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(54) Title: SIPE BLADE VENTING STRUCTURE

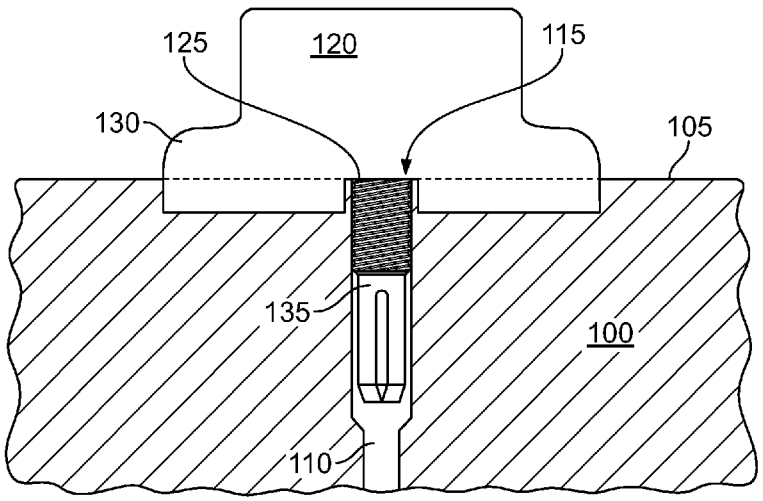


FIG. 1

(57) Abstract: A system for venting a tire mold including at least one conduit that creates a fluid connection between an interior and an exterior of a tire mold, with at least one sipe blade extending across the conduit such that the air to either side of the sipe blade will exit the tire mold interior when a tire is formed.

SIPE BLADE VENTING STRUCTURE

FIELD OF THE INVENTION

[0001] The present disclosure relates to venting structures for tire molds. More particularly, the present disclosure relates to a venting structure for a sipe blade region of a tire mold.

BACKGROUND

[0002] Tire molds include vent structures that allow the air in a tire mold to be displaced when rubber is compressed or injected into the mold. Sipe blades are sometimes included in a tire mold to create patterns in the finished tire. When the rubber is injected into the mold, the rubber will form around a sipe blade to create a void in the cured tire matching the shape of the sipe in a finished tire. In prior art structures, sipe blades include holes within the blade to allow air to vent from one side of the sipe blade to the other. The size of the holes, the number of the holes and the location of the holes is an exacting process and due to sipe size, material constraints and sipe placement during mold preparation, can be limiting. This results in less than optimal air flow. These structures degrade the appearance of a finished tire, as sprues may form on either side of the sipe blade, and break when the tire is removed from the mold. This can also result in tire "lightness," where rubber does not completely fill in the voids of the tire mold and sipe junctions.

SUMMARY

[0003] In one embodiment, a tire mold has an interior surface and an exterior surface with a conduit connecting the two surfaces in a fluid connection. This embodiment further includes at least one sipe blade extending across an interior opening of the conduit, into an interior of the tire mold. This embodiment further includes a vent insert located within the at least one conduit.

[0004] In another embodiment, a system for venting a tire mold includes a tire mold with interior and exterior regions in fluid connection with each other via at least one conduit extending from the exterior region to the interior region. This embodiment further includes at least one sipe blade located in the interior region of the tire mold, that extends across the at least one conduit.

[0005] In another embodiment, a tire mold has an interior region and an exterior region with a conduit connecting the two in a fluid connection. This embodiment further includes at least one sipe blade positioned at an interior opening of the conduit, and extending into the interior region of the tire mold. The sipe blade in this embodiment is embedded into the tire mold. This embodiment further includes a vent insert located within the at least one conduit, and positioned between the sipe blade and the exterior region of the tire mold.

BRIEF DESCRIPTION OF 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 front view of one embodiment of a notched sipe blade and a vent insert in a tire mold shown in cross section;

[0008] **Figure 2** is a front view of an exemplary vent insert in a tire mold shown in cross section;

[0009] **Figure 3** is a front view of an alternative embodiment of a sipe blade and a notched vent insert in a tire mold shown in cross section;

[0010] **Figure 4** is a side view of an exemplary notched vent insert;

[0011] **Figure 5** is a front view of another alternative embodiment of a notched sipe blade in a notched vent insert in a tire mold shown in cross section;

[0012] **Figure 6A** is a top view of one embodiment of a sipe blade bisecting a single conduit; and

[0013] **Figure 6B** is a top view of an alternative embodiment of a sipe blade with three segments and two conduits for venting.

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] Directions are stated herein with reference to the tire mold. For example "interior," "inside," or "inner" refers to a direction or area towards the center cavity of a tire mold. The terms "exterior," "outside," or "outer" refer to a direction or area generally outside of the tire mold.

[0016] **Figure 1** illustrates a cross-section view of a first embodiment of the sipe venting structure. A tire mold **100** includes an interior surface **105** for receiving material used in manufacturing tires. The interior surface **105** may take any shape suitable for forming tires. The tire mold **100** further comprises a conduit **110** for venting air from the interior of the tire mold **100** to an exterior (not shown) of the tire mold **100**. The conduit **110** may take any form, but here is depicted as a cylindrical through hole, with an opening **115** in the interior surface **105**. The opening **115** permits fluid communication between the interior of the tire mold **100** and the exterior of the tire mold **100** via the conduit **110**. Other venting structures known in the art may be used without departing from the scope of the present disclosure.

[0017] A sipe blade **120** is secured in an opening in the tire mold **100**, such that a bottom of the sipe blade **120** is embedded within the tire mold **100**. Any means of securing the sipe blade **120** to the tire mold **100** may be used without departing from the scope of the present disclosure, including but not limited to forming the tire mold with the sipe blade, permanently mounting sipe blade after forming the tire mold, or affixing sipe blade to tire mold in a removable manner.

[0018] In this embodiment, the sipe blade **120** is depicted as having a flat rectangular top, having side portions **130** being shorter than the flat rectangular

top, extending further than the flat rectangular top in a lengthwise direction, and having rounded outer portions. A bottom edge of the sipe blade **120** is substantially straight, with a notch **125** located in a central region of the bottom edge. The notch **125** is sized such that it is coextensive with the opening **115** in the interior surface **105**. Other shapes are possible for the sipe blade **120**, and may be substituted without departing from the scope of the present disclosure.

[0019] In this embodiment, the notch **125** is located near the center of the sipe blade **120**, and the sipe blade **120** is positioned so as to bisect the conduit **110** over a diameter of the conduit **110**. In an alternative embodiment, the notch is off-centered. In other alternative embodiments, sipe blade may not bisect the conduit.

[0020] **Figure 1** also shows a schematic of a generally cylindrical vent insert **135**, located within the conduit **110**. The top of vent insert **135** is positioned parallel to the interior surface **105** and to the notch **125**. The notch **125** is dimensioned to receive the vent insert **135**. The vent insert **135** can be mounted into the conduit **110** using any means known to one of ordinary skill in the art. The notch **125** may vary in depth, but in this embodiment, notch **125** has a depth matching the 'sipe embedment depth' of the sipe into the mold. The 'sipe embedment depth' (the depth to which the sipe blade **120** is embedded into the tire mold **100**) is a design depth established by a designer, taking into account constraints of the particular application. The 'sipe embedment depth' in this embodiment ranges from 0.15 inches to 0.25 inches, but this range may be increased based on constraints of the application.

[0021] **Figure 2** illustrates a front view of an exemplary vent insert in a tire mold shown in cross section. It should be understood that the illustrated insert is merely exemplary and that any vent insert may be employed. The vent insert **135** includes a threaded portion **140** having a plurality of spiral channels **145**. Spiral channels **145** are formed in the threaded portion **140** and run continuously from a top **150** of the vent insert **135** and along a portion of a length of the vent insert **135**. Each spiral channel **145** defines an intake opening **155** located at the top **150** of the vent insert **135**. In other embodiments, the spiral channels may be replaced with straight channels. Any number of channels may be employed. Additionally, other types of vent inserts may be used without departing from the scope of the present disclosure, including but not limited to spring vents, drill vents, micro vents, or sinter vents.

[0022] With continued reference to **Figure 2**, the vent insert **135** in this embodiment is a sprueless type vent insert. The exemplary vent insert **135** allows gas from the interior of the tire mold **100** to vent to an exterior of tire mold **100**, reducing or preventing the formation of tire sprues. When tire material is compressed or injected into the tire mold **100**, the air inside the tire mold **100** is displaced. The displaced air is forced into the intake openings **155**, through the channels **145**, out the threaded portion **140** and finally through the rest of conduit **110** until reaching an exterior of the tire mold **100**. The shape and size of the intake openings **155** prevent sprues from forming when tire material comes into contact with the interior surface **105** and the threaded portion top **150**. A designer

can optimize the airflow through the channels **145** on each side of the vent by varying the size, geometry, location, or number of channels.

[0023] The threaded portion **140** in this exemplary vent insert **135** has an outer diameter approximately equivalent to an inner diameter of the conduit **110** and diameter of the opening **115**. In this embodiment, an equal number of intake openings **155** are located on either side of the sipe blade **120** when installed. However, other arrangements of the intake openings **155** may be used without departing from the scope of the present disclosure. For example an unequal number of vent intakes **155** may be located to either side of the sipe blade **120**. In alternative embodiments, a different type of vent insert may be used, or the vent insert may be omitted altogether. The diameter of the vent insert **135** can be optimized to accommodate the width of the sipe blade and the available mold surface area available.

[0024] **Figure 3** depicts a front view of an alternative embodiment of a sipe blade and a notched vent insert in a tire mold shown in cross section. In this embodiment, a tire mold **200** has an interior surface **205** and a conduit **210**. The conduit **210** includes an opening **215** that permits fluid communication between the interior of the tire mold **100** and an exterior (not shown) of the tire mold **100**. A vent insert **225** is located within the conduit **210**. The vent insert **225** is positioned so that a top portion is flush with the interior surface **205**. As in other embodiments, other types of vent inserts or other arrangements of vent inserts may be used without departing from the scope of the present disclosure.

[0025] In the embodiment shown in **Figure 3**, the bottom edge of the sipe blade **220** does not include a notch. Rather, the bottom edge of the sipe blade **220** is straight, and located outside of the interior surface **205**. The vent insert **225** includes a vent insert notch **230** in a top portion thereof, which receives the sipe blade **220**. The vent insert notch **230** is positioned in a central diameter of the vent insert **225**. In this embodiment, the sipe blade **220** passes through the conduit opening **215**, and through the vent insert **225** via the vent insert notch **230**. The vent insert notch **230** has a width approximately equal to the thickness of the sipe blade **220**, to form a tight connection between the vent insert **225** and the sipe blade **220**. Alternatively, the vent insert notch may have a width greater than the blade thickness. Vent insert notch **230** may vary in depth, but in this embodiment, vent insert notch **230** has a depth matching the 'sipe embedment depth' of the sipe into the mold. The 'sipe embedment depth' (the depth to which the sipe blade **220** is embedded into the tire mold **200**) is a design depth established by a designer, taking into account constraints of the particular application. The 'sipe embedment depth' in this embodiment ranges from 0.15 inches to 0.25 inches, but this range may be increased based on constraints of the application.

[0026] In an alternative embodiment (not shown), the vent insert notch may be located off-center of the vent insert, so that it is not positioned along a diameter of the vent insert. In such an embodiment, the sipe blade would not pass through a diameter of the conduit opening, and instead would pass through a distance less than the diameter of the conduit.

[0027] **Figure 4** illustrates a side view of the exemplary vent insert **225** of the **Figure 3** embodiment. The vent insert **225** is substantially the same as the vent insert **150** of **Figures 1** and **2**, except for the addition of the notch **230** in a top portion of the vent insert **225** for receiving the sipe blade **220**. It should be understood that the illustrated insert is merely exemplary and that any vent insert may be employed. As in other embodiments, other types of vent inserts or other arrangements of vent inserts may be used without departing from the scope of the present disclosure.

[0028] **Figure 5** illustrates another alternative embodiment of a sipe vent structure in a tire mold shown in cross section. In this embodiment, a tire mold **300** comprises an interior surface **305** and a conduit **310**. The conduit **310** permits fluid communication between an interior of the tire mold **300** and an exterior (not shown) of the tire mold **300**. A vent insert **325** is located in conduit **310**.

[0029] A bottom edge of the sipe blade **315** includes a notch **320**. The notch **320** is dimensioned to the receive vent insert **325**. A top of the notch **320** is located outside of the interior surface **305**. Additionally, the vent insert **325** includes a vent notch **330** located on a top portion thereon, and aligned with the notch **320** of the sipe blade **315**. In this embodiment, the vent notch **330** is the same width as the sipe blade **315**. The bottom of the vent notch **330** is adjacent to a top of the notch **320** such that the vent notch **330** and the notch **320** form an interlocking engagement. In an alternative embodiment (not shown) a gap may be formed between the bottom of the vent notch **330** and the top of notch **320** of the

sipe blade **315**. In another alternative embodiment, the vent insert notch **330** may have a width greater than the sipe blade thickness.

[0030] In yet another alternative embodiment (not shown), the vent insert notch may be located off-center of the vent insert, so that it is not positioned along a diameter of the vent insert. In such an embodiment, the sipe blade would not pass through a diameter of the conduit opening, and instead would pass through a distance less than the diameter of the conduit.

[0031] In the embodiment of **Figure 5**, a top of the vent insert **325** is flush with the interior surface **305**. Other arrangements are possible without departing from the scope of the present disclosure. The notch **320** and the vent notch **330** may vary in depth, but in this embodiment meet at a depth slightly less than the 'sipe embedment depth' of the sipe into the mold. The 'sipe embedment depth' (the depth to which the bottom most edge of sipe blade **315** is embedded into the tire mold **300**) is a design depth established by a designer, taking into account constraints of the particular application. The 'sipe embedment depth' in this embodiment ranges from 0.15 inches to 0.25 inches, but this range may be increased based on constraints of the application.

[0032] **Figure 6a** depicts a top-down view of one possible arrangement of a sipe blade **400** and a vent structure **405**. In this arrangement, sipe blade **400** bisects venting structure **405**. This arrangement can be used for any of the embodiments disclosed herein.

[0033] **Figure 6b** illustrates an alternative arrangement of the sipe blade **500**. The sipe blade **500** in this embodiment is segmented into three parts, each angled

with respect to the adjacent segment. In this embodiment, any number of sipe blade segments may be used, and the sipe blades may be arranged to form any angles with respect to each other. Alternatively, three separate sipe blades may be arranged in this manner. This type of arrangement may be used with any of the above described embodiments of the sipe venting structure. One or more venting structures **505** may be located beneath the sipe blade **500**. The venting structures **505** may be any of the above described embodiments, and may include vent inserts, conduits, vents inserts with notches, etc. as described above. The sipe blade may also be a single curve, multiple curves, or a serpentine shape incorporating different radii.

[0034] 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.

While the present application 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 application, 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 tire mold comprising:

a tire mold interior surface;

at least one conduit extending from the tire mold interior surface to an exterior of the tire mold, wherein the at least one conduit includes at least one conduit opening at the tire mold interior surface;

at least one sipe blade disposed in the tire mold interior surface, wherein the sipe blade extends across the at least one conduit opening; and

at least one vent insert, and

wherein at least a portion of the at least one vent insert is located inside of the at least one conduit.

2. The tire mold of claim 1, wherein a top surface of the at least one vent insert is adjacent to the at least one sipe blade, and the top surface of the at least one vent insert includes a vent notch configured to receive the at least one sipe blade.

3. The tire mold of claim 1, wherein the at least one conduit is a plurality of conduits each having a conduit opening, and the at least one sipe blade is a plurality of sipe blades, wherein each of the of sipe blades extends across one of the conduit openings.

4. The tire mold of claim 1, wherein the at least one vent insert has an even number of vent insert channels extending along a side surface of the vent

insert, and wherein each vent insert channel has an intake opening at a vent insert top surface.

5. The tire mold of claim 1, wherein the at least one sipe blade further includes a sipe blade notch that is aligned with the opening of the at least one conduit.

6. The tire mold of claim 1, wherein the at least one sipe blade includes a sipe blade notch that is wider than a diameter of the at least one conduit.

7. The tire mold of claim 1, wherein the at least one vent insert includes a top surface that is flush with the tire mold interior surface.

8. A system for venting a tire mold, comprising:

a tire mold having an interior region and an exterior region,

wherein the interior and exterior regions of the tire mold are in fluid connection with each other via at least one conduit extending from the exterior region to the interior region; and

at least one sipe blade located in the interior region of the tire mold, extending across the at least one conduit.

9. The system of claim 8, further including at least one vent insert, wherein at least a portion of the at least one vent insert is located inside the at least one conduit, and at least a portion of the vent insert is located between the sipe blade and the exterior region.

10. The system of claim 9, wherein a top surface of the vent insert is adjacent to the sipe blade, and wherein a vent insert front surface includes a vent insert notch that receives the sipe blade.

11. The system of claim 10, wherein the vent insert front surface is flush with an interior surface of the interior region of the tire mold.

12. The system of claim 8, wherein the at least one sipe blade bisects the at least one conduit opening along a diameter of the at least one conduit opening.

13. The system of claim 9, wherein the at least one vent insert has an even number of channels extending along a side surface of the vent insert,

wherein each channel has an intake opening at a top surface of the vent insert, and

wherein an equal number of intake openings are located to either side of the sipe blade.

14. The system of claim 9, wherein the at least one sipe blade includes a sipe blade notch that receives a vent top surface of the vent insert.

15. The system of claim 9, wherein the at least one sipe blade includes a sipe blade notch, wherein the at least one vent insert includes a vent insert notch, and wherein the sipe blade notch and vent insert notch are configured to interlock with each other.

16. A tire mold comprising:

an interior region;

an exterior region,

wherein the interior and exterior regions of the tire mold are connected via at least one conduit extending from the exterior region to the interior region, and

wherein the interior region is defined by an interior surface;

at least one sipe blade embedded in the tire mold and extending from the interior surface into the tire mold interior region, wherein the sipe blade is positioned at an interior opening of the conduit;

at least one vent insert, wherein at least a portion of the vent insert is located within the at least one conduit, and at least a portion of the vent insert is located between the sipe blade and the exterior region.

17. The tire mold of claim 16, wherein the at least one vent insert includes a vent insert top surface adjacent to the sipe blade, wherein the vent insert top surface includes a vent notch, and wherein the vent notch is configured to receive the at least one sipe blade.

18. The tire mold of claim 16, wherein the at least one sipe blade includes a sipe blade notch that is configured to receive the vent insert.

19. The tire mold of claim 16, wherein the vent insert has an even number of vent insert channels extending along a side surface of the vent insert.

20. The tire mold of claim 19, wherein at least a portion of the at least one vent insert is located within the conduit,

wherein each vent insert channel has an intake opening on a top surface of the vent insert, and

wherein half of the vent insert channel intake openings are located on one side of the sipe blade.

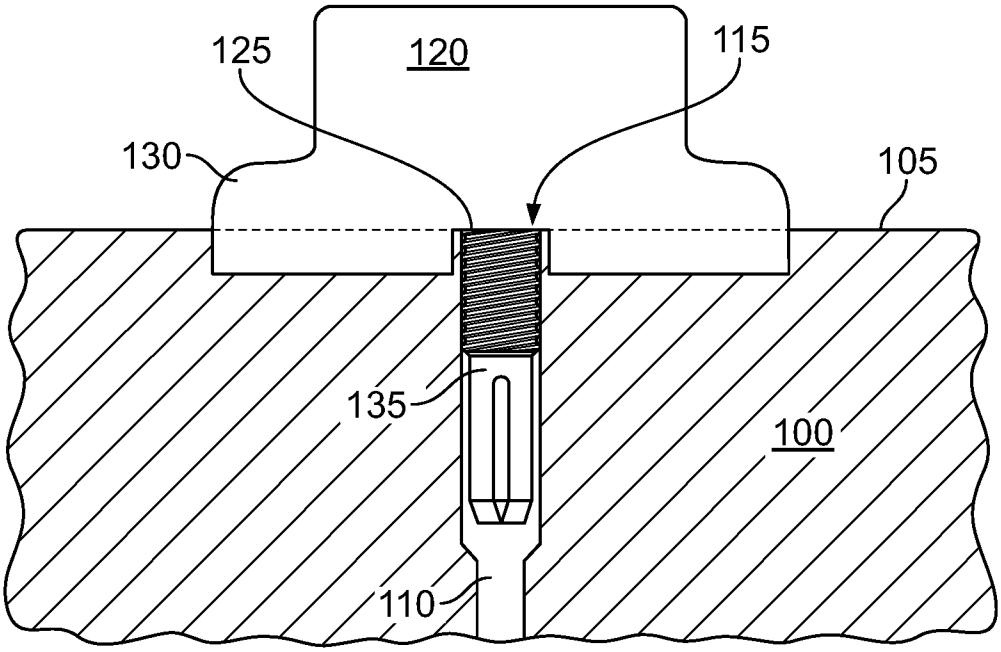


FIG. 1

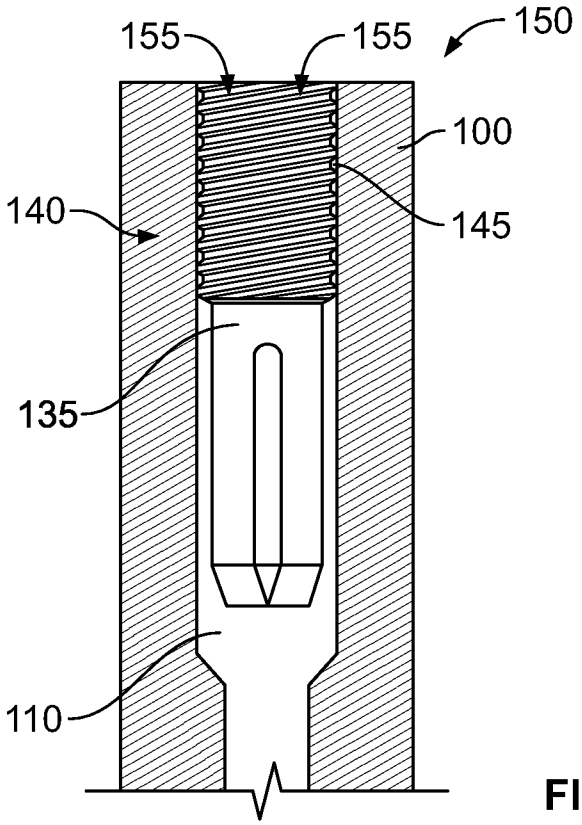


FIG. 2

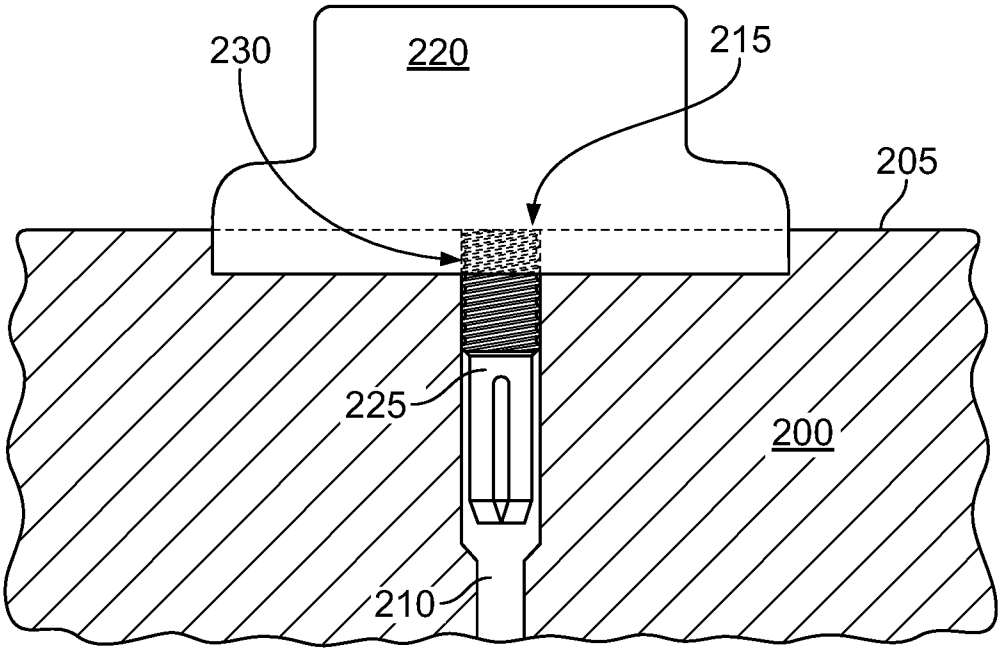


FIG. 3

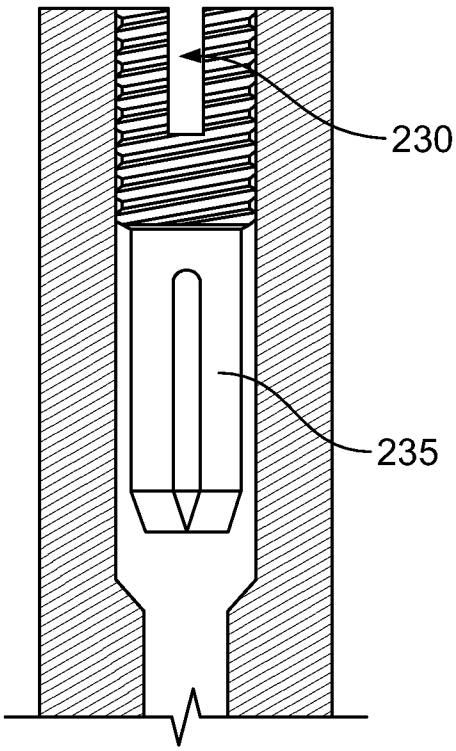


FIG. 4

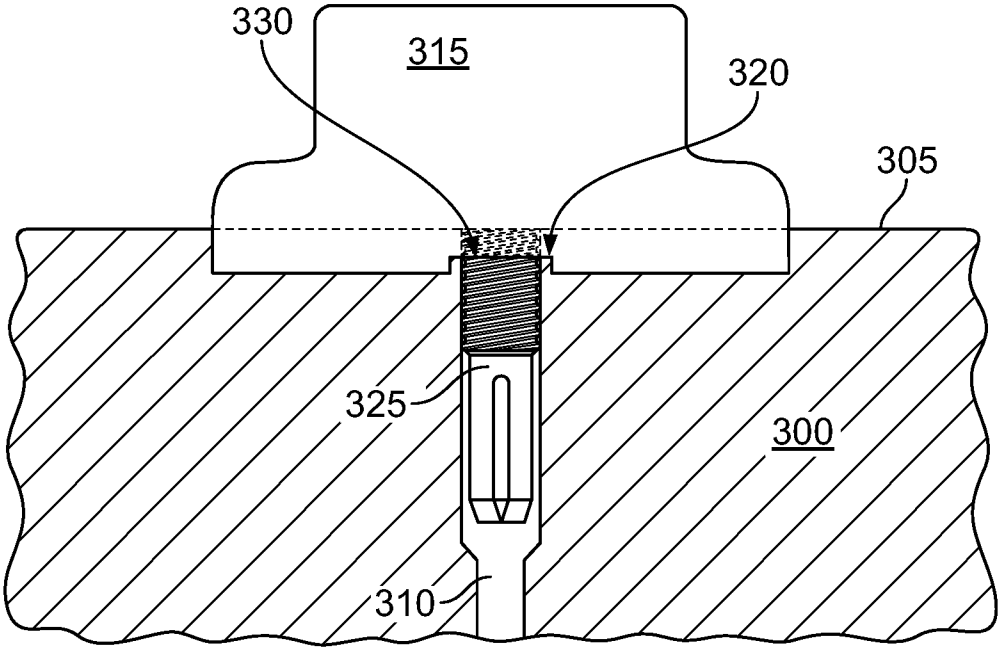


FIG. 5

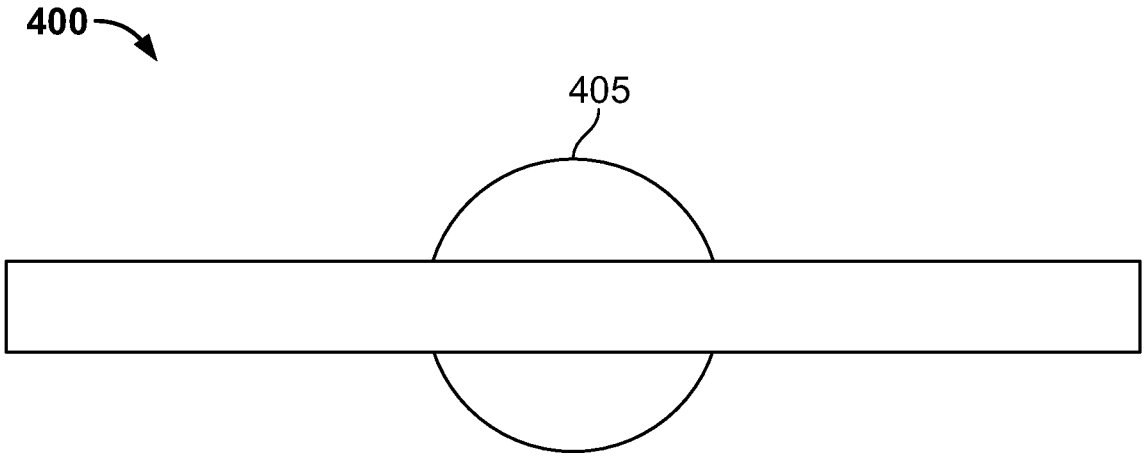


FIG. 6A

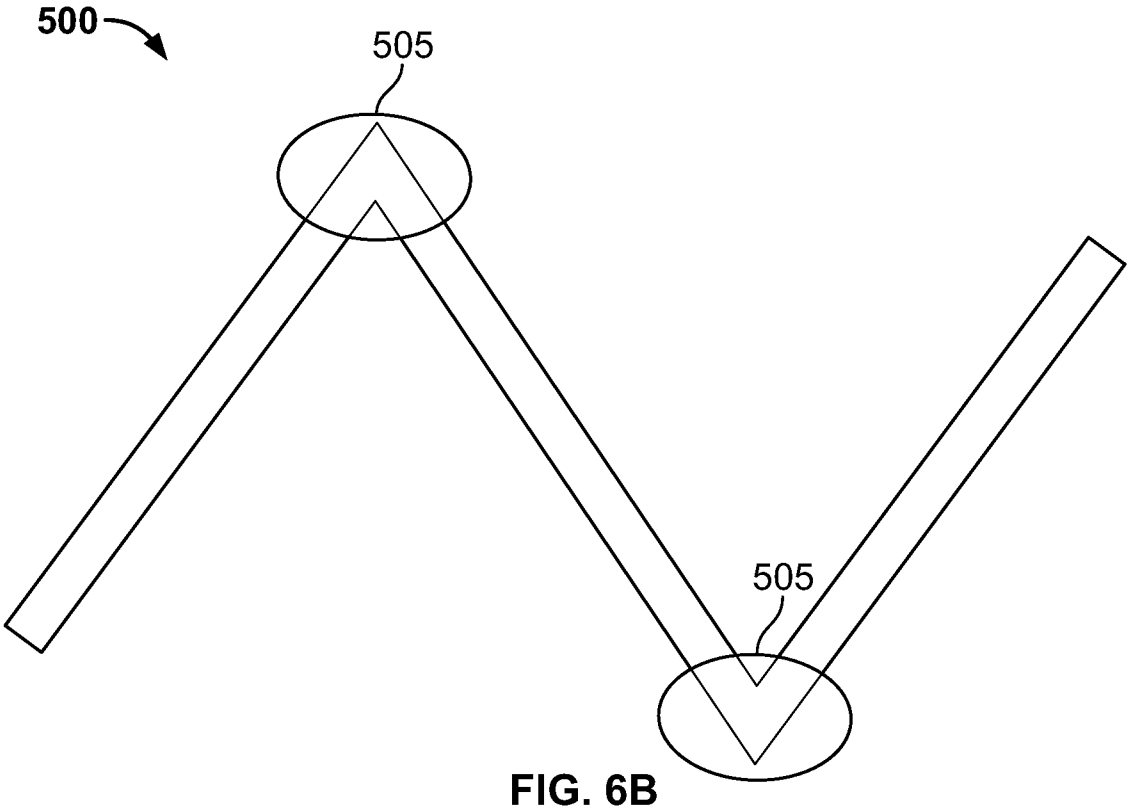


FIG. 6B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/061062

A. CLASSIFICATION OF SUBJECT MATTER

B29D 30/06(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)
B29D 30/06; B29C 33/42; B29C 35/02; B29D 30/00; B29C 35/00; B29C 33/10

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, mold, vent, air, conduit, sipe blade, vent insert

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7717691 B2 (COLEMAN, RICHARD E.) 18 May 2010 See abstract; claim 1; paragraph [0011]; and figures 2-5.	1-20
Y	US 2009-0061032 A1 (SEROKA, EDWARD) 5 March 2009 See abstract; claim 1; paragraphs [0026], [0042]; and figures 1, 5.	1-20
A	US 2002-0162941 A1 (HANYA, MASAHIRO) 7 November 2002 See abstract; claims 1, 14; and figure 1. See	1-20
A	KR 10-2003-0029739 A (KUMHO TIRE CO., INC.) 16 April 2003 See abstract; claims 1-3; and figures 1, 2, 4.	1-20
A	KR 10-2005-0098063 A (MOON, JUNG KEUN) 11 October 2005 See abstract; claims 1-3; and figures 3, 6, 7.	1-20
A	JP 10-264169 A (NGK INSULATORS LTD.) 6 October 1998 See abstract; claim 1; and figure 1.	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
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