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(54) Title: METHOD AND APPARATUS FOR UTILIZING PREPRINTED LABELS AND APPLIQUÉS ON A TIRE

(57) Abstract: A tire for displaying at least one indicium includes a label affixed to the tire at a mounting location. The label has a first side facing away from the tire and a second side connected to the tire. The label's first side is configured to receive at least one adhesive appliqué having at least one indicium. The mounting location is a location on a sidewall of the tire where the label undergoes a strain equal to or less than a threshold strain under pre-defined conditions.

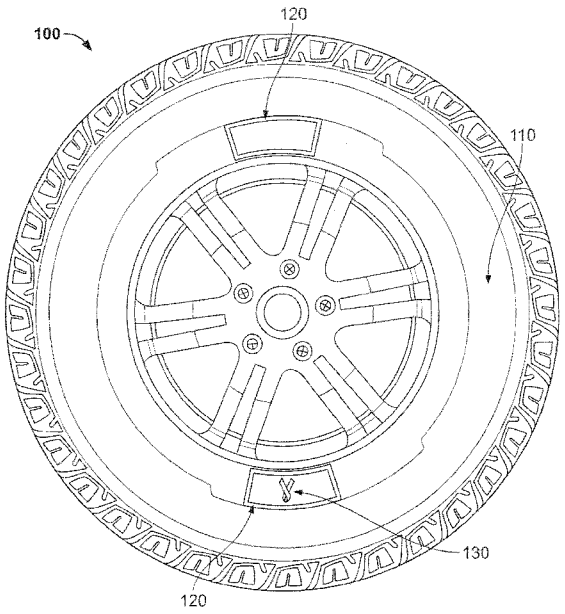


Fig. 1

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METHOD AND APPARATUS FOR UTILIZING PREPRINTED LABELS AND APPLIQUÉS ON A TIRE

FIELD OF INVENTION

[0001] The present disclosure is directed to a method and apparatus for utilizing preprinted labels and adhesive appliqués that may be affixed to labels. More particularly the present disclosure is directed to a method for manufacturing a tire with affixed preprinted labels and optional adhesive appliqué, the tire itself, and a method for affixing an adhesive appliqué to a tire.

BACKGROUND

[0002] Adhesive appliqués known in the art suffer from degradation when affixed to a sidewall of a tire at a non-ideal location. When an adhesive appliqué is applied to a location on a sidewall of a tire that undergoes a high strain, the cyclical loading and unloading of the sidewall may cause the adhesive appliqué to fail and fall off of the sidewall. Other fixed sidewall tire labels known in the art are incapable of customization after the manufacturing process, and are not designed to receive an adhesive appliqué to allow customization by an end-user.

SUMMARY

[0003] In one embodiment, a method for providing a tire configured to receive a pre-printed adhesive appliqué includes identifying a threshold strain of an adhesive appliqué and identifying a mounting location on a tire sidewall that undergoes a strain less than or equal to the threshold strain under pre-defined conditions. The method also includes providing a label configured to be mounted

on a sidewall of the tire at the mounting location. The method further includes curing the tire while the label is adjacent to the mounting location on the sidewall of the tire.

[0004] In another embodiment, a method for affixing an adhesive label to a tire includes obtaining a tire that has a label located at a mounting location of the tire. The mounting location of the tire is on a sidewall of the tire, where the label undergoes a strain less than or equal to a threshold strain under pre-defined conditions. The method further includes obtaining an adhesive appliqué and affixing the adhesive appliqué to the label.

[0005] In yet another embodiment, a tire for displaying at least one indicium includes a label affixed to the tire at a mounting location. The label has a first side facing away from the tire and a second side connected to the tire. The label's first side is configured to receive at least one adhesive appliqué having at least one indicium. The mounting location is a location on a sidewall of the tire where the label undergoes a strain equal to or less than a threshold strain under pre-defined conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] In the accompanying drawings, structures are illustrated that, together with the detailed description provided below, describe exemplary embodiments of the claimed invention. Like elements are identified with the same reference numerals. It should be understood that elements shown as a single component may be replaced with multiple components, and elements shown as multiple components may be replaced with a single component. The drawings are not to

scale and the proportion of certain elements may be exaggerated for the purpose of illustration.

[0007] **Figure 1** is a side view of one embodiment of a tire having labels affixed at exemplary mounting locations;

[0008] **Figure 2A** is a front view of an exemplary label that can be used with the tire of Figure 1;

[0009] **Figure 2B** is a front view of an exemplary adhesive appliqué that can be used with the tire of Figure 1;

[0010] **Figure 3** is a schematic drawing of a portion of a tire mold configured to receive a label;

[0011] **Figure 4** is a flow chart of an exemplary method of manufacturing a tire and affixing a label at an exemplary mounting location, wherein the label is affixed during the curing process;

[0012] **Figure 5** is a flow chart of an exemplary method of manufacturing a tire and affixing a label at an exemplary mounting location, wherein the label is affixed after the curing process; and

[0013] **Figure 6** is a flow chart of an exemplary method of affixing an adhesive appliqué to the tire of Figure 1.

DETAILED DESCRIPTION

[0014] The following includes definitions of selected terms employed herein. The definitions include various examples or forms of components that fall within the scope of a term and that may be used for implementation. The examples are

not intended to be limiting. Both singular and plural forms of terms may be within the definitions.

[0015] "Axial" and "axially" refer to a direction that is parallel to the axis of rotation of a tire.

[0016] "Equatorial plane" refers to the plane that is perpendicular to the tire's axis of rotation and passes through the center of the tire's tread.

[0017] "Radial" and "radially" refer to a direction perpendicular to the axis of rotation of a tire.

[0018] "Sidewall" as used herein, refers to that portion of the tire between the tread and the bead.

[0019] Directions are stated herein with reference to the axis of rotation of the tire. The terms "upward" and "upwardly" refer to a general direction towards the tread of the tire, whereas "downward" and "downwardly" refer to the general direction towards the axis of rotation of the tire. Thus, when relative directional terms such as "upper" and "lower" or "top" and "bottom" are used in connection with an element, the "upper" or "top" element is spaced closer to the tread than the "lower" or "bottom" element. Additionally, when relative directional terms such as "above" or "below" are used in connection with an element, an element that is "above" another element is closer to the tread than the other element.

[0020] The terms "inward" and "inwardly" refer to a general direction towards the equatorial plane of the tire, whereas "outward" and "outwardly" refer to a general direction away from the equatorial plane of the tire and towards the sidewall of the tire. Thus, when relative directional terms such as "inner" and

"outer" are used in connection with an element, the "inner" element is spaced closer to the equatorial plane of the tire than the "outer" element

[0021] **Figure 1** illustrates a tire **100** having a sidewall **110**. Affixed to sidewall **110** are two labels **120**. The top and bottom edges of labels **120** are curved in this embodiment, while the side edges are straight. In alternative embodiments, the top, bottom, and side edges of labels can include any combination of straight and curved edges. For example, the top, bottom, and side edges of labels can all be straight, forming a rectangular shape. In other embodiments, the labels can be formed in any geometric shape, including shapes with more or less than four edges.

[0022] One surface of each label **120** can display a logo, graphic, design, or other indicia. The other surface of labels **120** is suited for attaching to a tire **100**. In alternative embodiments the labels may include any type of indicia, including text such as slogans, phrases, symbols, etc. In still other embodiments, the labels may be blank and not include any type of indicia.

[0023] In one embodiment, the labels may be applied to a green tire in a mold. Labels applied in this manner may be referred to as "in situ labels." In situ labels can be made from ethylene-vinyl acetate copolymer, fluorocarbon rubber, halogenated butyl rubber, melt processible rubber, neoprene rubber, nitrile rubber, silicone-modified ethylene propylene diene monomer ("EPDM") rubber, silicone rubber, rubber-epoxy mixture, cyanoacrylate-rubber mixture, natural rubber, sulfur-cured EPDM rubber, peroxide-cured EPDM rubber, butyl rubber, ethylene acrylic rubber, bisphenol-cured fluorocarbon rubber, styrene-butadiene rubber,

castable urethane, millable urethane, thermoplastic urethane, and other polymeric or elastomeric materials.

[0024] In another embodiment, labels may be applied to a cured tire. Such labels may be referred to as a "post-manufactured labels." Post-manufactured labels can be made from ethylene acrylic rubber, ethylene-vinyl acetate copolymer, fluorosilicone rubber, halogenated butyl rubber, melt processible rubber, neoprene rubber, nitrile rubber, polyacrylate rubber, rubber-epoxy mixture, urethane resin, cyanoacrylate-rubber mixture, ethylene acrylic rubber, bisphenol-cured fluorocarbon rubber, styrene-butadiene rubber, peroxide-cured silicone, castable urethane, millable urethane, thermoplastic urethane, and other polymeric or elastomeric materials

[0025] In the illustrated embodiment, two labels **120** are depicted, but those skilled in the art will appreciate that any number of labels **120** may be included without departing from the scope of the present disclosure. In the embodiment shown, one of the labels **120** includes an adhesive appliqué **130** affixed thereto.

[0026] The adhesive appliqué **130** may include a logo, slogan, symbol, design, phrase, solid color, or any other indicia. The adhesive appliqué **130** includes an adhesive on one surface, and the displayed indicia on the other surface. For example, one surface of adhesive appliqué may be a gummed adhesive surface, while the other displays a breast cancer ribbon logo. The adhesive is configured to adhere to the material of a label, such as label **120**. Additionally, the adhesive is configured to adhere to a display surface of a second adhesive appliqué, so that a given adhesive appliqué may be fastened over another adhesive appliqué **130**, if

desired. This way, a user may selectively display different indicia based on preference.

[0027] In other embodiments (not shown), the adhesive appliqué may be blank or may be the same color as a tire sidewall. This way, a user may selectively cover a label or an adhesive appliqué that the user no longer wishes to display.

[0028] Labels **120** are mounted to the sidewall **110** at a mounting location where a strain in the radial direction is equal to or below a threshold value. The mounting location can be unique to every tire, and can be calculated based on the operating conditions of a particular tire (e.g., load, rotation speed, torsion, etc.), and on the mechanical properties of either a label **120** or an adhesive appliqué **130**. This threshold value is determined by first defining a level of strain for either a label **120** or an adhesive appliqué **130**, based on the ultimate tensile strength, fatigue life, maximum elastic strain, and other material properties for a label **120** or adhesive appliqué **130**. Using these properties, a designer may select a threshold value for a given label **120** or an adhesive appliqué **130**. For example a threshold value for a typical adhesive appliqué falls within a range of 0 to 10%, but may fall anywhere within a range of 0 to 25%. In this way, a label **120** or an adhesive appliqué **130** attached to the label **120** will undergo strain equal to or less than a threshold value. A higher threshold value tends to result in more rapid degradation of the label or the adhesive appliqué, and a lower threshold value tends to result in less rapid degradation of the label or the adhesive appliqué. Based on the properties of the label **120**, adhesive appliqué **130**, the tire **100**, and

the desired life cycle for the label **120** or the adhesive appliqué **130**, a person of ordinary skill in the art will be able to determine the threshold value.

[0029] To determine the mounting location, a designer can run tests known in the art to determine the strain distribution of a tire's sidewall under specified conditions. For example, a designer may run tests for meeting requirements of the National Highway Traffic Safety Administration, the Department of Transportation, or other regulatory bodies. Endurance testing may be performed under low inflation conditions (*e.g.*, at 14–19 PSI, or other inflation levels below standard operational pressure), high load conditions (such as at 200% of maximum load), high temperature conditions (*e.g.*, above 100° F), or a combination of such conditions. Once the designer determines the locations on the tire sidewall that will undergo strain that is at or below a selected strain, the designer identifies a mounting location.

[0030] In one embodiment, the labels **120** are flush with sidewall **110** of tire **100**. In an alternative embodiment, the labels protrude axially outward from the sidewall. In another alternative embodiment, the labels are depressed axially inward from the sidewall.

[0031] **Figure 2A** is a close up view of an exemplary label **200**. Label **200** includes a logo on one side. In this embodiment, the logo is a corporate logo. Label **200** may be used in conjunction with the tire of **Figure 1**. In alternative embodiments, label **200** may also include a radio frequency identification ("RFID") tag or chip, for gathering and providing data according to methods known in the art.

[0032] **Figure 2B** is a close up view of another exemplary adhesive appliqué **210** displaying a logo. In this example, the logo is a symbol for a cause. In other embodiments, the logo may represent, without limitation, a team, a geographic location, a hobby, a religious organization, other organizations, or a personal message.

[0033] **Figure 3** is a cross-section of a portion of a tire mold **300** having a securing device used to manufacture a tire having a label. In this embodiment, securing device takes the form of an indentation **310**, which is sized to receive a label (such as label **120**) and to hold the label in place while a green tire is inserted into mold **300** for curing. In this embodiment, when a label is inserted into indentation **310**, the label will have a rubber-backed side facing the interior of the tire mold. During the curing process, the rubber-backed side of the label becomes vulcanized and bonds with the sidewall of the tire, thereby becoming permanently affixed to the tire. As seen in **Figure 3**, the indentation **310** can be designed such that the label will be substantially flush with the sidewall of the tire after curing.

[0034] The indentation **310** in this embodiment is at a mounting location as discussed with respect to **Figure 1** above. The mounting location may be unique to a specific tire, a specific label, or a specific adhesive appliqué.

[0035] Alternatively, the tire mold may include a different securing device. For example, the tire mold may include a vacuum line (not shown) extending through the tire mold, which creates a vacuum at an interior surface of the tire mold. One of ordinary skill will appreciate that such a vacuum line may be inserted at a desired mounting location, to hold a label in place during the curing

process. Those of skill in the art will appreciate that any other type of securing device may be practiced with the tire mold of the present embodiment. Any securing device that holds a label in place during a curing process may be employed.

[0036] In other alternative embodiments (not shown), the label may be disposed between ribs, between posts, or between retractable grippers of the tire mold prior to curing. In another alternative embodiment, one or more magnets (not shown) retain the label against the tire mold. In yet another alternative embodiment, electrostatics may be employed to retain the label against the tire mold.

[0037] In an alternative embodiment (not shown), the label may be placed on the green tire prior to curing, and the green tire is positioned such that the label aligns with appropriate geometry of the mold. In such an embodiment, adhesive may be employed to affix the label to the green tire. Alternatively, the green tire may be sufficiently tacky, such that adhesive is not required.

[0038] In an alternative embodiment (not shown), the mold does not include any special geometry or means for retaining the label. Instead, in one embodiment, the mold is oriented substantially horizontally, and the label may simply be positioned at a desired location on the mold. The label will remain in place due to gravity. In an alternative embodiment, the label may be placed on the green tire prior to curing

[0039] In other embodiments (not shown), the label may be affixed to the tire after the tire has been cured. In one such embodiment, the label will have an

adhesive surface on one side, for attachment to the tire. In another such embodiment, adhesive is applied to the sidewall or to the label, and the label is then affixed to the sidewall at the mounting location.

[0040] **Figure 4** is a flow chart describing manufacturing steps for providing a tire having a label. At step **400**, a designer or manufacturer determines, based on the constraints of a particular application, a threshold strain for either a label or an adhesive appliqué for attachment to a label. To perform step **400**, the designer or manufacturer will take into account the mechanical properties of the label or the adhesive appliqué and a desired life cycle for the same. At step **410**, the designer or manufacturer will then identify a location on a sidewall of a particular tire where the label or adhesive appliqué would undergo strain that is equal to or less than the threshold strain when the tire is loaded and operating under pre-defined conditions. The designer or manufacturer will determine the pre-defined conditions based on the particular constraints of each application. For example, the pre-defined conditions might include a particular tire model's average operating speed, loading conditions, driving conditions, and weather conditions.

[0041] At step **420**, the designer or manufacturer will place a label into a tire mold corresponding to the mounting location of a tire formed by the mold. At step **430**, the designer or manufacture will insert a green tire into the mold and cure the tire, thereby affixing the label to the tire at the mounting location.

[0042] Optionally, at step **440** an adhesive appliqué is provided to an end-user of the cured tire, for attachment to the label.

[0043] **Figure 5** is a manufacturing process similar to that of Figure 4, only differing in the step for attaching a label to the tire. At step **500**, a designer or manufacturer determines, based on the constraints of a particular application, a threshold strain for either a label or an adhesive appliqué for attachment to a label. To perform step **500**, the designer or manufacturer will take into account the mechanical properties of the label or the adhesive appliqué and a desired life cycle for the same. At step **510**, the designer or manufacturer will then identify a location on a sidewall of a particular tire where the label or adhesive appliqué would undergo strain that is equal to or less than the threshold strain when the tire is loaded and operating under pre-defined conditions. The designer or manufacturer will determine the pre-defined conditions based on the particular constraints of each application. For example, the pre-defined conditions might include a particular tire model's average operating speed, loading conditions, driving conditions, and weather conditions.

[0044] At step **520**, the designer or manufacturer will insert a green tire into the mold and cure the tire. At step **530**, the designer or manufacture will affix a label onto a corresponding to the mounting location of the cured tire, using an adhesive or any other known means of affixing.

[0045] Optionally, at step **540**, an adhesive appliqué is provided to an end-user of the cured tire, for attachment to the label.

[0046] **Figure 6** depicts a method of affixing an adhesive appliqué to a tire having a label. At step **600**, an end user obtains a tire made by one of the methods discussed above. The user may purchase the tire, for example. At step **610**, the

user obtains a first adhesive appliqué, for example by purchasing an adhesive appliqué from a seller. The seller may be a tire manufacturer, a retailer associated with a tire manufacturer, a vehicle manufacturer, a retailer associated with a vehicle manufacturer, a retailer not associated with either a tire or a vehicle manufacturer, a tire maintenance provider, a vehicle maintenance provider, or a third party, such as a service station. At step **620**, the adhesive appliqué is affixed to the label of the tire. The step of affixing the label may be performed by an end-user of the tire, a tire manufacturer, a vehicle manufacturer, a retailer associated with either a tire manufacturer or a vehicle manufacturer, a retailer not associated with either a tire manufacturer or a vehicle manufacturer, a vehicle maintenance provider, a tire maintenance provider, another third party, or any actor. Optionally, at step **630** and step **640**, the user may obtain a second adhesive appliqué, and the second adhesive appliqué may be affixed over the first adhesive appliqué. Step **630** or step **640** may be performed by an end-user of the tire, a tire manufacturer, a vehicle manufacturer, a retailer associated with either a tire manufacturer or a vehicle manufacturer, a retailer not associated with either a tire manufacturer or a vehicle manufacturer, a vehicle maintenance provider, a tire maintenance provider, another third party, or any actor.

[0047] To the extent that the term "includes" or "including" is used in the specification or the claims, it is intended to be inclusive in a manner similar to the term "comprising" as that term is interpreted when employed as a transitional word in a claim. Furthermore, to the extent that the term "or" is employed (e.g., A or B) it is intended to mean "A or B or both." When the applicants intend to

indicate "only A or B but not both" then the term "only A or B but not both" will be employed. Thus, use of the term "or" herein is the inclusive, and not the exclusive use. See, Bryan A. Garner, A Dictionary of Modern Legal Usage 624 (2d. Ed. 1995). Also, to the extent that the terms "in" or "into" are used in the specification or the claims, it is intended to additionally mean "on" or "onto." Furthermore, to the extent the term "connect" is used in the specification or claims, it is intended to mean not only "directly connected to," but also "indirectly connected to" such as connected through another component or components.

[0048] While the present disclosure has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the disclosure, in its broader aspects, is not limited to the specific details, the representative apparatus and method, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's general inventive concept.

CLAIMS

What is claimed is:

1. A method for providing a tire configured to receive a pre-printed adhesive appliqué, comprising:

identifying a threshold strain of an adhesive appliqué;

identifying a mounting location on a tire sidewall that undergoes a strain less than or equal to the threshold strain under pre-defined conditions;

providing a label configured to be mounted on a sidewall of the tire at the mounting location; and

curing the tire while the label is adjacent to the mounting location on the sidewall of the tire.

2. The method of claim 1, further comprising providing a tire mold with a securing device at a tire mold location corresponding to the mounting location of the tire.

3. The method of claim 2, further comprising securing the label in the securing device before curing the tire.

4. The method of claim 2, wherein the securing device includes an indentation in the tire mold.

5. The method of claim 2, wherein the securing device includes a vacuum line that runs to an interior surface of the tire mold and holds the label in place during curing.

6. The method of claim 1, wherein the label contains a radio frequency identification tag or a radio frequency identification chip.

7. The method of claim 1, wherein the threshold strain is 10%.

8. The method of claim 1, wherein the label is rubber-backed, and is at least partially vulcanized with the tire during curing.

9. The method of claim 1, wherein the label is substantially flush with the sidewall of the tire after curing.

10. The method of claim 1, further comprising providing an adhesive appliqué configured to be mounted on the label.

11. The method of claim 1, wherein the pre-defined conditions include a condition in which the tire bears a pre-defined load and operates at pre-defined speeds.

12. A method for affixing an adhesive label to a tire, comprising:

obtaining a tire that has a label located at a mounting location of the tire, wherein the mounting location of the tire is on a sidewall of the tire, and wherein the label undergoes a strain less than or equal to a threshold strain under pre-defined conditions;

obtaining an adhesive appliqué; and

affixing the adhesive appliqué to the label.

13. The method of claim 12, wherein the adhesive appliqué is a gummed adhesive appliqué.

14. The method of claim 12, wherein the adhesive appliqué is obtained from a tire manufacturer or a retailer associated with a tire manufacturer.

15. A tire for displaying at least one indicium, comprising:

a label affixed to the tire at a mounting location,

wherein the label has a first side facing away from the tire and a second side connected to the tire,

wherein the label first side is configured to receive at least one adhesive appliqué having at least one indicium, and

wherein the mounting location is a location on a sidewall of the tire where the label undergoes a strain equal to or less than a threshold strain under pre-defined conditions.

16. The tire of claim 15, wherein the pre-defined conditions include a condition in which the tire is loaded and in operation.

17. The tire of claim 15, wherein the label first side includes at least one of a graphic, a phrase, and a logo.

18. The tire of claim 15, wherein the label second side is affixed to the tire before the tire is manufactured.

19. The tire of claim 15, wherein the label second side includes an adhesive surface and is affixed to the tire after the tire is manufactured.

20. The tire of claim 15, wherein the label is substantially flush with the sidewall of the tire.

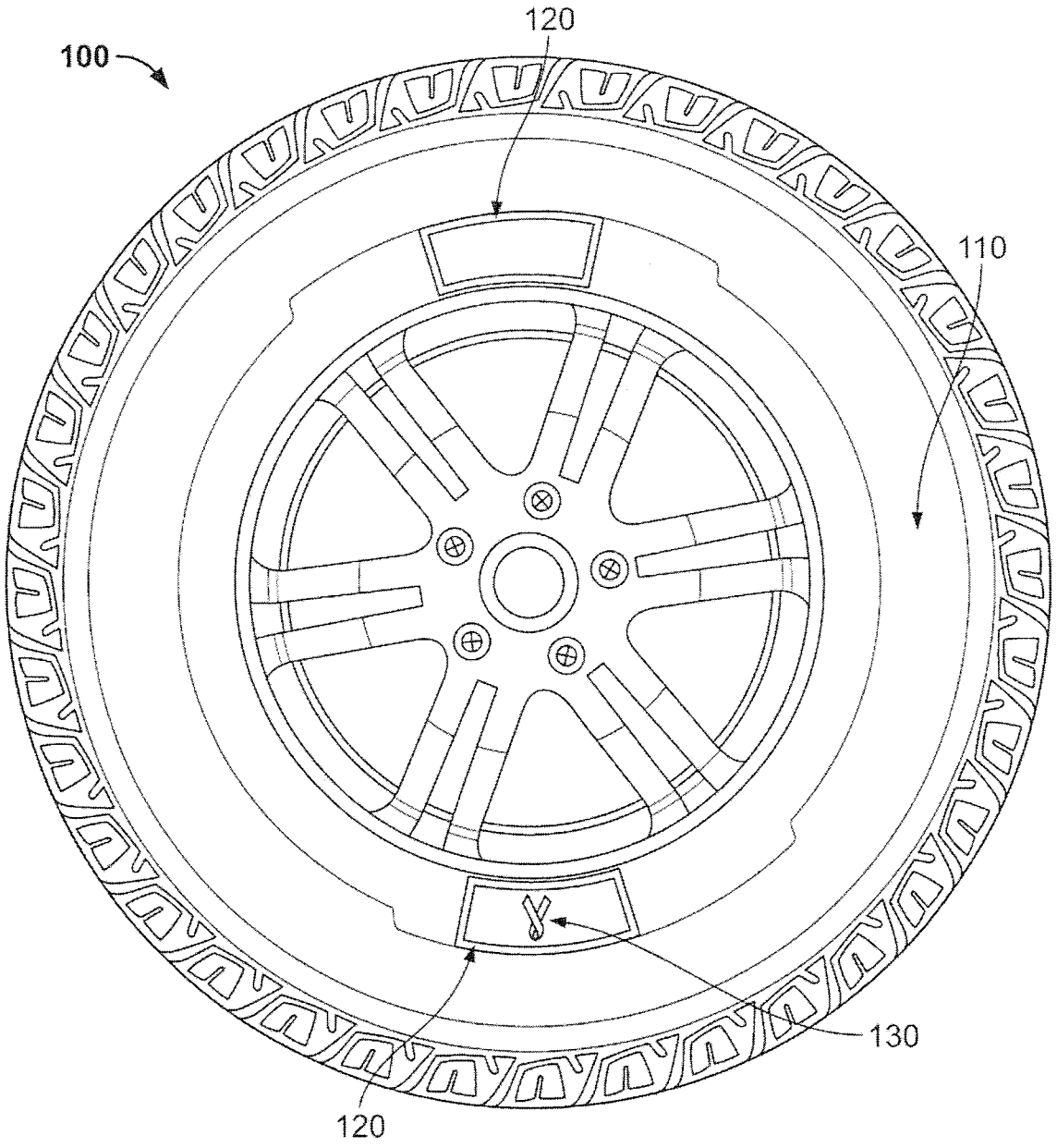


Fig. 1

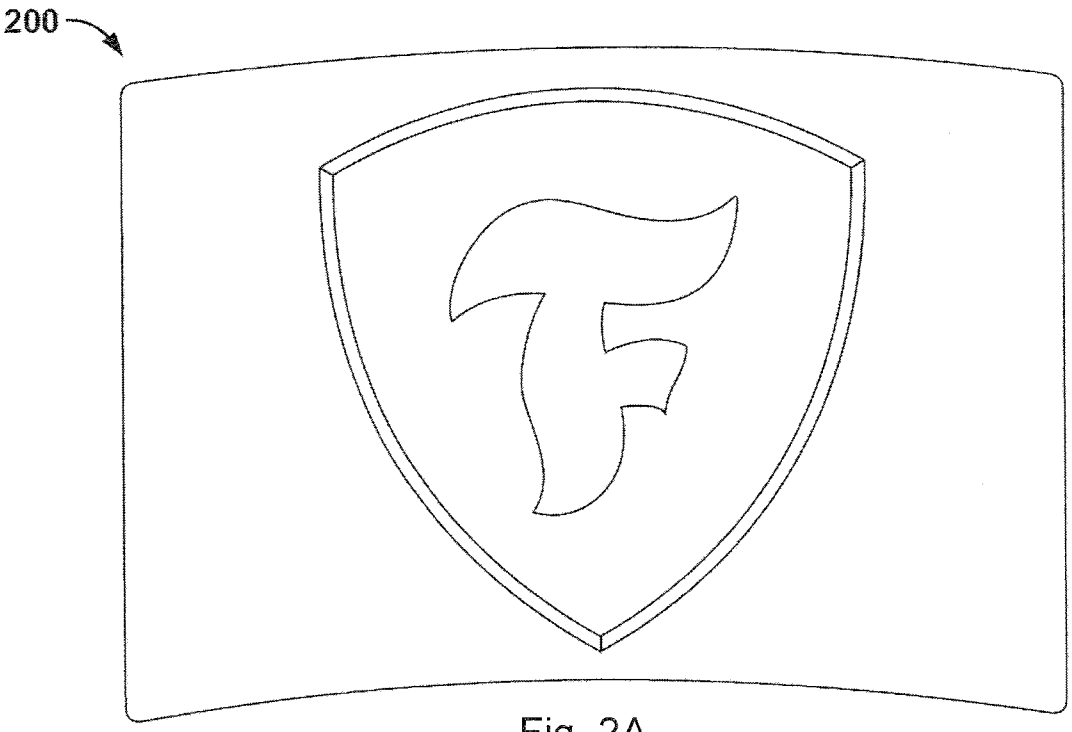


Fig. 2A

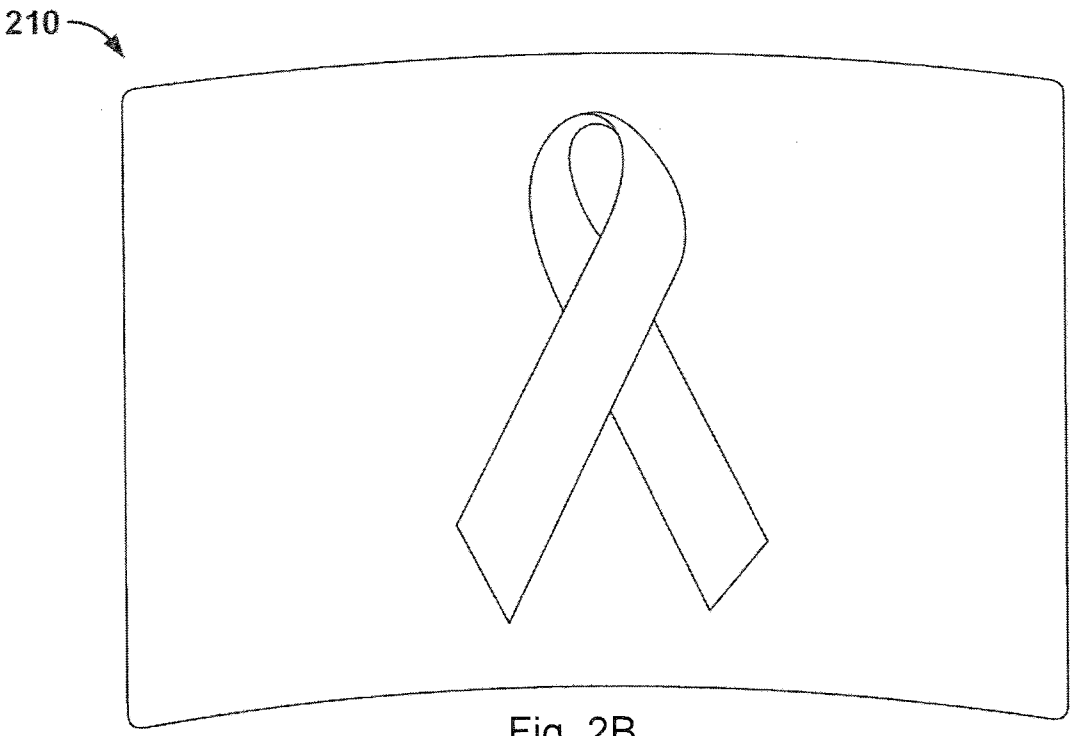


Fig. 2B

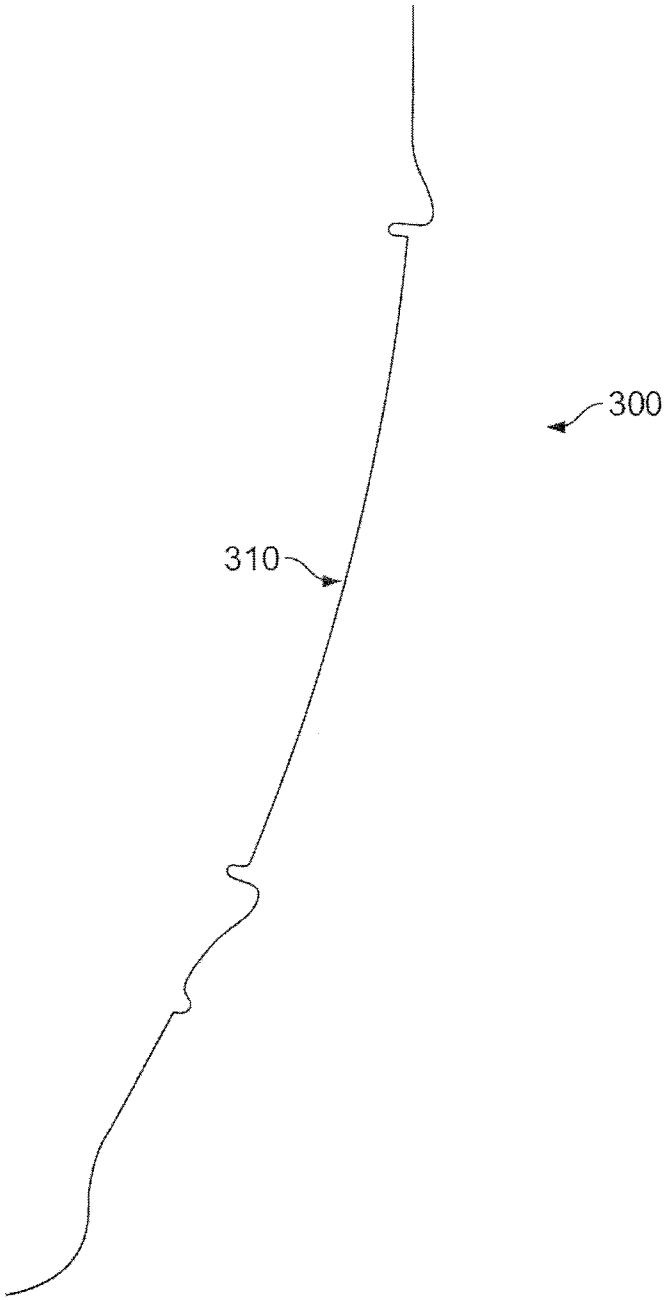


Fig. 3

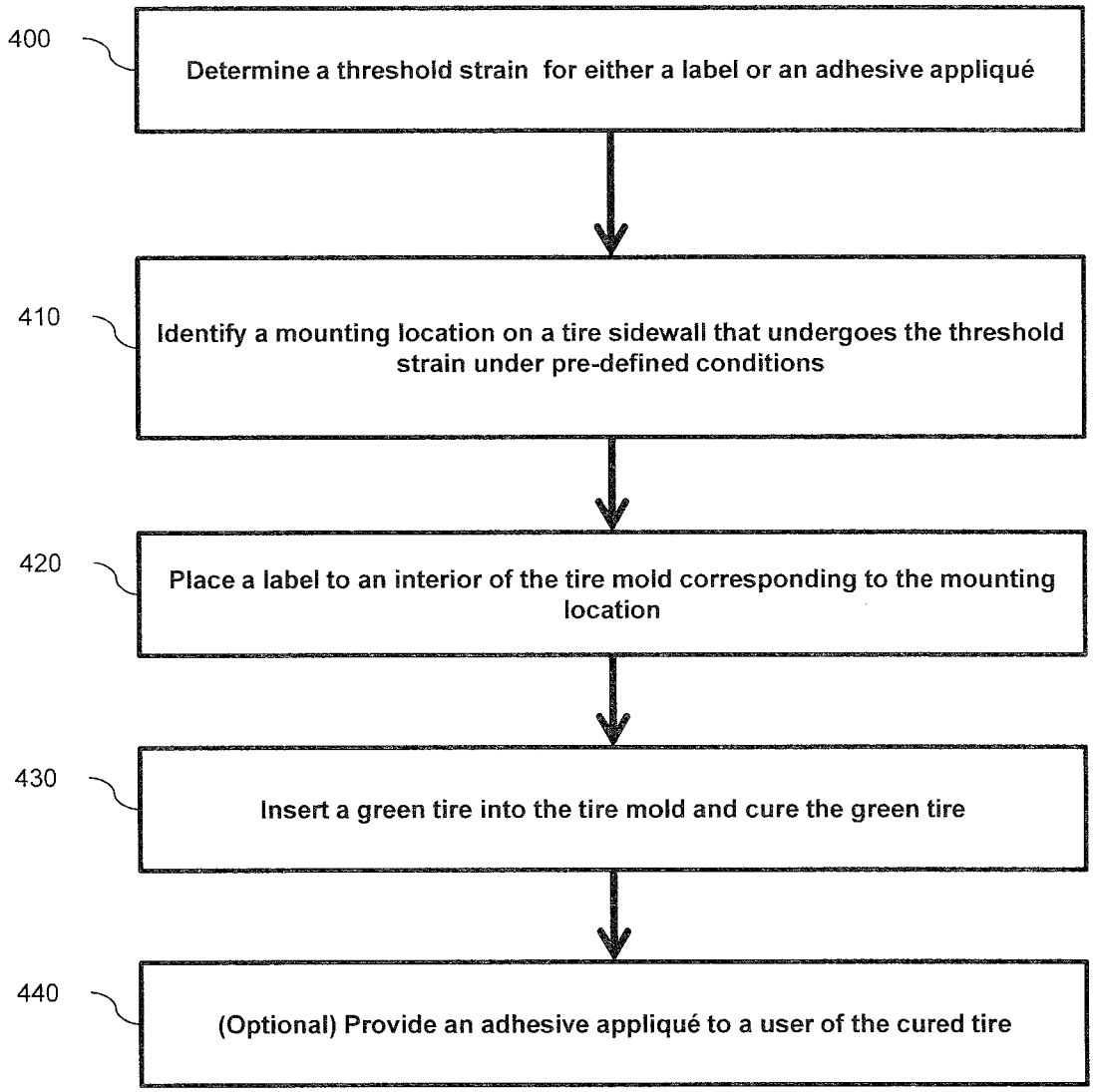

400
Determine a threshold strain for either a label or an adhesive appliqué
410
Identify a mounting location on a tire sidewall that undergoes the threshold strain under pre-defined conditions
420
Place a label to an interior of the tire mold corresponding to the mounting location
430
Insert a green tire into the tire mold and cure the green tire
440
(Optional) Provide an adhesive appliqué to a user of the cured tire

Fig. 4

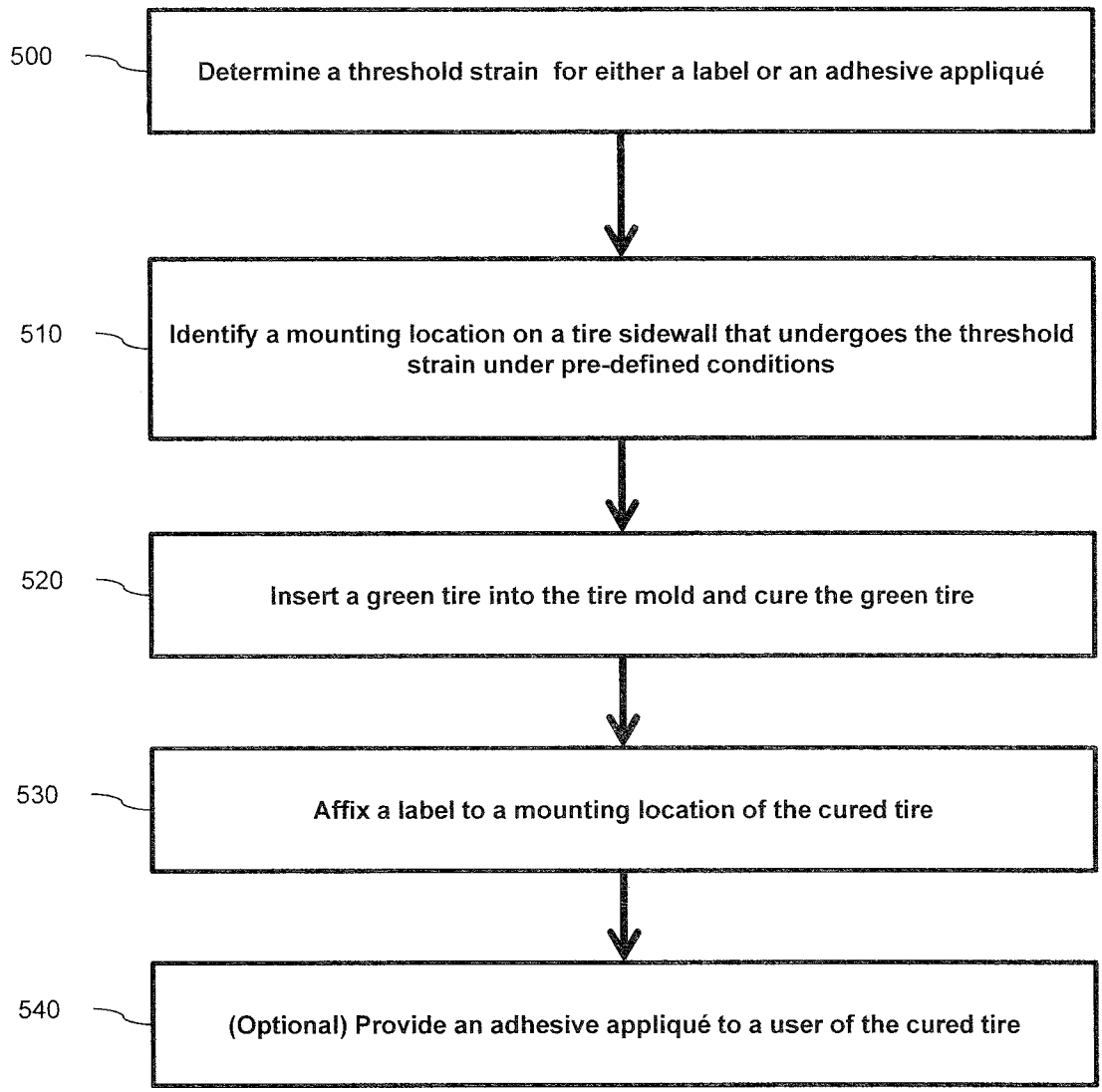

500
Determine a threshold strain for either a label or an adhesive appliqué
510
Identify a mounting location on a tire sidewall that undergoes the threshold strain under pre-defined conditions
520
Insert a green tire into the tire mold and cure the green tire
530
Affix a label to a mounting location of the cured tire
540
(Optional) Provide an adhesive appliqué to a user of the cured tire

Fig. 5

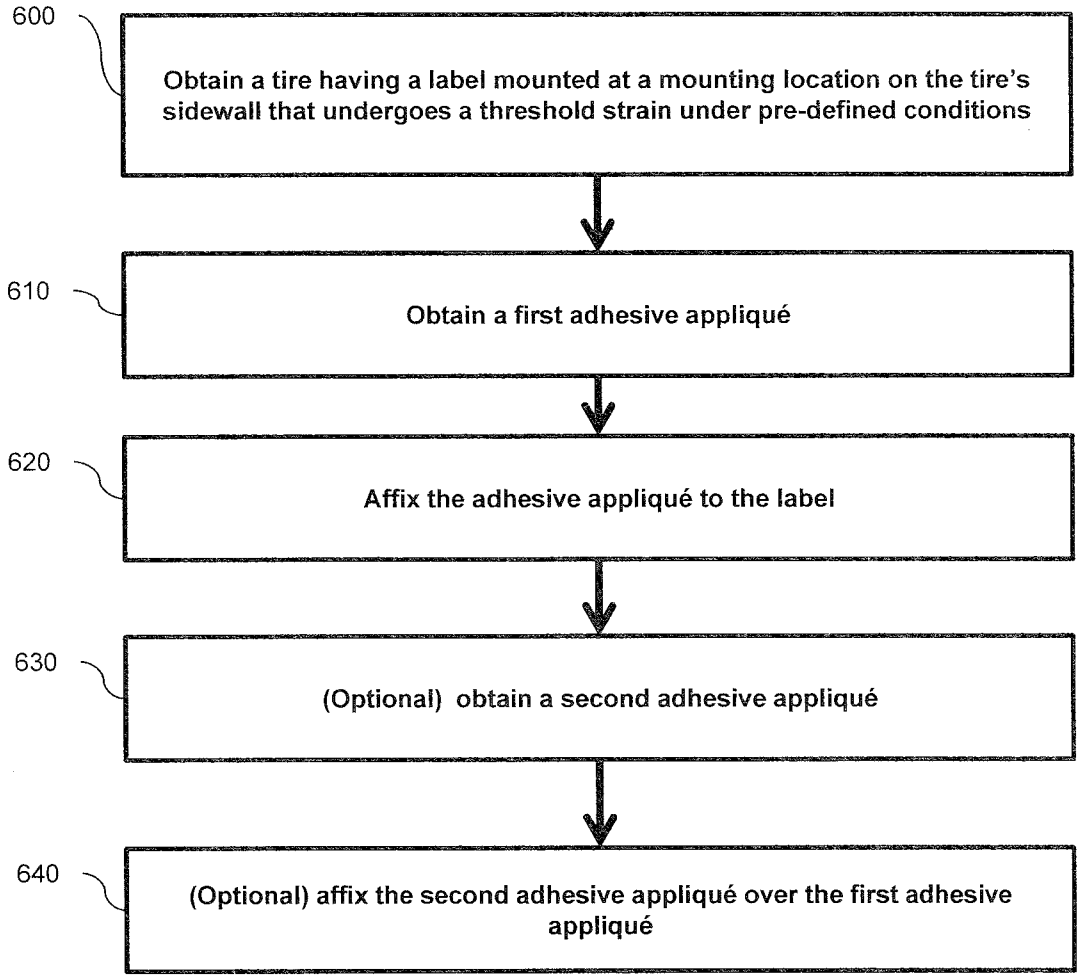

600
Obtain a tire having a label mounted at a mounting location on the tire's sidewall that undergoes a threshold strain under pre-defined conditions
610
Obtain a first adhesive appliqué
620
Affix the adhesive appliqué to the label
630
(Optional) obtain a second adhesive appliqué
640
(Optional) affix the second adhesive appliqué over the first adhesive appliqué

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/063405

A. CLASSIFICATION OF SUBJECT MATTER

B60C 13/00(2006.01)i, B60C 19/00(2006.01)i

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 13/00; B29D 30/72; B60C 5/00; B60C 13/04; B60C 19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: tire, sidewall, adhesive, applique, curing, label, strain, threshold, location

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2013-0160913 A1 (LONKAR et al.) 27 June 2013 See paragraphs [0018]-[0020] and figures 2-5.	1-20
A	US 5300164 A (DETRANO et al.) 05 April 1994 See column 2, line 42-column 10, line 66 and figures 1-4.	1-20
A	US 6391134 B1 (LIPOVAC, JOSEPH EDWARD) 21 May 2002 See column 4, line 48-column 8, line 5 and figures 1-10.	1-20
A	US 2006-0032569 A1 (ZIMMER et al.) 16 February 2006 See paragraphs [0013]-[0057] and figure 1.	1-20
A	US 2007-0209743 A1 (MELLET, YANN) 13 September 2007 See paragraphs [0014]-[0039] and figures 1-6.	1-20

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

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 February 2016 (19.02.2016)	**19 February 2016 (19.02.2016)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/063405

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		EP 0701913 A1	20/03/1996
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US 2007-0209743 A1	13/09/2007	US 2007-0000589 A1	04/01/2007
		US 7118643 B1	10/10/2006