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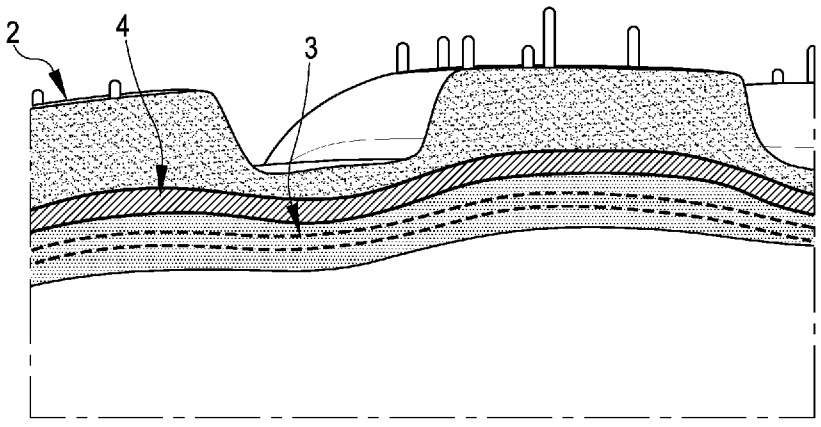


FIG.2

(57) Abstract: The present invention relates to a pneumatic tyre comprising a layer of polyurethane within the portion underlying the tread. The present invention relates to a process for the production of such a pneumatic tyre. The technical problem underlying the present invention is therefore to provide a low noise level pneumatic tyre without changing the basic structure and the production processes. The present invention proposes to "filter" the energy generated by the contact between the pneumatic tyre and the roughness of the road by means of a layer of polyurethane, preferably having a closed cell structure.

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PNEUMATIC TYRE WITH A LAYER OF POLYURETHANE AS THE BASE LAYER OF THE TREAD FOR THE REDUCTION IN THE NOISE OF PNEUMATIC TYRES

DESCRIPTION

Technical field of the invention

The present invention relates to a pneumatic tyre comprising a layer of polyurethane within the portion underlying the tread. The present invention relates to a process for the production of such a pneumatic tyre.

Background

Over time interest has greatly increased in seeking to eliminate or at least diminish, the noise generated by vehicles. Amongst the various factors that contribute to the noise generated by vehicles, there is the rolling noise generated by pneumatic tyres. External noise is generated by the discontinuity of the tread pattern and the roughness of the road, which excite the structure of the pneumatic tyre. It follows that in addition to the continuous improvement in rolling resistance, the weight and grip of pneumatic tyres, the reduction is noise is also a particularly important requirement. Such a requirement for noise reduction has increased for all types of pneumatic tyres, in particular for those for automobiles.

One object of the invention is to provide a low noise level pneumatic tyre that is capable of also maintaining high performance in regard to the other characteristics of the product such as, for example, the wear resistance. It is also important that the solution proposed for the reduction of noise does not negatively impact upon the production processes.

Summary

The technical problem underlying the present invention is therefore to provide a low noise level pneumatic tyre without changing the basic structure and the production processes. The present invention proposes to "filter" the energy produced by the impact of the discontinuities of the tread geometry and those coming from the roughness of the road by means of a layer of polyurethane, preferably one having a closed cell structure. The proposed solution is the use of

one or more layers of polyurethane positioned within any portion of the pneumatic tyre that is not in contact with the exterior.

Compared to the use of a thin layer of rubber compound, the polyurethane solution is better in terms of noise balancing, considering that expanded polyurethane has lower hysteresis (at equal volume) compared to a conventional compound.

The object of the present invention is a pneumatic tyre according to claim 1 and a process for the production thereof according to claim 12.

Preferred characteristics of the invention are the subject of the dependent claims.

Brief description of the figures

Reference will be made to the figures of the accompanying drawings, wherein:

- Figure 1 shows a cross-sectional view of a part of the pneumatic tyre according to an embodiment of the present invention;
- Figure 2 shows a photograph of a detail of the pneumatic tyre according to an embodiment of the present invention;
- Figure 3 shows a schematic representation of the Layout of the internal PBN test;
- Figure 4 is a graph showing the level of PBN expected at 80 km/h of a standard pneumatic tyre and of a pneumatic tyre manufactured according to the embodiment of figure 2;
- Figure 5 is a graph showing a comparison of the representative MIC spectra at 80 km/h of a standard pneumatic tyre and of a pneumatic tyre manufactured according to the embodiment of figure 2;
- Figure 6 shows the layer of polyurethane after the treatment in the oven following the application of the RFL solution;
- Figure 7 is a photograph showing the assembly of the Cellasto® + CPD sandwich as described in the examples at points 1.1-1.3;
- Figure 8 shows a diagram of the final layout as described in the examples at points 1.1-1.3;
- Figure 9 is a photograph that refers to the ASTM D143 methodology used in the example of point 1.3;
- Figure 10 is a photograph showing the lack of adhesion using Cellasto® that is not treated with RFL;
- Figure 11 shows a diagram of a comparison between a conventional pneumatic tyre (figure 11A) and the embodiment of figure 2 (figure 11B);

- Figure 12 is a photograph showing the cutting of the layer of Cellasto® for the replacement of the undertread.

Detailed description of the invention

Consistent with the consolidated terminology in the field, within the present context:
tread refers to the portion of the pneumatic tyre that is in contact with the road surface.
Undertread refers to the portion of the tread compound between the bottom of the tread grooves and the upper part of the layers of fabric that form the carcass of the pneumatic tyre.
Cap ply refers to the upper layer of fabric of the carcass of the pneumatic tyre.
The term polyurethane (PU) refers to a broad family of polymers wherein the polymer chain is composed of urethane -NH-(CO)-O bonds.
In one aspect of the present invention, the term "polyurethane" refers to a non-thermoplastic polyurethane, preferably a microcellular polyurethane elastomer.
Belt. The belts of the pneumatic tyre are an assembly of fabrics and/or wires used to reinforce the tread area of the pneumatic tyre.

The present invention relates to a pneumatic tyre 1 wherein any portion of said pneumatic tyre that is not in contact with the exterior comprises one or more layers of polyurethane (4). The expression "not in contact with the exterior" refers to all of the internal parts of the pneumatic tyre, i.e., not in direct contact with the external environment or with the road surface. For example, as schematically shown in the embodiment of figure 1, said one or more layers of polyurethane 4 are positioned between the tread 2 and the layer commonly defined as the *cap ply 3*. Alternatively, when the *cap ply* 3 is not present within the pneumatic tyre, said one or more layers of polyurethane 4 can be positioned between the portion of tread in contact with the exterior and the belts. According to one embodiment said one or more layers of polyurethane can be inserted into the portion commonly defined as the *undertread*. More generally, in the present invention, the one or more polyurethane layers are interposed between different layers of rubber of a pneumatic tyre.
Within the context of the present invention, the term "layer of polyurethane" refers to a continuous layer of such material, defined by a determined thickness of polyurethane, that is equal all over or else variable over the area wherein it

extends, but never zero. In other words, the layer of polyurethane according to the invention is a continuous material that is devoid of discontinuities, such as are instead present, for example, within a material in the form of a net or mesh or similar.

Said one or more layers of polyurethane may have a closed or open cell structure, preferably the layers of polyurethane will be a closed cell elastomer, still more preferably they will be a microcellular polyurethane elastomer, in particular the polyurethane marketed by BASF under the trade name Cellasto® can be used. The overall thickness of the layer of polyurethane 4 will preferably be at least 0.3 mm, even more preferably between 0.5 mm and 10 mm. The tread 2 may be mono or multi compound, for example, it may consist of three compounds A, B and C such as those shown in the examples.

The pneumatic tyre 1 may comprise all of the other elements that are commonly used in the layout of these products, such as for example, a body ply, two beads, a tread belt comprising at least two tread plies, an innerliner and any other layers of additional functional material arranged between the innerliner and the inner cavity of the pneumatic tyre.

According to a preferred embodiment, the layer of polyurethane will be advantageously treated with a solution of resorcinol, formaldehyde and latex (RFL) before vulcanization with the other elements of the pneumatic tyre. For example with a solution of resorcinol, formaldehyde, latex and ammonia in the following ratios:

	Comp.
Latex	100
Resorcinol	5.5
Free formaldehyde	12
Ammonia	20

As shown in the examples, this embodiment allows for the effective adhesion of the layer of polyurethane.

A further object of the present invention is a process for the production of a pneumatic tyre, wherein during the step of preparing the "green" pneumatic tyre, into any of the portions of the pneumatic tyre not in contact with the exterior, one or more layer of polyurethane are positioned in order to create a continuous layer

of such material interposed between two layers of rubber of the pneumatic tyre. In the process according to the present invention, one or more layers can be used of polyurethane according to any of the embodiments described above.

According to one embodiment, such a process comprises the following steps:

A first step a) wherein the layer of polyurethane is treated with a solution of resorcinol-formaldehyde-latex (RFL).

Preferably a second step will follow b) wherein the layer of polyurethane 4 is dried in such a way as to remove the solvent and to promote the uniform distribution of the RFL over the entire surface. The drying may for example be performed in an oven at a temperature of at least 100-120 degrees for at least 10-15 minutes.

In the next step c) of the preparation of the green pneumatic tyre, the layer of polyurethane 4 thus treated is then inserted into any portion of the pneumatic tyre that is not in contact with the exterior. Once all of the elements that will constitute the pneumatic tyre are arranged, it is possible to proceed with the vulcanization according to the procedures and equipment known to those skilled in the sector.

In the process described above, said one or more polyurethane layers 4 may be positioned between the tread 2 and the layer commonly defined as the *cap ply 3* or alternatively, when the *cap ply* 3 is not present within the pneumatic tyre, they may be positioned between the tread portion that is in contact with the exterior and the belts.

The present invention has heretofore been described with reference to preferred embodiments. It is understood that there may be other embodiments which refer to the same inventive concept and which fall within the scope of the following claims.

EXAMPLES

1.1 Description of the selected layer of polyurethane

For the layer of polyurethane, a high performance microcellular polyurethane elastomer was selected that is marketed by BASF under the trade name Cellasto®. The semifinished Cellasto® has a thickness of 2.5 mm and a density of 0.6 g/cm^3.

1.2 Preparation of the layer of polyurethane

The Cellasto® layer of polyurethane was initially immersed with the resorcinol-formaldehyde-latex solution (RFL) by means of a brush. It was then dried in an oven for 15 minutes at 120 °C in order to remove the solvent and to promote the uniform distribution of the RFL over the entire surface.

The following is the composition of the RFL solution used:

	Comp.
Latex	100
Resorcinol	5.5
Free formaldehyde	12
Ammonia	20

1.3 Tests on a laboratory scale

The Cellasto layer was assembled (fig. 7) together with a CPD layer (CPD A/B/C) in a dedicated mold in order to replicate in the laboratory a vulcanization condition similar to that used for the manufacture of a pneumatic tyre.

The composition of the CPD layer (CPD A/B/C) is shown in detail below:

	COMPOUND A	COMPOUND B	COMPOUND C
NR	0	100	50
SYNTHETIC RUBBER	100	0	50
CB	5	40	50
SILICA	70	0	0
SULFUR	2	3	3
ZNO	2	4	3
ACC	3	1	1

The three Cellasto + CPD sandwiches were then vulcanized in a press for 25 minutes at 160 °C and at 20 bar. The final arrangement of the assembly is depicted in figure 8. After the vulcanization, the vulcanized layers (Cellasto + CPD) were cut into thin sheets and the forces of adhesion between Cellasto/CPD_A, Cellasto/CPD_B, Cellasto/CPD_C were measured according to the ASTM D413 procedure in order to demonstrate the adhesion capacity (fig. 9). For comparative purposes the same procedure was repeated but in skipping the treatment step with the RFL solution described in paragraph 1.2. However, in this case, there was no adhesion between the Cellasto and each of the CPD layers (fig. 10), and it was not possible perform the adhesion test.

The levels of adhesive strength are shown in table 1 and show a clear advantage of the use of the treatment with RFL in improving the adhesion between the rubber and the layer of polyurethane.

Table 1.

Normalized adhesive strength	Untreated Cellasto	Cellasto treated with RFL
CPD_A	0	100
CPD_B	0	87.5
CPD_C	0	75

1.4 Production of the pneumatic tyre

On the basis of the laboratory results mentioned above, the aforesaid method was adapted to a passenger car pneumatic tyre (Bridgestone Turanza 225/50R17) in order to also confirm the validity of the results obtained using finished products.

The objective was to replace the compound of the rubber of the undertread with a layer of Cellasto as shown in the diagram of fig. 11.

The Cellasto layer was cut in such a way as to replicate the geometry of a corresponding undertread layer of the pneumatic tyre. The width of the Cellasto® strips was optimized for a better finish, avoiding the trapping of air, and in particular strips of 150 mm and 190 mm in width were used. The treatment with RFL and the subsequent oven drying were performed according to the procedure described at point 1.2.

The Cellasto layer was then embedded within the layout of the pneumatic tyre during the manufacturing step of the pneumatic tyre. Thereafter, the pneumatic tyre was vulcanized at 160 °C for 15 minutes using standard vulcanization settings. After vulcanization the pneumatic tyre was cut open in order to verify the effective adhesion between the Cellasto and the surrounding components (Tread and CPS). Interfaces were observed that were homogeneous and without defect (fig. 2).

EXAMPLE 2 experimental measurements

2.1 Noise emission test

The acoustic evaluation of the pneumatic tyre produced as described in example 1 was performed within a semi-anechoic environment for certified ISO 3744 acoustic measurements (Sound Power Test). The rubber was loaded by means of a pneumatic tyre support onto the drum covered in resin shells that replicate the asphalt used for the pass by noise (PBN) approval test performed on the vehicle on the track.

The measurement setup is composed of a series of angularly equally spaced microphones for evaluating the intensity and directionality of noise, as shown below. The post-processing algorithm calculates the expected external PBN value at 80 km/h. The test described above is schematically represented in figure 3,

whilst in figures 4 and 5 the measurements are shown in graph form that were obtained with a conventional pneumatic tyre without a layer of polyurethane and the pneumatic tyre produced according to example 1. The results indicate that the pneumatic tyre manufactured according to the present invention is effective in reducing external noise, in particular:

- On the basis of the sound pressure level spectra, it is clear that it has effective insulating properties insofar as it reduces the inputs from both the geometry of the tread pattern and the roughness of the road.
- In relation to an equivalent volume of a standard compound, it reduces the overall PBN by an additional 0.4 dB.

CLAIMS

1. Pneumatic tyre (1) characterized in that any portion of said pneumatic tyre that is not in contact with the exterior comprises one or more layers of polyurethane (4), said layers of polyurethane being continuous layers interposed between different layers of said pneumatic tyre

2. Pneumatic tyre (1) according to claim 1 comprising a layer defined as the *cap ply* (3) and wherein said one or more layers of polyurethane (4) are interposed between the portion of tread that is in contact with the exterior and said *cap ply* (3).

3. Pneumatic tyre (1) according to claim 1, wherein said one or more layers of polyurethane (4) are interposed between the portion of tread that is in contact with the exterior and the belts, and wherein said pneumatic tyre (1) is devoid of the *cap ply* (3).

4. Pneumatic tyre (1) according to any one of the claims from 1 to 3, comprising a tread (2) characterized in that the portion defined as the *undertread* comprises or consists in one or more layers of polyurethane (4).

5. Pneumatic tyre (1) according to any one of the claims from 1 to 4, wherein said one or more layers of polyurethane (4) have a closed or open cell structure.

6. Pneumatic tyre (1) according to any one of the claims from 1 to 5, wherein said one or more layers of polyurethane (4) are microcellular polyurethane elastomers.

7. Pneumatic tyre (1) according to any one of the claims from 1 to 6, wherein the overall thickness of said one or more layers of polyurethane (4) is at least 0.3 mm.

8. Pneumatic tyre (1) according to any one of the claims from 1 to 7, wherein the overall thickness of said one or more layers of polyurethane (4) is of between 0.5 mm and 10 mm.

9. Pneumatic tyre (1) according to any one of the claims from 1 to 8, wherein said one or more layers of polyurethane (4) before vulcanization with the other elements

of the pneumatic tyre are treated with a solution comprising resorcinol, formaldehyde and latex (RFL).

10. Pneumatic tyre (1) according to any one of the claims 1 to 9, wherein said tread (2) is a multicompound tread.

11. Pneumatic tyre (1) according to any one of the claims from 1 to 10, comprising a body ply, two beads, a tread belt comprising at least two tread plies, an innerliner and any other layers of additional functional material arranged between the innerliner and the inner cavity of the pneumatic tyre (1).

12. Process for the production of a pneumatic tyre according to any one of the claims from 1 to 11, wherein one or more layers of polyurethane (4) are positioned during the preparation of the green pneumatic tyre within any portion of said pneumatic tyre that is not in contact with the exterior.

13. Process according to claim 12 comprising the following steps:

a) treating a continuous layer of polyurethane (4) with a solution comprising resorcinol, formaldehyde and latex (RFL);
b) preferably drying the layer of polyurethane (4) treated in step a) in such a way as to remove the solvent and to promote the uniform distribution of the RFL over the entire surface;
c) during the step of preparing the not yet vulcanized pneumatic tyre, arranging said layer of polyurethane (4) within any portion of said pneumatic tyre that is not in contact with the exterior in such a way that it is found to be interposed between different layers of said pneumatic tyre;
d) vulcanizing the pneumatic tyre prepared in step c).

14. Process according to claim 12 or 13 wherein said layer of polyurethane is a microcellular polyurethane elastomer.

15. Process according to any one of the claims from 12 to 14, wherein said portion is the portion defined as the undertread.

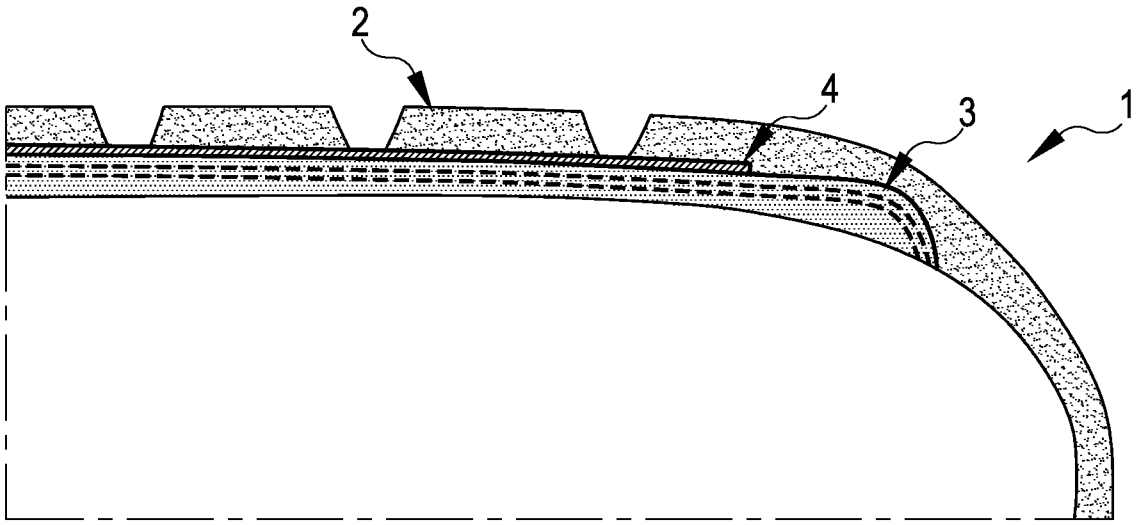


FIG.1

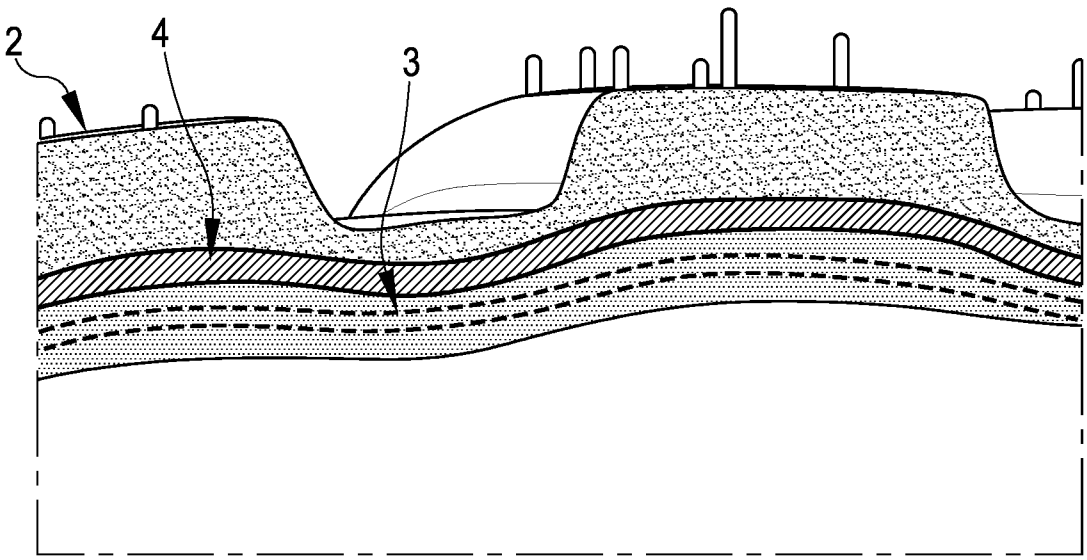


FIG.2

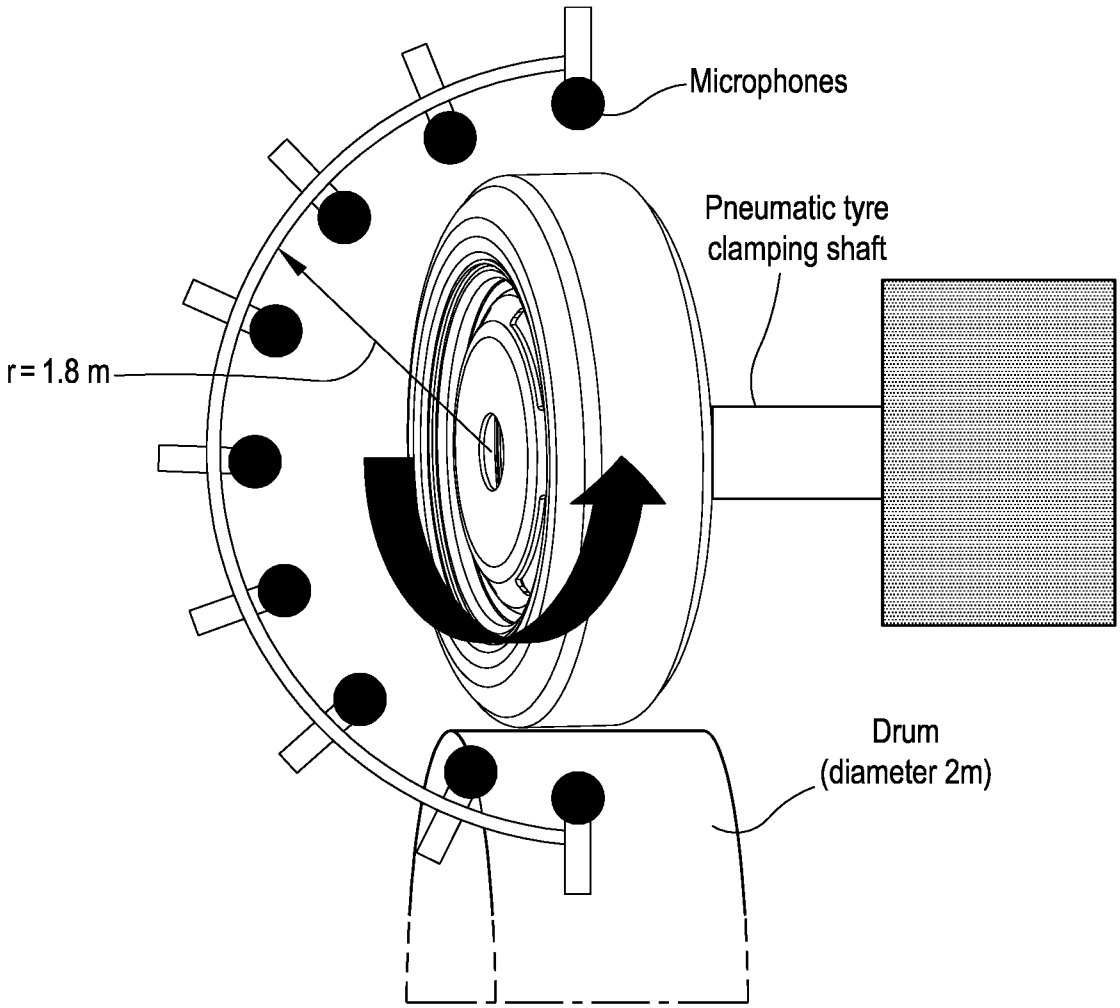

Microphones
Pneumatic tyre
clamping shaft
r = 1.8 m
Drum
(diameter 2m)

FIG.3

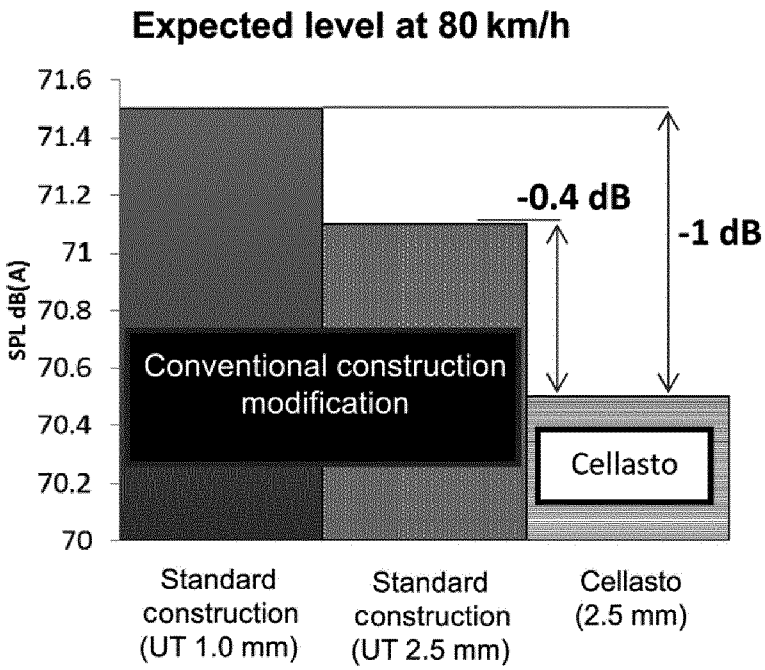

Expected level at 80 km/h
71.6
71.4
71.2
71
70.8
70.6
70.4
70.2
70
SPL dB(A)
-0.4 dB
-1 dB
Conventional construction modification
Cellasto
Standard construction (UT 1.0 mm)
Standard construction (UT 2.5 mm)
Cellasto (2.5 mm)

FIG.4

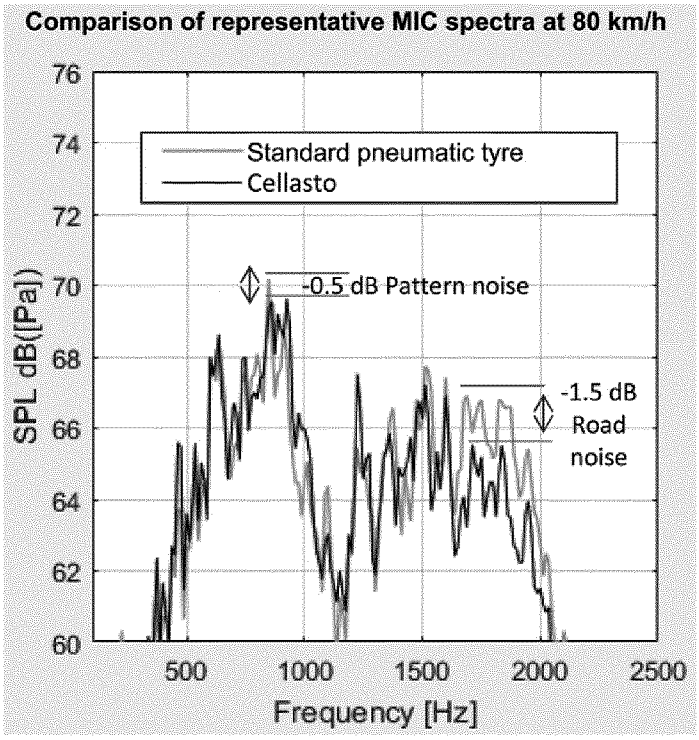

Comparison of representative MIC spectra at 80 km/h
76
74
72
70
68
66
64
62
60
SPL dB([Pa])
Standard pneumatic tyre
Cellasto
-0.5 dB Pattern noise
-1.5 dB
Road noise
500
1000
1500
2000
2500
Frequency [Hz]

FIG.5

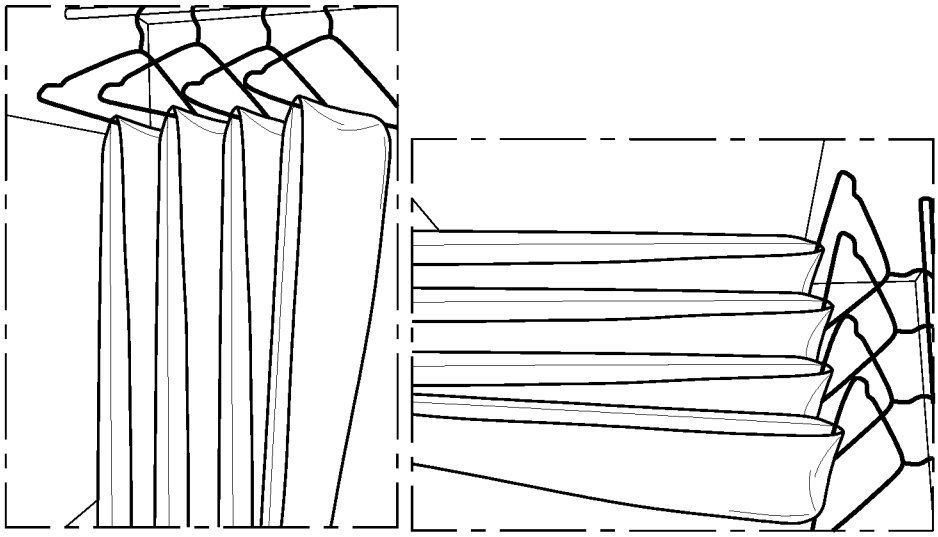


FIG.6

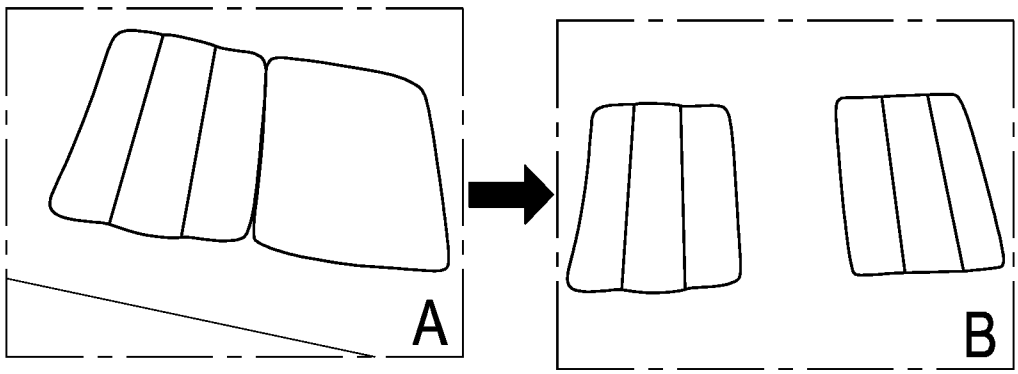


FIG.7

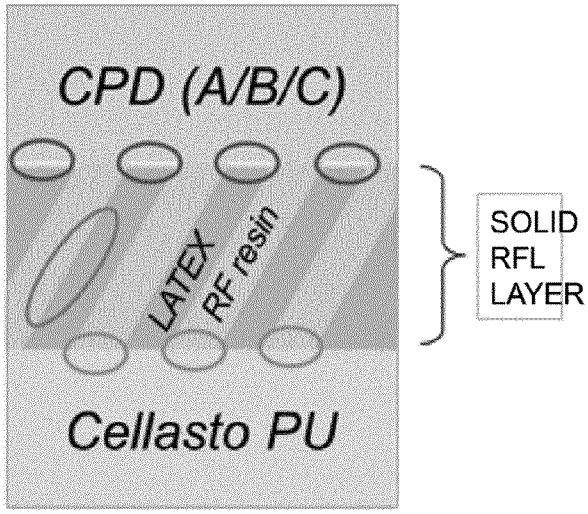


FIG.8

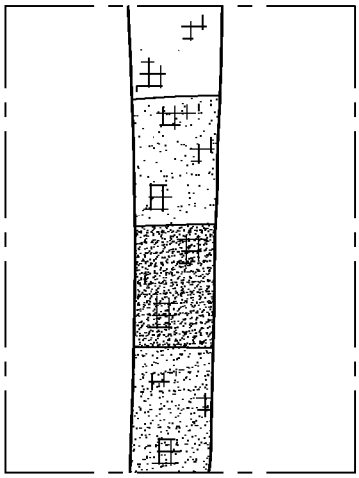


FIG.9

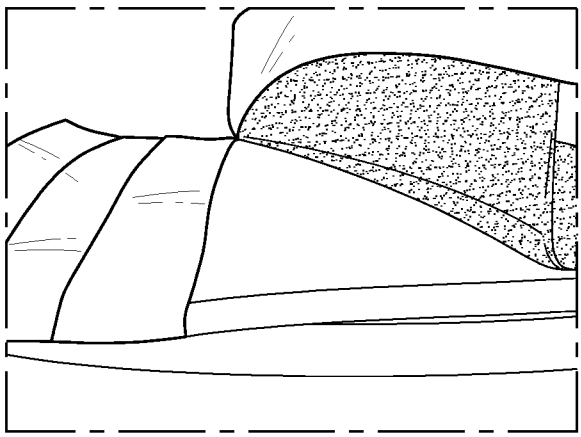


FIG.10

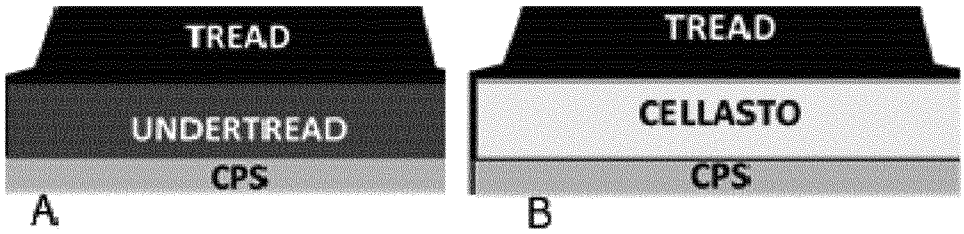


FIG.11

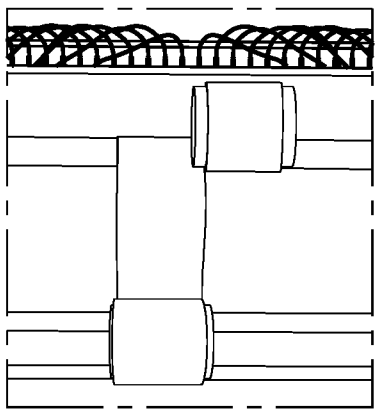


FIG.12

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/069901

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60C1/00 B60C19/00 B60C11/00
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.
X	FR 3 033 288 A1 (MICHELIN & CIE [FR]; MICHELIN RECH TECH [CH]) 9 September 2016 (2016-09-09) paragraph [0018] - paragraph [0027] claims 1, 3, 4, 5, 7 figures -----	1-15
X	FR 2 988 728 A1 (MICHELIN & CIE [FR]; MICHELIN RECH TECH [CH]) 4 October 2013 (2013-10-04) paragraph [0022] - paragraph [0038] paragraph [0047] paragraph [0066] paragraph [0077] paragraph [0112] figures -----	1-8, 10-12,14

☐ 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
16 September 2019	22/10/2019

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2019/069901

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 3033288 A1	09-09-2016	FR 3033288 A1	09-09-2016
		WO 2016139005 A1	09-09-2016
FR 2988728 A1	04-10-2013	CN 104204063 A	10-12-2014
		EP 2834297 A1	11-02-2015
		FR 2988728 A1	04-10-2013
		JP 2015514040 A	18-05-2015
		US 2015034226 A1	05-02-2015
		WO 2013149803 A1	10-10-2013