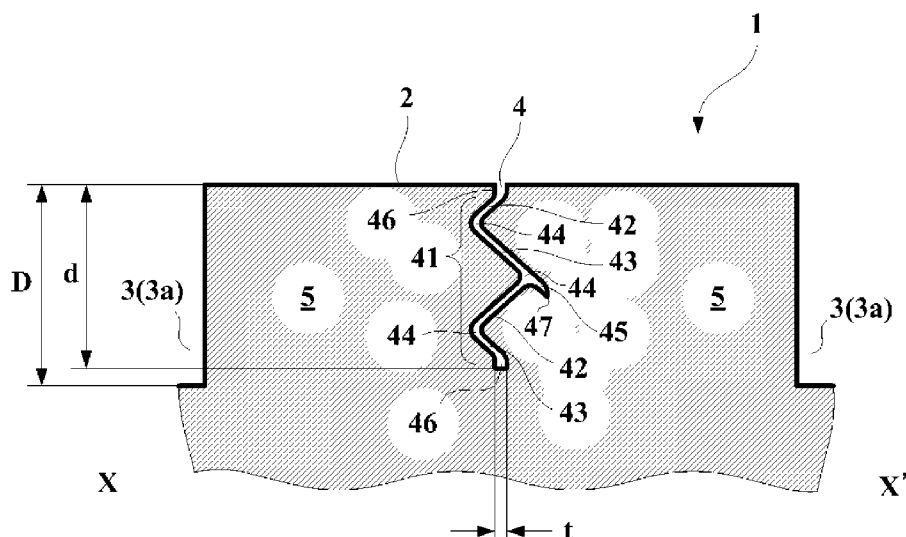
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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
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SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: A TREAD WITH INCISION FOR BALANCED PERFORMANCE



(57) Abstract: Present invention provides a tread for a tire having a contact face, the tread being provided with a plurality of grooves, the plurality of groove delimitating a plurality of contact element being provided with at least one incision, the at least one incision comprising a zigzag portion consisting of at least two first inclined portions extending downwardly in an orientation with non-zero angle relative to radial orientation and at least one second inclined portion extending downwardly in an orientation with non-zero angle relative to radial orientation and opposite to the first inclined portion, the first inclined portion and the second inclined portion being connected via a connecting portion at closest extremities, the at least one incision has at least one projection portion projecting from the connecting portion toward the same orientation as the first inclined portion or the second inclined portion positioned radially outward of the connecting portion.

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

Description

Title of Invention: A TREAD WITH INCISION FOR BALANCED PERFORMANCE

Technical Field

[0001] The present invention relates to a tread for a tire, in particular to a tread for a tire possible to maintain high level performance on normal road until close to end of wear life.

Background Art

[0002] In recent years, a tire so-called “all-season” tire which has capability to drive on wintry surface while maintaining high speed driving capability on non-wintry surface is beginning to popularize.

[0003] Also to a tire so-called “studless” tire which is suitable for driving on ice covered and/or snow covered wintry surface, there is a desire to increase performance on non-wintry surface that is not covered by ice nor snow while still improving performance on wintry surface.

[0004] In order to increase performance at close to end of wear life, it is known that increasing a void (a space not in contact with ground) after certain level of wear is effective. Several solutions have been proposed for increasing the void after certain level of wear.

[0005] FR2641501 discloses a tread provided with incisions which in cross-section have a fork-shaped outline with at least two branches for improving adherence during the life of the tire.

[0006] WO2014102039 discloses a tread having a raised element comprising a recess in its side wall for better compromise between grip on a snowy road surface and grip on an icy road surface.

[0007] WO2014040958 discloses a tread comprising a channel internal to the tread adapted to form a new groove after the tread has partially worn away useful in draining away water in wet weather.

Citation List

Patent Literature

[0008] PTL 1: FR2641501

PTL 2: WO2014/102039

PTL 3: WO2014/040958

[0009] However with the solutions disclosed in these documents, rigidity of a contact element decreases due to increased void in the contact element which leads degradation of handling and/or braking performance, and there is a desire to maintain

rigidity of the contact element even with increased void for end of wear life performance.

[0010] Therefore, there is a need for a tread for a tire which provides higher performance at close to end of wear life while maintaining a rigidity of a contact element.

[0011] Definitions:

[0012] A “radial direction/orientation” is a direction/orientation perpendicular to axis of rotation of the tire. This direction/orientation corresponds to thickness orientation of the tread.

[0013] An “axial direction/orientation” is a direction/orientation parallel to axis of rotation of the tire.

[0014] A “circumferential direction/orientation” is a direction/orientation which is tangential to any circle centered on axis of rotation. This direction/orientation is perpendicular to both the axial direction/orientation and the radial direction/orientation.

[0015] A “tire” means all types of elastic tire whether or not subjected to an internal pressure.

[0016] A “tread” of a tire means a quantity of rubber material bounded by lateral surfaces and by two main surfaces one of which is intended to come into contact with ground when the tire is rolling.

[0017] A “groove” is a space between two rubber faces/sidewalls which do not contact between themselves under usual rolling condition connected by another rubber face/bottom. A groove has a width and a depth.

[0018] An “incision”, also referred to as a “sipe”, is a narrow cutout formed toward radially inwardly from a surface of a tread made by, for example a thin blade having a shape like a knife blade. A width of the incision at the surface of the tread is narrower than a groove, for example less than or equal to 2.0mm. This incision may, different from the groove, be partly or completely closed when such the incision is in a contact patch and under usual rolling condition.

[0019] It is thus an object of the invention to provide higher performance at close to end of wear life while maintaining a rigidity of a contact element.

Summary of Invention

[0020] The present invention provides a tread for a tire having a contact face intended to come into contact with ground during rolling, the tread being provided with a plurality of grooves of a depth D, the plurality of groove delimitating a plurality of contact element, the contact element being provided with at least one incision of a width t and a depth d opening to the contact face and extending radially inwardly from the contact face, in cross sectional view on a plane perpendicular to both the contact face and an average extension direction of the incision on the contact face, the at least one incision

comprising a zigzag portion consisting of at least two first inclined portions extending downwardly in an orientation with non-zero angle relative to radial orientation and at least one second inclined portion extending downwardly in an orientation with non-zero angle relative to radial orientation and opposite to the first inclined portion, the first inclined portion and the second inclined portion being connected via a connecting portion at closest extremities, the at least one incision has at least one projection portion projecting from the connecting portion toward the same orientation as the first inclined portion or the second inclined portion positioned radially outward of the connecting portion.

[0021] This arrangement provides higher performance at close to end of wear life while maintaining a rigidity of a contact element.

[0022] Since the contact element is provided with at least one incision comprising a zigzag portion consisting of at least two first inclined portions extending downwardly in an orientation with non-zero angle relative to radial orientation and at least one second inclined portion extending downwardly in an orientation with non-zero angle relative to radial orientation and opposite to the first inclined portion, the first inclined portion and the second inclined portion being connected via a connecting portion at closest extremities, opposing side of the zigzag portion contact each other at least partly at loading or applied acceleration/braking force which prevent degradation of rigidity of the contact element.

[0023] Since the at least one incision has at least one projection portion projecting from the connecting portion toward the same orientation as the first inclined portion or the second inclined portion positioned radially outward of the connecting portion, the at least one projection portion acts as an extra storage volume for evacuating water between ground and the contact face appears after certain level of tread wear, thus performance at close to end of wear life especially wet performance can be improved.

[0024] In another preferred embodiment, the incision comprises at least one straight portion.

[0025] According to this arrangement, it is possible to increase manufacturing efficiency of the tread provided with the incision in case one straight portion is provided at radially outermost of the incision as a positioning of the incision at the contact face of the contact element becomes easier, and it is possible to improve endurance of the tread provided with the incision in case one straight portion is provided at radially innermost of the incision as a stress at a bottom (radially innermost) of the incision can evenly be distributed. More preferably, the incision comprises two straight portions at radially outermost and radially innermost of the incision.

[0026] In another preferred embodiment, the projection portion comprises an acute portion at an end opposite to the connecting portion.

[0027] According to this arrangement, it is possible to increase manufacturing efficiency of

the tread provided with the incision as the acute portion comprised in the projection portion facilitates push the incision provided with the projection portion into a green tire during molding.

[0028] In another preferred embodiment, the depth d of the incision is the same as the depth D of the groove.

[0029] According to this arrangement, it is possible to maintain performance at close to end of wear life as the incision remains while the groove remains.

[0030] In another preferred embodiment, the incision has at least two connecting portions, and a projected distance between axially two adjacent connecting portions projected to the contact face is at most equal to 5 times of the width t of the incision.

[0031] If this projected distance is more than 5 times of the width t of the incision, there is a risk that the incision cannot be demolded due to too wide zigzag portion leading decrease of manufacturing efficiency of the tread having the incision provided with the zigzag portion. By setting this projected distance at most equal to 5 times of the width t of the incision, it is possible to increase manufacturing efficiency of the tread having the incision provided with the zigzag portion.

[0032] In another preferred embodiment, a projected length of the projection portion projected to the contact face is at most equal to 5 times of the width t of the incision.

[0033] If this projected length of the projection portion is more than 5 times of the width t of the incision, there is a risk that the incision cannot be demolded due to too wide projection portion leading decrease of manufacturing efficiency of the tread having the incision provided with the projection portion. By setting this projected length at most equal to 5 times of the width t of the incision, it is possible to increase manufacturing efficiency of the tread having the incision provided with the projection portion.

[0034] In another preferred embodiment, a width of the projection portion is at most equal to twice the width t of the incision.

[0035] If this width of the projection portion is more than twice the width t of the incision, there is a risk that a void created by the projection portion becomes too large which leads decrease of rigidity of the contact element provided with the incision having the projection portion. By setting this projection at most equal to twice the width t of the incision, it is possible to improve performance at close to end of wear life especially wet performance without degrading rigidity of the contact element.

Advantageous Effects of Invention

[0036] According to the arrangements described above, it is possible to provide higher performance at close to end of wear life while maintaining a rigidity of a contact element.

Brief Description of Drawings

[0037] Other characteristics and advantages of the invention arise from the description made

hereafter in reference to the annexed drawings which show, as nonrestrictive examples, the embodiment of the invention.

[0038] In these drawings:

[fig.1]Fig. 1 is a schematic plan view of a tread according to a first embodiment of the present invention;

[fig.2]Fig. 2 is a cross sectional view taken along line II-II in Fig. 1;

[fig.3]Fig. 3 is a schematic cross sectional view according to a second embodiment of the present invention;

[fig.4]Fig. 4 is a schematic cross sectional view according to a third embodiment of the present invention;

Description of Embodiments

[0039] Preferred embodiments of the present invention will be described below referring to the drawings.

[0040] A tread 1 for a tire according to a first embodiment of the present invention will be described referring to Figs. 1 and 2.

[0041] Fig. 1 is a schematic plan view of a tread according to a first embodiment of the present invention. Fig. 2 is a cross sectional view taken along line II-II in Fig. 1

[0042] The tread 1 is a tread for a tire having a contact face 2 intended to come into contact with ground during rolling, and a plurality of groove 3 of a depth D (shown in Fig. 2) opening to the contact face 2. The plurality of groove 3 includes a lateral groove 3a extending generally in axial orientation and a circumferential groove 3b extending generally in circumferential orientation as indicated by line XX'. The plurality of groove 3 (the lateral groove 3a and the circumferential groove 3b) is delimiting a plurality of contact element 5. Each the plurality of contact element 5 is provided with at least one incision 4 of a width t (shown in Fig. 2) and a depth d (shown in Fig. 2) opening to the contact face 2 and extending radially inwardly from the contact face 2 and generally in axial orientation. The at least one incision 4 is opening to the circumferential groove 3b at two axial ends.

[0043] As shown in Fig. 2, in cross sectional view on a plane perpendicular to both the contact face 2 and an average extension direction of the incision 4 on the contact face 2, the at least one incision 4 comprising a zigzag portion 41 consisting of at least two first inclined portions 42 extending downwardly in an orientation with non-zero angle relative to radial orientation and at least one second inclined portion 43 extending downwardly in an orientation with non-zero angle relative to radial orientation and opposite to the first inclined portion 42, the first inclined portion 42 and the second inclined portion 43 being connected via a connecting portion 44 at closest extremities of the first inclined portion 42 and the second inclined portion 43. In this first em-

bodiment, the zigzag portion 41 of the incision 4 is consisting of two first inclined portions 42 and two second inclined portions 43, and three connecting portions 44 are connecting the first inclined portion 42 and the second inclined portion 43, the first inclined portion 42 is extending from top-right to bottom-left orientation, and the second inclined portion 43 is extending from top-left to bottom-right orientation.

[0044] As shown in Fig. 2, the incision 4 comprises at least one straight portion 46, more precisely the incision 4 comprises two straight portions 46 at radially outermost and radially innermost of the incision 4.

[0045] As shown in Fig. 2, the incision 4 has one projection portion 45 projecting from the connecting portion 44 toward the same orientation as the first inclined portion 42 or the second inclined portion 43 positioned radially outward of the connecting portion 44 where the projection portion 45 is affixed to.

[0046] As shown in Fig. 2, the projection portion 45 comprises an acute portion 47 at an end opposite to the connecting portion 44. The acute portion 47 is facing to radially inward orientation.

[0047] As shown in Fig. 2, the incision 4 has at least two connecting portions 44, and a projected distance between axially two adjacent connecting portions 44 projected to the contact face 2 is at most equal to 5 times of the width t of the incision 4.

[0048] As shown in Fig. 2, a projected length of the projection portion 45 projected to the contact face 2 is at most equal to 5 times of the width t of the incision 4.

[0049] As shown in Fig. 2, a width of the projection portion 45 is at most equal to twice the width t of the incision 4. In this first embodiment, the projection portion 45 is extending as to extend continuously the second inclined portion 43 keeping the same width as the second inclined portion 43.

[0050] Since the contact element 5 is provided with at least one incision 4 comprising the zigzag portion 41 consisting of at least two first inclined portions 42 extending downwardly in an orientation with non-zero angle relative to radial orientation and at least one second inclined portion 43 extending downwardly in an orientation with non-zero angle relative to radial orientation and opposite to the first inclined portion 42, the first inclined portion 42 and the second inclined portion 43 being connected via a connecting portion 44 at closest extremities, opposing side of the zigzag portion 41 contact each other at least partly at loading or applied acceleration/braking force which prevent degradation of rigidity of the contact element 5.

[0051] Since the at least one incision 4 has at least one projection portion 45 projecting from the connecting portion 44 toward the same orientation as the first inclined portion 42 or the second inclined portion 43 positioned radially outward of the connecting portion 44, the at least one projection portion 45 acts as an extra storage volume for evacuating water between ground and the contact face 2 appears after certain level of tread wear,

thus performance at close to end of wear life especially wet performance can be improved.

- [0052] Since the incision 4 comprises at least one straight portion 46, it is possible to increase manufacturing efficiency of the tread 1 provided with the incision 4 in case one straight portion 46 is provided at radially outermost of the incision 4 as a positioning of the incision 4 at the contact face 2 of the contact element 5 becomes easier, and it is possible to improve endurance of the tread 1 provided with the incision 4 in case one straight portion 46 is provided at radially innermost of the incision 4 as a stress at a bottom (radially innermost) of the incision 4 can evenly be distributed. More preferably, the incision 4 comprises two straight portions 46 at radially outermost and radially innermost of the incision 4.
- [0053] Since the projection portion 45 comprises an acute portion 47 at an end opposite to the connecting portion 44, it is possible to increase manufacturing efficiency of the tread 1 provided with the incision 4 as the acute portion 47 comprised in the projection portion 45 facilitates push the incision 4 provided with the projection portion 45 into a green tire during molding.
- [0054] Since the incision 4 has at least two connecting portions 44, and a projected distance between axially two adjacent connecting portions 44 projected to the contact face 2 is at most equal to 5 times of the width t of the incision 4, it is possible to increase manufacturing efficiency of the tread 1 having the incision 4 provided with the zigzag portion 41.
- [0055] If this projected distance is more than 5 times of the width t of the incision 4, there is a risk that the incision 4 cannot be demolded due to too wide zigzag portion leading decrease of manufacturing efficiency of the tread 1 having the incision 4 provided with the zigzag portion 41.
- [0056] Since a projected length of the projection portion 45 projected to the contact face 2 is at most equal to 5 times of the width t of the incision 4, it is possible to increase manufacturing efficiency of the tread 1 having the incision 4 provided with the projection portion 45.
- [0057] If this projected length of the projection portion 45 is more than 5 times of the width t of the incision 4, there is a risk that the incision 4 cannot be demolded due to too wide projection portion 45 leading decrease of manufacturing efficiency of the tread 1 having the incision 4 provided with the projection portion 45.
- [0058] Since a width of the projection portion 45 is at most equal to twice the width t of the incision 4, it is possible to improve performance at close to end of wear life especially wet performance without degrading rigidity of the contact element 5.
- [0059] If this width of the projection portion 45 is more than twice the width t of the incision 4, there is a risk that a void created by the projection portion 45 becomes too large

which leads decrease of rigidity of the contact element 5 provided with the incision 4 having the projection portion 45.

[0060] Each the first inclined portion 42 and the second inclined portion 43 may extend not only in straight manner but also in curved manner. Each the first inclined portion 42 and the second inclined portion 43 may extend at different angle relative to radial orientation each other.

[0061] A form of the incision 4 on the contact face 2 may be straight, curved, waved or zigzagged. The incision 4 may or may not open to the circumferential groove 3b, only at one axial end or both two axial ends.

[0062] The projection portion 45 may be provided at any connecting portion 44 in the incision 4, number of the projection portion 45 in one incision 4 being less than or equal to number of the connecting portion 44 in the incision 4. In case multiple number of incisions are provided in one contact element 5, the contact element 5 may include an incision without projection portion 45, and/or without zigzag portion 41.

[0063] A tread 21 for a tire according to a second embodiment of the present invention will be described referring to Fig. 3. Fig. 3 is a schematic cross sectional view according to a second embodiment of the present invention. The construction of this second embodiment is similar to that of the first embodiment other than the arrangement shown in Fig. 3, thus description will be made referring to Fig. 3.

[0064] As shown in Fig. 3, in cross sectional view on a plane perpendicular to both the contact face 22 and an average extension direction of the incision 24 on the contact face 22, the at least one incision 24 comprising a zigzag portion 241 consisting of at least two first inclined portions 242 extending downwardly in an orientation with non-zero angle relative to radial orientation and at least one second inclined portion 243 extending downwardly in an orientation with non-zero angle relative to radial orientation and opposite to the first inclined portion 242, the first inclined portion 242 and the second inclined portion 243 being connected via a connecting portion 244 at closest extremities of the first inclined portion 242 and the second inclined portion 243. In this second embodiment, the zigzag portion 241 of the incision 24 is consisting of three first inclined portions 242 and two second inclined portions 243, and four connecting portions 244 are connecting the first inclined portion 242 and the second inclined portion 243, the first inclined portion 242 is extending from top-right to bottom-left orientation, and the second inclined portion 243 is extending from top-left to bottom-right orientation.

[0065] As shown in Fig. 3, the incision 24 comprises one straight portion 246 at radially innermost of the incision 24. Contrary the zigzag portion 241 of the incision 24 is opening to the contact face 22 without having the straight portion.

[0066] As shown in Fig. 3, the incision 24 has two projection portions 245 projecting from

the connecting portion 244 toward the same orientation but radially downwardly as the first inclined portion 242 or the second inclined portion 243 positioned radially outward of the connecting portion 244 where the projection portion 245 is affixed to.

[0067] As shown in Fig. 3, the projection portion 245 comprises an acute portion 247 at an end opposite to the connecting portion 244. The acute portion 247 is facing to radially inward orientation.

[0068] As shown in Fig. 3, the depth d of the incision 24 is the same as the depth D of the groove 23.

[0069] Since the depth d of the incision 24 is the same as the depth D of the groove 23, it is possible to maintain performance at close to end of wear life as the incision 24 remains while the groove 23 remains.

[0070] The projection portions 245 projecting from different connecting portions 244 may have different dimensional characteristics such as a width, a length or a shape one another.

[0071] A tread 31 for a tire according to a third embodiment of the present invention will be described referring to Fig. 4. Fig. 4 is a schematic cross sectional view according to a third embodiment of the present invention. The construction of this third embodiment is similar to that of the first and the second embodiment other than the arrangement shown in Fig. 4, thus description will be made referring to Fig. 4.

[0072] As shown in Fig. 4, in cross sectional view on a plane perpendicular to both the contact face 32 and an average extension direction of the incision 34 on the contact face 32, the at least one incision 34 comprising a zigzag portion 341 consisting of at least two first inclined portions 342 extending downwardly in an orientation with non-zero angle relative to radial orientation and at least one second inclined portion 343 extending downwardly in an orientation with non-zero angle relative to radial orientation and opposite to the first inclined portion 342, the first inclined portion 342 and the second inclined portion 343 being connected via a connecting portion 344 at closest extremities of the first inclined portion 342 and the second inclined portion 343. In this third embodiment, the zigzag portion 341 of the incision 34 is consisting of two first inclined portions 342 and two second inclined portions 343, and three connecting portions 344 are connecting the first inclined portion 342 and the second inclined portion 343, the first inclined portion 342 is extending from top-right to bottom-left orientation, and the second inclined portion 343 is extending from top-left to bottom-right orientation.

[0073] As shown in Fig. 4, the incision 34 comprises two straight portions 346 at radially innermost and at radially outermost of the incision 34.

[0074] As shown in Fig. 4, the incision 34 has one projection portion 345 projecting from the connecting portion 344 toward the same orientation as the first inclined portion 342

or the second inclined portion 343 positioned radially outward of the connecting portion 344 where the projection portion 345 is affixed to. The projection portion 345 is projecting from radially lower part of the connecting portion 344. A width of the projection portion 345 is a little narrower than a width t of the incision 34.

[0075] As shown in Fig. 4, the projection portion 345 comprises an acute portion 347 at an end opposite to the connecting portion 344. The acute portion 347 is facing to radially inward orientation.

[0076] Since the width of the projection portion 345 is narrower than the width t of the incision 34, it is possible to prevent more efficiently degradation of rigidity of the contact element 35 while still securing an extra storage volume for evacuating water between ground and the contact face 32 appears after certain level of tread wear, thus performance at close to end of wear life especially wet performance can be improved.

[0077] The invention is not limited to the examples described and represented and various modifications can be made there without leaving its framework.

Examples

[0078] In order to confirm the effect of the present invention, one type of block sample of Example to which the present invention is applied and other type of block sample of Reference were investigated using computer simulation (finite element method) employing commercially available software.

[0079] The Example was a block model as described in the above first embodiment. The Reference was a block model as described in the above first embodiment but an incision was provided without a projection portion. Both the Example and Reference were designed as to be made of the same rubber material, and had the same block width of 20 mm, groove depth D of 8.5 mm, incision depth d of 7.0 mm and incision width t of 0.6 mm.

[0080] With suitable loading applied to the block models and with 1.0 mm sharing in circumferential orientation, block stiffness was calculated. The results are shown in table 1. In this table 1, results are represented by an index of 100 for Reference, higher the number indicates higher the block stiffness.

[0081] [Table 1]

	Example	Reference
Block stiffness (index)	101	100

[0082] As seen from table 1, the Example shows equivalent block stiffness against Reference even with additional void thanks to the projection portion, which leads higher performance at close to end of wear life while maintaining a rigidity of a contact element.

Reference Signs List

- [0083] 1, 21, 31 tread
2, 22, 32 contact face
3(3a, 3b), 23(23a), 33(33a) groove
4, 24, 34 incision
41, 241, 341 zigzag portion
42, 242, 342 first inclined portion
43, 243, 343 second inclined portion
44, 244, 344 connecting portion
45, 245, 345 projection portion
46, 246, 346 straight portion
47, 247, 347 acute portion
5, 25, 35 contact element

Claims

- [Claim 1] A tread (1) for a tire having a contact face (2) intended to come into contact with ground during rolling, the tread (1) being provided with a plurality of grooves (3) of a depth D, the plurality of groove (3) delimitating a plurality of contact element (5), the contact element (5) being provided with at least one incision (4) of a width t and a depth d opening to the contact face (2) and extending radially inwardly from the contact face (2), in cross sectional view on a plane perpendicular to both the contact face (2) and an average extension direction of the incision (4) on the contact face (2), the at least one incision (4) comprising a zigzag portion (41) consisting of at least two first inclined portions (42) extending downwardly in an orientation with non-zero angle relative to radial orientation and at least one second inclined portion (43) extending downwardly in an orientation with non-zero angle relative to radial orientation and opposite to the first inclined portion (42), the first inclined portion (42) and the second inclined portion (43) being connected via a connecting portion (44) at closest extremities, the tread being characterized in that the at least one incision (4) has at least one projection portion (45) projecting from the connecting portion (44) toward the same orientation as the first inclined portion (42) or the second inclined portion (43) positioned radially outward of the connecting portion (44).
- [Claim 2] The tread (1) according to Claim 1, wherein the incision (4) comprises at least one straight portion (46).
- [Claim 3] The tread (1) according to Claim 2, wherein the incision (4) comprises two straight portions (46) at radially outermost and radially innermost of the incision (4).
- [Claim 4] The tread (1) according to any one of the Claims 1 to 3, wherein the projection portion (45) comprises an acute portion (47) at an end opposite to the connecting portion (44).
- [Claim 5] The tread (1) according to any one of the Claims 1 to 4, wherein the depth d of the incision (4) is the same as the depth D of the groove (3).
- [Claim 6] The tread (1) according to any one of the Claims 1 to 5, wherein the incision (4) has at least two connecting portions (44), and wherein a projected distance between axially two adjacent connecting portions (44) projected to the contact face (2) is at most equal to 5 times of the

width t of the incision (4).

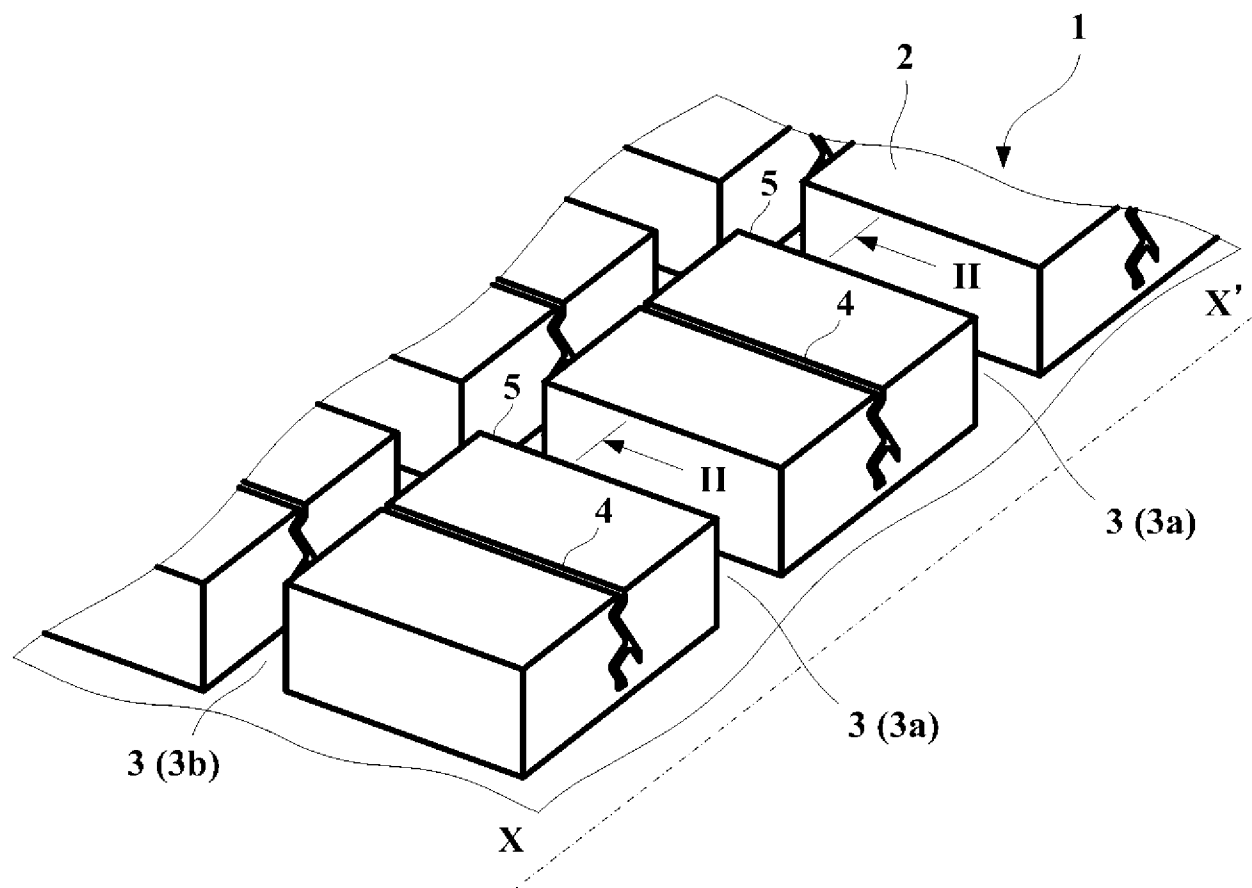
[Claim 7] The tread (1) according to any one of the Claims 1 to 6, wherein a projected length of the projection portion (45) projected to the contact face (2) is at most equal to 5 times of the width t of the incision (4).

[Claim 8] The tread (1) according to any one of the Claims 1 to 7, wherein a width of the projection portion (45) is at most equal to twice the width t of the incision (4).

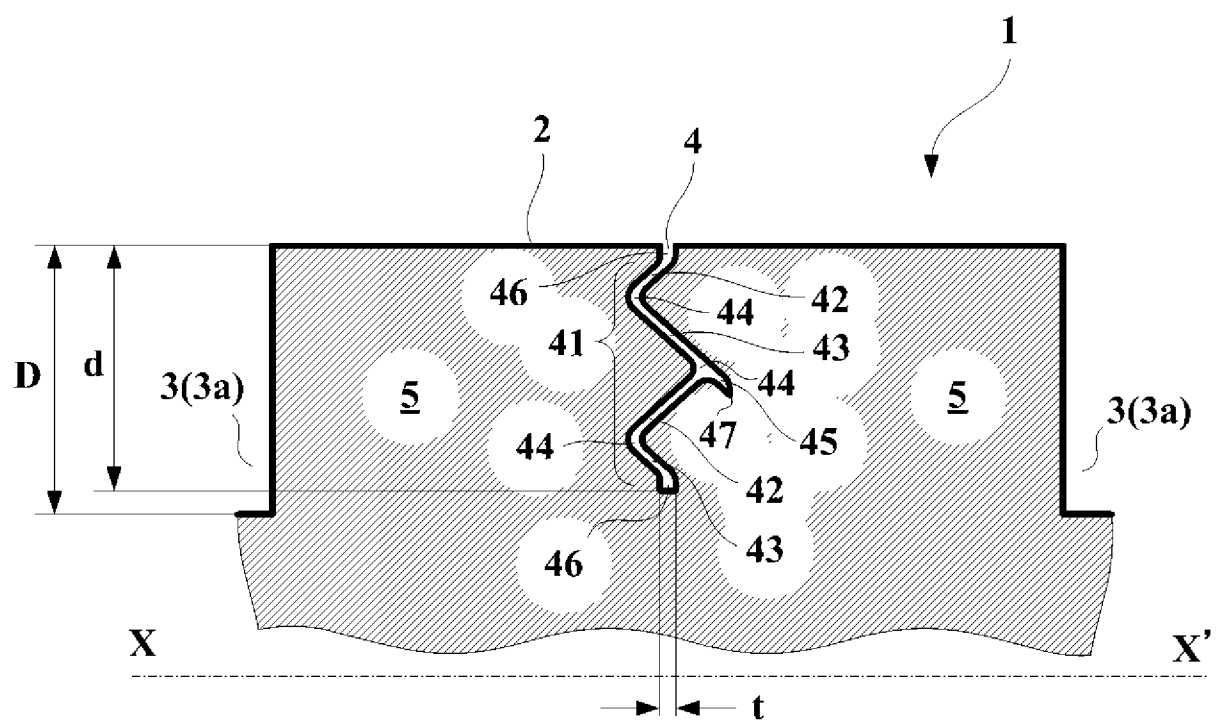
[Claim 9] The tread (1) according to Claim 8, wherein the width of the projection portion (45) is less than or equal to the width t of the incision (4).

[Claim 10] A tire having a tread according to any one of the claims 1 to 9.

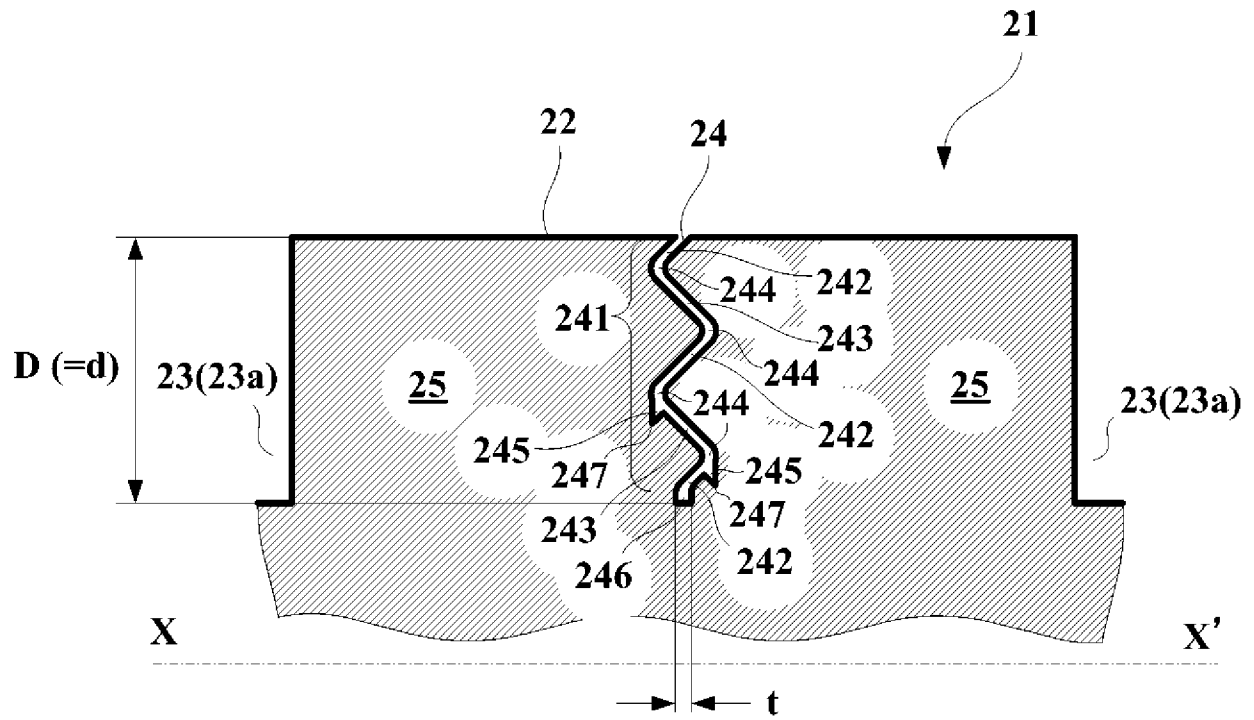
[Fig. 1]



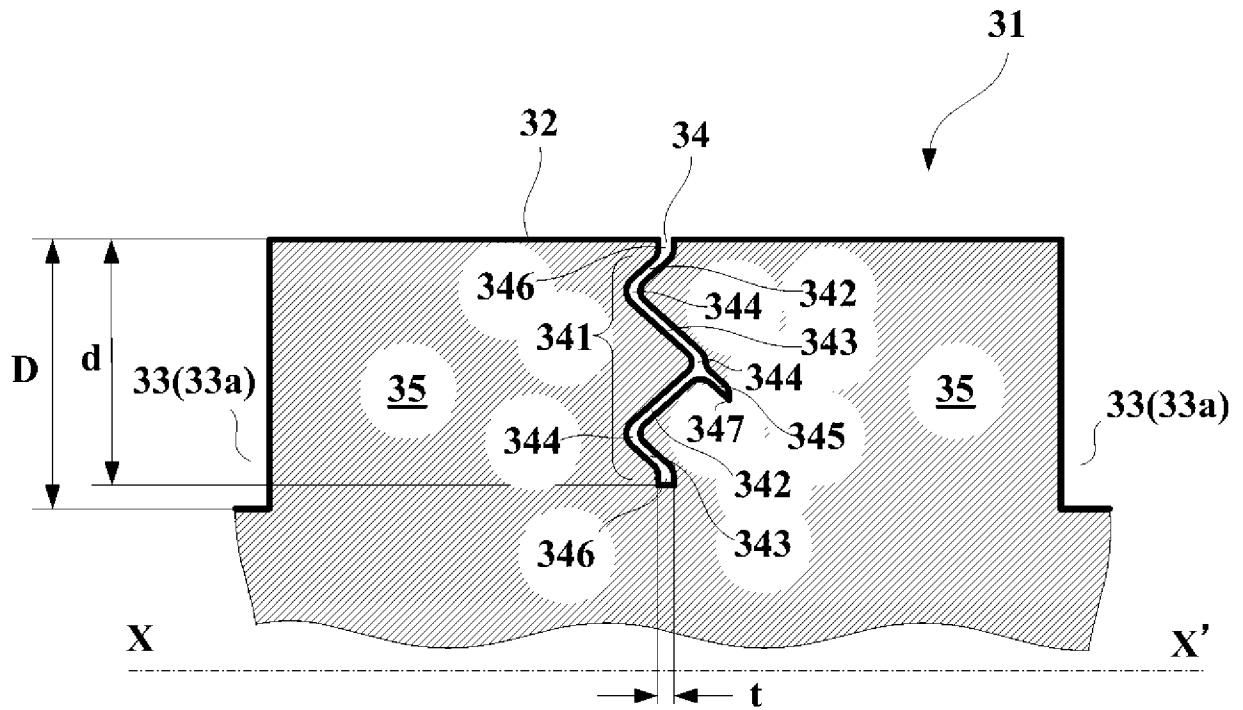
[Fig. 2]



[Fig. 3]



[Fig. 4]



INTERNATIONAL SEARCH REPORT

International application No

PCT/JP2019/049980

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60C11/12

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/144091 A1 (MICHELIN SOC TECH [FR]; MICHELIN RECH TECH [CH] ET AL.) 16 December 2010 (2010-12-16)	1-7,10
A	abstract; claim 14; figures 1,2,3,8,9 paragraphs [0003], [0041], [0060] - [0064]	8,9
A	----- US 2010/288408 A1 (OHASHI TOSHIYUKI [JP]) 18 November 2010 (2010-11-18) abstract; figures 1-5	1
A	----- JP 2000 211322 A (TOYO TIRE & RUBBER CO) 2 August 2000 (2000-08-02) abstract; figures 1-7	1



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

14 February 2020

Date of mailing of the international search report

28/02/2020

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/JP2019/049980

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