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(54) Title: METHOD OF TIRE RETREADING USING ADHESIVES

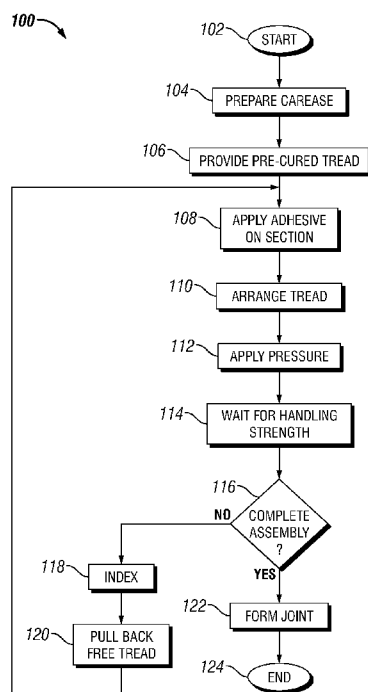


FIG. 2

(57) Abstract: A method of forming a retreaded tire is provided that employs adhesion of a pre-cured tread (202) to a tire carcass. The adhesive is applied to at least one of at least of the carcass surface (200a) and at least a section of the tread undersurface (204) such the adhesive is applied in a predetermined pattern (205). The polymerization process of the adhesive is initiated, wherein the initiating includes collapsing the adhesive to spread the adhesive thereby. The method also comprises the step of waiting until polymerization of the adhesive attains a predetermined handling strength along an interface of the pre-cured tread an the carcass.



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METHOD OF TIRE RETREADING USING ADHESIVES

TECHNICAL FIELD

The presently disclosed invention relates generally to methods and apparatuses for manufacturing retreaded tires. More specifically, this invention is directed to adhesion of a tread to a carcass and consequent obviation of a curing membrane.

BACKGROUND

When tires become worn, they may be restored with new tread bands or tread layers during a retread process. Retreading is a restoration or re-manufacturing process that preserves much of the material in spent tires and incurs a fraction of material cost as compared to new tire manufacture. Retreading is often incorporated in the operation plans of many industries, including those that employ fleets of vehicles with the expectation that the tire carcasses of such vehicles will have a long service life.

For the restoration of tire treads on various vehicles, a variety of pre-cured treads have been designed for use in tire retreading processes. FIG. 1 illustrates an exemplary pre-cured tread as used on a retread tire 10. Tire 10 includes a tire carcass 12 with a crown section 14, reinforcement 16 and sidewall 18. Crown section 14 may have been buffed or otherwise worked to provide a prepared bonding surface to which a laterally extending tread 20 can be bonded. Buffing old tread off of the tire in preparation for retreading removes rubber that is typically replaced during the retreading process as part of the undertread portion of the tread that is bonded to the carcass.

A tread 20 that is applied to carcass 12 includes respective top and bottom faces 20a, 20b and a predetermined thickness T coextensive therewith. Tread 20 also extends between opposing lateral sides 20c that may be coextensive with tire carcass 12. One or more tread elements 21 are integral with tread 20 in a variety of configurations as known in the art to impart predictable and repeatable performance characteristics to any tire upon which tread 20 is employed. An undertread 23 provides a cushion and/or protective layer between the ground contacting tread and reinforcement 16 in tire carcass 12, thereby ensuring reinforcement 16 is not exposed through the wearing of the grooved tread area.

Tread 20 further incorporates a plurality of longitudinal grooves 22 that may be provided in communication with one or more lateral grooves (not shown) as known in the art. Grooves 22 have a predetermined width delineated by opposing sides 23a of adjacent tread

elements 21. Each groove 22 terminates at a groove trough 22a that is offset by a predetermined distance D from tread bottom face 20b. In retreading operations, this offset distance often corresponds to a thickness of undertread 23 (i.e., the thickness of the undertread of pre-cured tread 20).

A layer of bonding material 24 (such as a cushion gum) may be arranged between bottom tread face 20b and tire carcass 12. Bonding material 24 may be selected from any amenable bonding material, including but not limited to bonding rubber and adhesive. During known cold retreading processes, tires are at least partially encased in flexible covers (or “envelopes”) to create a sealed fluid chamber between the envelope and the tire. The tire and envelope are disposed in an autoclave in which air is pressurized (e.g., from between 1 to 6 bars) to force the new tread (with the bonding layer) against the carcass and thereby achieve a uniform, tight bond and to prevent the formation of porosity in the bonding layer during the vulcanization process. The air is heated to a temperature sufficient to produce the vulcanization reaction of the bonding layer interposed between the tread and carcass.

Because these flexible curing membranes are used to cure numerous retreaded tires, the membranes undergo numerous flexing cycles. This is due to repeated penetration of the grooves and other voids arranged along the tread, which can notably reduce the useful life of the flexible curing membrane. Additionally, the membranes may wear out from exposure to rapidly changing and often elevated temperatures as well as pressure changes.

Therefore, more efficient retreading processes are demanded that obviate consumable curing membranes while ensuring repeatable and predictable manufacture of retreaded tire assemblies.

SUMMARY

A method of forming a retreaded tire from a tire carcass is provided in which the tire carcass has a carcass surface with a preexisting tread. The presently disclosed method includes providing a pre-cured tread having respective top and bottom faces and a predetermined thickness coextensive therewith. The tread also extends between opposing lateral sides, with the top face having one or more integral tread elements for engagement with a tire contact surface and the bottom face having a tread undersurface. The method also includes removing at least a portion of the preexisting tread from the carcass surface. An adhesive is applied to at least one of at least a section of the carcass surface and at least a section of the tread undersurface, such that the adhesive is applied in a predetermined pattern.

The method further includes arranging a section of the pre-cured tread corresponding to a selected carcass section in contact with the adhesive. A polymerization process of the adhesive is initiated, wherein initiating the process includes collapsing the adhesive and spreading the adhesive thereby. Upon waiting, polymerization of the adhesive attains a predetermined handling strength along an interface of the pre-cured tread and the carcass. In some embodiments, an adhesive is selected from a group of cyanoacrylate adhesives.

In some embodiments, the presently disclosed method may include at least one of preparing at least a portion of a tread undersurface of the pre-cured tread, wherein the preparing includes at least one of texturing, roughening and buffing; indexing the carcass subsequent to each application of adhesive; repeating one or more of the applying, the arranging, the initiating and the waiting until the pre-cured tread adheres to an entire extent of the carcass surface; and forming a joint at an interface between lateral sides of adjacent pre-cured treads adhered with the carcass surface.

In additional embodiments, a freely disposed portion of the pre-cured tread is retracted and the adhesive is applied on a subsequent section of the pre-cured tread. The carcass may be indexed such that the predetermined pattern of adhesive comprises consecutively applied lines that are parallel and have a predetermined spacing therebetween.

In some embodiments, the presently disclosed method includes providing one or more kits. Each kit includes at least one of one or more pre-cured treads; one or more corresponding tire carcasses, wherein any selected pre-cured tread may be interchangeable with at least one non-selected pre-cured tread for use with a commensurate selected carcass; at least one adhesive; and a mobile device pre-loaded with one or more software applications.

Other aspects of the presently disclosed invention will become readily apparent from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The nature and various advantages of the presently disclosed invention will become more apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

FIG. 1 shows an exemplary retread tire assembly as known in the art.

FIG. 2 shows a flow chart describing an exemplary method of forming a retreaded tire.

FIGS. 3 and 4 are front perspective views of a retreaded tire wherein the components are subject to adhesion in accordance with an embodiment of the presently invention.

FIG. 5 is a front perspective view of an assembled retreaded tire produced by an embodiment of the presently disclosed invention.

DETAILED DESCRIPTION

Reference now will be made in detail to embodiments of the presently disclosed invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation and not by limitation. It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit thereof. For instance, features illustrated or described as part of one embodiment can be used with one or more other embodiments to yield at least one further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

Particular embodiments contemplate methods of forming a retreaded tire and one or more retreaded tire assemblies formed thereby. One or more of such methods include arranging a pre-cured tread annularly around an outer circumference of an annular tire carcass. The tread includes a pair of opposing tread edges laterally-spaced to define a width of the pre-cured tread. The annular tire carcass comprises a pair of sidewalls spaced apart in an axial direction of the tire, each of the pair of sidewalls extending radially inward from an undertread portion to a bead portion. The outer side of an unbonded retreaded tire may also be described as having a first lateral portion and a second lateral portion, which are spaced apart and arranged on opposing axial sides of the tire. Accordingly, the first lateral portion includes a first sidewall and associated bead portion and the second lateral portion includes a second sidewall and associated bead portion. The width or widthwise direction of the tread extends perpendicular to a length of the tread, which ultimately extends around the outer circumference of the tire in an assembly, where the lengthwise and widthwise directions both extend perpendicular to each other and to a thickness of the tread, which extends in a radial direction of the tire in the assembly.

Now referring to the figures, wherein like numbers represent like elements, a user can initiate an exemplary method 100 for forming a retreaded tire as provided by FIG. 2. As used herein, a “user” may be a single user or a group of users and may refer to any electronic

apparatus configured for receiving control input and configured to send commands or data either interactively or automatically to other devices (including but not limited to user devices, client devices, network-connected devices and devices). As used herein, the term “process” or “method” may include one or more steps performed at least by one electronic or computer-based apparatus. Any sequence of steps is exemplary and is not intended to limit methods described herein to any particular sequence, nor is it intended to preclude adding steps, omitting steps, repeating steps or performing steps simultaneously.

A user initiates method 100 at 102 and proceeds to 104, at which step a carcass 200 is prepared for a retreading operation by removing at least a portion of the carcass's preexisting tread. The preexisting tread is removed to a desired depth, for example by performing a buffing or abrading operation. Buffing may be accomplished by one or more buffing or abrasion tools as known in the art. Such buffing or abrasion tools may include, but are not limited to, cylindrical cutters (or “peelers”) and abrading devices such as rasps, grinding wheels and wire brushes. The material that is removed from the tire to be retreaded creates waste that is discarded and then replaced with new material that is bonded to the tire carcass during the retreading process. Step 104 may include mounting carcass 200 on at least one mounting and inflation post (not shown) as is known in the art. The carcass is optionally inflated, for example, to a range from about 10 psi to about 20 psi. It is understood that carcass 200 is not limited to any particular tire configuration and may be selected from any pneumatic tire configuration as well as any non-pneumatic tire (e.g., such as disclosed by co-owned U.S. Patent Nos. 7,201,194, 7,650,919 and 7,418,98, the entire disclosures of which are incorporated by reference herein).

Tire carcass 200 is of similar original tread design to a pre-cured tread sculpture of tread 202. Carcass 200 and tread 202 may each have a configuration similar to that of respective tread 20 and carcass 12 shown in FIG. 1 (although it is understood that the tread sculpture is not limited to any particular tread type, e.g., treads that comprise blocks, treads that comprise ribs, etc.). It is understood that any tread configuration (i.e., any combination of grooves, ribs, sipes and other tire features as is known in the art) and any carcass configuration may be employed that is amenable with practice of the presently disclosed invention.

In step 106, one or more pre-cured treads are provided for assembly with corresponding tire carcasses. In method 100, any selected pre-cured tread may be interchangeable with at least one non-selected pre-cured tread so long as either tread is

amenable for use with a commensurate selected carcass. The present disclosure contemplates grouping one or more pre-cured tread configurations in a kit. Step 106 may include providing one or more such kits having at least one pre-cured tread and optionally having at least one or more corresponding carcasses with which a selected tread may be combined to provide a retreaded tire assembly. The pre-cured treads may be pre-manufactured in small or mass quantities as needed. In this manner, an extensive selection of tread and carcass combinations may be made available that are suitable for standard and customizable retread operations.

At step 108, an adhesive is applied through a precision adhesive doser and nozzle (not shown) to one or more of a carcass surface 200a and a tread undersurface 204. Step 110 may include applying the adhesive in a bead-like manner on carcass surface 200a. The adhesive may be applied over a section of carcass surface 200a corresponding to a predetermined portion of the length of tread undersurface 204. The adhesive is deposited in a predetermined pattern as dictated not only by the selected carcass and pre-cured tread but also by the surface texture of each. In this manner, the adhesive, prior to polymerization, preserves an interface between carcass 20 and pre-cured tread 202. For example, in some embodiments, a predetermined pattern may comprise adhesive lines 205 that are coextensive with a buffed area of the carcass and applied over a tread section corresponding to about 12" along tread undersurface 204. In such embodiments, the adhesive is deposited in consecutive parallel lines 205 having predetermined spaces 207 therebetween.

The adhesive is desirably selected from, but not limited to, a group of cyanoacrylate adhesives that permit retreading at room temperature and pressure (examples of which include those adhesives sold under the mark CYBERBOND). Cyanoacrylate adhesives are medium viscosity adhesives that exhibit fast setting properties with a wide range of substrates. Such adhesives provide thermal resistance when bonding rubbers and exhibit desirable ageing and strength properties. The selected cyanoacrylate as employed herein is used to bond solid substrates rather than as a surface preparation that enables adhesion of urethane to rubber, for example. It is understood, however, that any commensurate adhesive may be employed that is conducive to successful practice of the presently disclosed invention. In step 110, and as further shown in FIG. 3, a selected pre-cured tread 202 is arranged relative to a tire carcass 200. Step 110 may include preparing at least a portion of a tread undersurface 204 for bonding before pre-cured tread 202 is assembled with carcass 200. For example, tread undersurface 204 may be textured or roughened so that contaminants and

foreign matter (including mold release agents) are removed, thereby facilitating sufficient adhesion and bonding of the tread to the tire carcass. One known texturing process uses a brush or abrasive roller, as disclosed by co-owned U.S. Patent No. 8,303,371 (the entire disclosure of which is incorporated by reference herein). Additional adhesion benefits may be derived from a macroroughness created upon buffing tread undersurface 204 as disclosed by co-owned and co-pending PCT application no. PCT/US14/54466 filed 8 September 2014, the entire disclosure of which is incorporated by reference herein. It is understood that the presently disclosed invention is amenable for practice with numerous existing texturing processes without requiring deviation therefrom.

At step 112, a section 202a of pre-cured tread 202 corresponding to carcass section 202a is disposed in contact with adhesive lines 205a. Pressure is deliberately applied to collapse adhesive lines 205a thereunder and spread the adhesive, thereby ensuring uniform coverage at the interface between carcass section 202a and commensurate tread section 200a. The collapse of adhesive lines 205 initiates a polymerization process of the adhesive in a controlled manner. Step 112 may optionally include the use of a vacuum and a membrane as is known in the retreading arts, except that the present disclosure eliminates thermal cycle repeatability.

Pressure may be applied (as indicated by arrow B shown in FIGS. 3 and 4) by a device that is contoured to the tread sculpture and loaded with a vertical force. For example, pressure may be applied by a device that embodies a negative of tread elements of pre-cured tread 202 (e.g., a device including but not limited to a conforming and compliant pressure pad, an inert, a bag and equivalent devices). After collapsing and spreading the adhesive along the interface, sufficient pressure is maintained therealong in order to immobilize this portion of the tread-carcass assembly. This pressure does not affect the curing of the adhesive but rather restricts movement of the substrates until the adhesive is sufficiently polymerized.

At step 114, a sufficient time elapses to achieve a handling strength at an interface of the pre-cured tread and the carcass. In some embodiments, the handling time is at or about 20 minutes at room temperature and pressure. During step 114, it is critical to maintain the interface between carcass 200 and pre-cured tread 202. A pre-set humidity level from about 50% to 70% should therefore be preserved during step 114. Step 114 may include curing of the adhesive to its handling strength (established by the adhesive manufacturer) for each glued section.

At step 116, the combination of carcass 200 and tread 202 is observed to determine if a completed retreaded tire assembly is obtained. If not, at step 118, carcass 200 is desirably indexed (indicated by arrow A in FIGS. 3 and 4) subsequent to the application of each line 205 so as to achieve predictable spacing between consecutive lines. Indexing may be effected by a translation device as known in the art to effect predictable and controllable rotation of carcass 200 thereby. For example, a rotation platform may be provided in communication with the mounting and inflation post, although it is understood that any other amenable translation device may be utilized.

Indexing of carcass 200 is desirably controllable (for example, as directed by a programmable logic controller or like device) so that the same angular rotation is effected between line applications. For example, in some embodiments, carcass 200 may be indexed such that consecutively applied lines 205 are parallel and have a predetermined spacing spaced by 10mm. In such embodiments, the rate of application of adhesive is at or about 0.23mg/mm^2 . In some embodiments, the spacing is modifiable so as to accommodate sufficient adherence of pre-cured tread to carcass surface 200a. For example, a space of 10mm between a pair of lines 205a may be followed by a space of 15mm between an adjacent pair of lines 205. Alternatively, the spacing between lines 205 may follow a predetermined pattern. For example, a set of three consecutive spacings at 10mm each may be followed by one or more sets of spaces of 5mm each and thereafter followed by another like set of spaces at 10mm each.

At step 120, a freely disposed portion of pre-cured tread 202 is folded back to expose an intersection of the tread and carcass. Step 120 may include retracting at least a portion of the affected rubber, applying the adhesive on a subsequent section, folding the pre-cured tread to collapse the adhesive for that subsequent section and proceeding until the entire extent of a tire carcass has a pre-cured tire tread adhered thereto. Each section may be of a limited predetermined length. In some embodiments, each section may have a length up to about 12". In some embodiments, each section may have a length from about 12" to about 18". Step 120 includes ensuring the stability of each arranged tread section relative to carcass 200 prior to arrangement of a subsequently arranged tread section. After step 120, steps 108 to 114 are repeated as necessary (i.e., one or more successive steps of adhesive lines may be applied and pressure controllably applied thereto as described herein) until the entirety of tread-undersurface 204 adheres to carcass surface 200a.

When a completed assembly 225 is attained as shown in FIG. 5, and a sufficient number of retreaded assemblies are produced, the method terminates at 124. In some exemplary embodiments of method 100, and before termination thereof, optional step 122 is performed, during which step a joint 230 is optionally formed by an interface between opposing lateral sides 202b of adjacent pre-cured treads 202. The forming of joint 230 is dependent upon a selected carcass configuration and is therefore not an essential element of this presently disclosed method.

It is understood that the presently disclosed exemplary methods are exemplary and may include different and/or additional steps. It is also understood that these steps are not restricted to performance in any particular order and that these steps may be varied without departing from the scope of the presently disclosed invention.

EXAMPLE

A commercially viable adhesive was proposed that exhibits initial green strength and covalent cure near room temperature. The selected cyanoacrylate combines initial contact adhesion with molecular interlocking into carcass and tread with a fast room temperature curing reaction without a reaction by-product. Two tire tread sections were tested having a tread adhesively applied as follows:

	Tire 1	Tire 2
Size	275 80 R22.5	275 80 R22.5
Unopened Cyanoacrylate 2245 bottle weight	62.1g	61.8g
After use weight	34.0g	39.2g
Adhesive Consumption	28.1g	22.6g
Sector weight	851.3g	847.7g
Adhesive weight on sector	23.0g	15.4g
Spacing between adhesive lines	10mm	15mm
Pressure method	envelope under vacuum	envelope under vacuum
Time under pressure	40 minutes	40 minutes
Ambient temperature	73°	73°
Relative humidity	63%	63%
Test speed	80 kph	80 kph
Initial test load	1000 kg	1000kg
Final test load	2500kg (Tire Rating = 2800kg)	2500kg (Tire Rating = 2800 kg)
Distance before separations	27,200 km	27,200 km

By the time the above tests were completed, tires having tread sectors attached with cyanoacrylate ran for 27,000 km on machine drum incremental load tests reaching 90% of the rated load. It is therefore seen that a viable adhesive process can replace a vulcanization process and thereby optimize energy consumption. Obviation of envelopes and associated autoclaves in some retread processes can reduce fiscal and temporal costs while attaining beneficial rolling resistance and carcass endurance properties in the resultant retreaded tire.

In one or more associated methods of retreading one or more tires, at least one pre-cured tread may be employed. In such methods, any selected pre-cured tread may be interchangeable with at least one non-selected pre-cured tread suitable for combination with a selected carcass. The present disclosure contemplates grouping one or more pre-cured treads in a kit that may optionally include at least one selected adhesive that is interchangeable with at least one other non-selected adhesive. The pre-cured treads may be pre-manufactured in small or mass quantities as needed so that an extensive selection of retread assemblies may thereby be made available.

It is understood that the present disclosure contemplates one or more systems that incorporate one or more associated methods as presently disclosed herein. Each such system may include a plurality of pre-assembled retread posts with each retread post being pre-tuned to facilitate proper adhesive application relative to one or more selected tire carcasses. Each such system may accommodate indexing of a carcass and/or adhesive application according to a retread assembly recipe selected from a plurality of retread assembly recipes as disclosed herein. Two or more retread posts may perform identical steps in accordance with current production requirements to support modularity of production capacity.

The presently disclosed invention may be practiced in concert with one or more networked devices, *e.g.*, in a cluster or other distributed computing system. The network may be a LAN, a WAN, a SAN, a wireless network, a cellular network, radio links, optical links and/or the Internet, although the network is not limited to these network selections. Accompanying interactive software applications may be downloaded on a local computer or uploaded from a remote site onto a mobile device. Instructions for use of the software applications may also be included along with resources for accessing any remote platforms that provide one or more users with an interface for collaboration with others. It is contemplated that a mobile device may be employed that has the software applications pre-loaded for ready use. Such a mobile device may be included with a kit as contemplated herein.

A server may be further configured to facilitate communication between at least one retread post as presently disclosed and one or more of the networked devices. A database may be built and accessed that includes stored data (e.g., tire types and sizes, availability of pre-cured treads, available adhesives, pressure, temperature, humidity, etc.) and calculated data forecasts that can be generated for intended tire integrity.

It is further understood that the presently disclosed methods are contemplated for use on tires that have previously been subject to one or more retread processes, either as disclosed herein or according to one or more other amenable retreading methods. It is understood, however, that the presently disclosed methods may be employed on tires that have never been retreaded. The presently disclosed invention may be utilized in association with retreaded heavy duty truck or trailer tires and any other tire type, including but not limited to light truck, off-road, ATV, bus, aircraft, agricultural, mining, bicycle, motorcycle and passenger vehicle tires.

Selected combinations of aspects of the disclosed technology correspond to a plurality of different embodiments of the present invention. It should be noted that each of the exemplary embodiments presented and discussed herein should not insinuate limitations of the present subject matter. Features or steps illustrated or described as part of one embodiment may be used in combination with aspects of another embodiment to yield yet further embodiments. Additionally, certain features may be interchanged with similar devices or features not expressly mentioned which perform the same or similar function.

The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as “40 mm” is intended to mean “about 40 mm.” Also, the dimensions and values disclosed herein are not limited to a specified unit of measurement. For example, dimensions expressed in English units are understood to include equivalent dimensions in metric and other units (e.g., a dimension disclosed as “1 inch” is intended to mean an equivalent dimension of “2.5 cm”).

As used herein, the term “method” or “process” refers to one or more steps that may be performed in other ordering than shown without departing from the scope of the presently disclosed invention. As used herein, the term “method” or “process” may include one or more steps performed at least by one electronic or computer-based apparatus. Any sequence of steps is exemplary and is not intended to limit methods described herein to any particular

sequence, nor is it intended to preclude adding steps, omitting steps, repeating steps, or performing steps simultaneously. As used herein, the term "method" or "process" may include one or more steps performed at least by one electronic or computer-based apparatus having a processor for executing instructions that carry out the steps.

The terms "a," "an," and the singular forms of words shall be taken to include the plural form of the same words, such that the terms mean that one or more of something is provided. The terms "at least one" and "one or more" are used interchangeably. Ranges that are described as being "between a and b" are inclusive of the values for "a" and "b."

Every document cited herein, including any cross-referenced or related patent or application is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document is not an admission that it is prior art with respect to any invention disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests or discloses any such invention. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern.

While particular embodiments of the disclosed apparatus have been illustrated and described, it will be understood that various changes, additions and modifications can be made without departing from the spirit and scope of the present disclosure. Accordingly, no limitation should be imposed on the scope of the presently disclosed invention, except as set forth in the accompanying claims.

CLAIMS

WHAT IS CLAIMED IS:

1. A method of forming a retreaded tire from a tire carcass having a carcass surface with a preexisting tread comprising:
 - providing a pre-cured tread having respective top and bottom faces and a predetermined thickness coextensive therewith, the tread also extending between opposing lateral sides, with the top face having one or more integral tread elements for engagement with a tire contact surface and the bottom face having a tread undersurface;
 - removing at least a portion of the preexisting tread from the carcass surface;
 - applying an adhesive to at least one of at least a section of the carcass surface and at least a section of the tread undersurface, such that the adhesive is applied in a predetermined pattern;
 - arranging a section of the pre-cured tread corresponding to a selected carcass section in contact with the adhesive;
 - initiating a polymerization process of the adhesive, wherein the initiating includes collapsing the adhesive to spread the adhesive thereby; and
 - waiting until polymerization of the adhesive attains a predetermined handling strength along an interface of the pre-cured tread and the carcass.
2. The method of claim 1, further comprising at least one of:
 - preparing at least a portion of a tread undersurface of the pre-cured tread, wherein the preparing includes at least one of texturing, roughening and buffing; indexing the carcass subsequent to each application of adhesive;
 - repeating one or more of the applying, the arranging, the initiating and the waiting until the pre-cured tread adheres to an entire extent of the carcass surface; and
 - forming a joint at an interface between lateral sides of adjacent pre-cured treads adhered with the carcass surface.
3. The method of claim 2, wherein a freely disposed portion of the pre-cured tread is retracted and the adhesive is applied on a subsequent section of the pre-cured tread.

4. The method of claim 2 or claim 3, wherein the carcass is indexed such that the predetermined pattern of adhesive comprises consecutively applied lines that are parallel and have a predetermined spacing therebetween.

5. The method of claim 4, wherein the consecutively applied lines have a predetermined spacing at or about at least 10mm and the adhesive is applied at a rate of application at or about 0.23mg/mm^2 .

6. The method of any of claims 1 to 5, wherein the removing is effected by at least one of buffing and abrading.

7. The method of any preceding claim, wherein the section of the pre-cured tread has a length of up to about 12".

8. The method of any of claims 1 to 6, wherein the section of the pre-cured tread has a length from about 12" to about 18".

9. The method of any preceding claim, wherein at least one of the arranging and the initiating includes applying pressure by at least one device that is contoured to the tread elements of the pre-cured tread.

10. The method of any preceding claim, wherein the preexisting tread has a tread design commensurate with a pre-cured tread sculpture of the pre-cured tread.

11. The method of any preceding claim, wherein indexing is effected by a rotation platform.

12. The method of any preceding claim, further comprising providing one or more kits comprising at least one of:

one of one or more pre-cured treads;

one or more corresponding tire carcasses, wherein any selected pre-cured tread may be interchangeable with at least one non-selected pre-cured tread for use with a commensurate selected carcass;

at least one adhesive; and
a mobile device pre-loaded with one or more software applications.

13. The method of any preceding claim, wherein an adhesive is selected from a group of cyanoacrylate adhesives.

14. The method of any preceding claim, wherein the waiting includes preserving a pre-set humidity level from about 50% to about 70%,

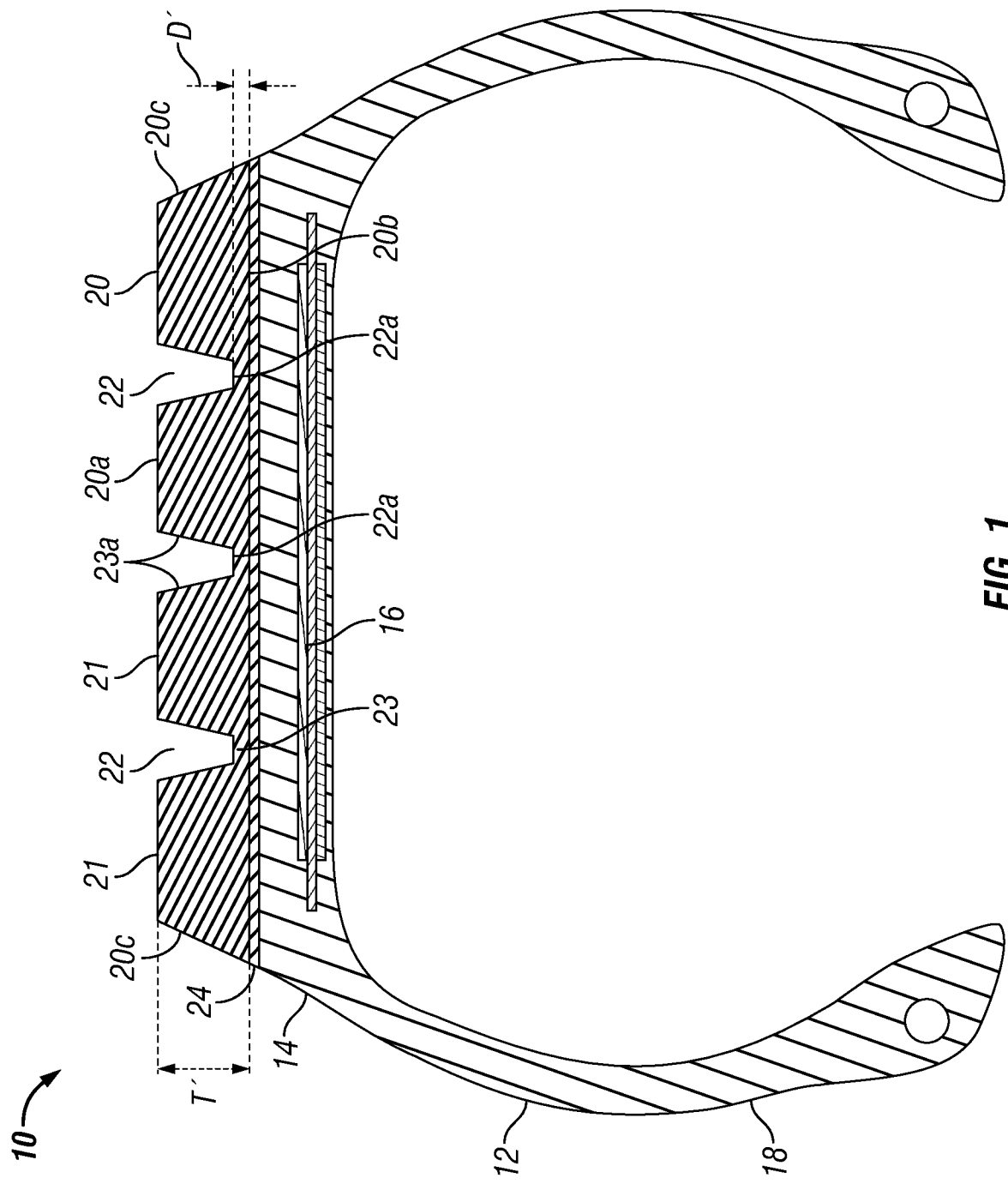


FIG. 1
(Prior Art)

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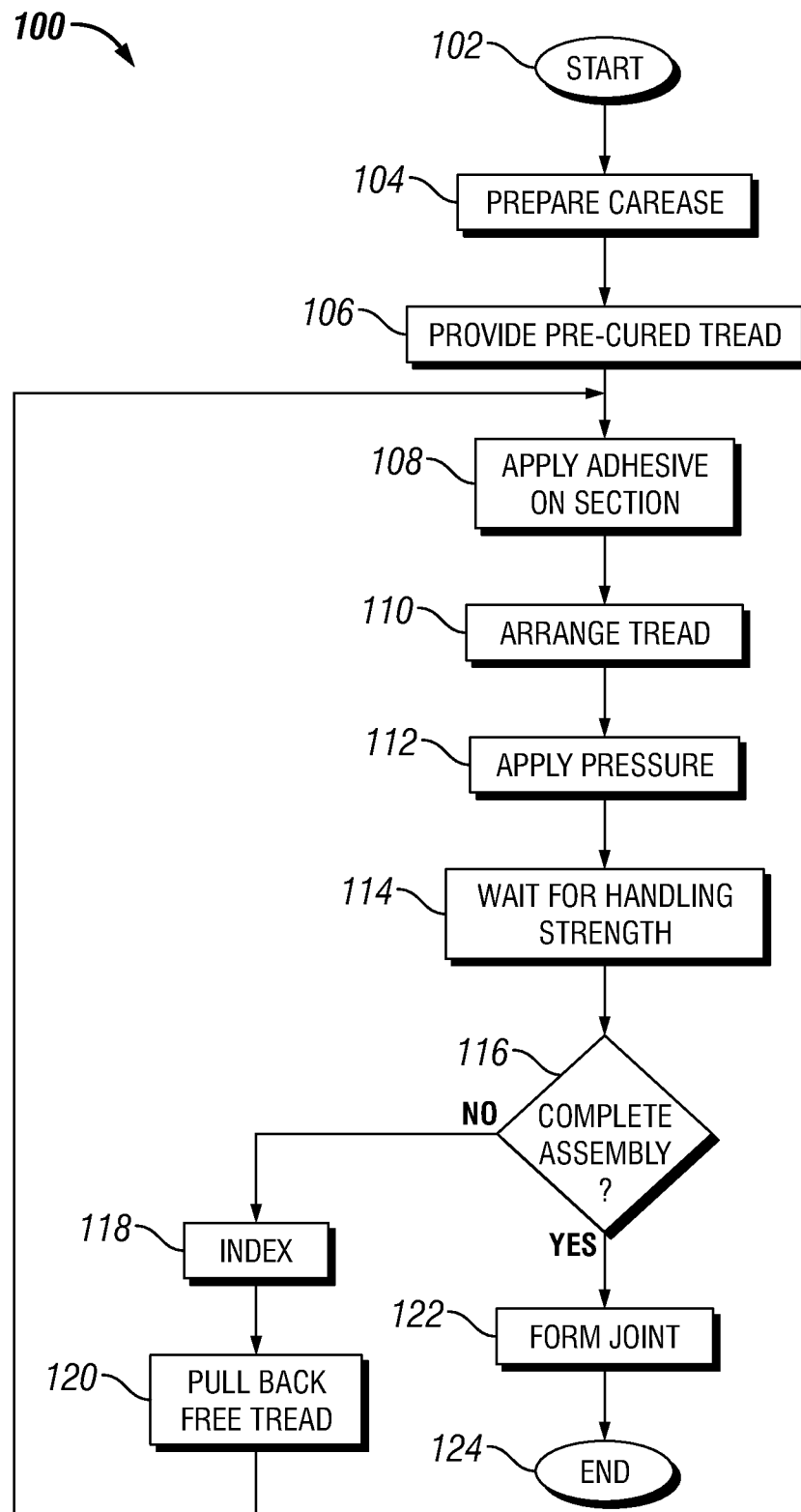


FIG. 2

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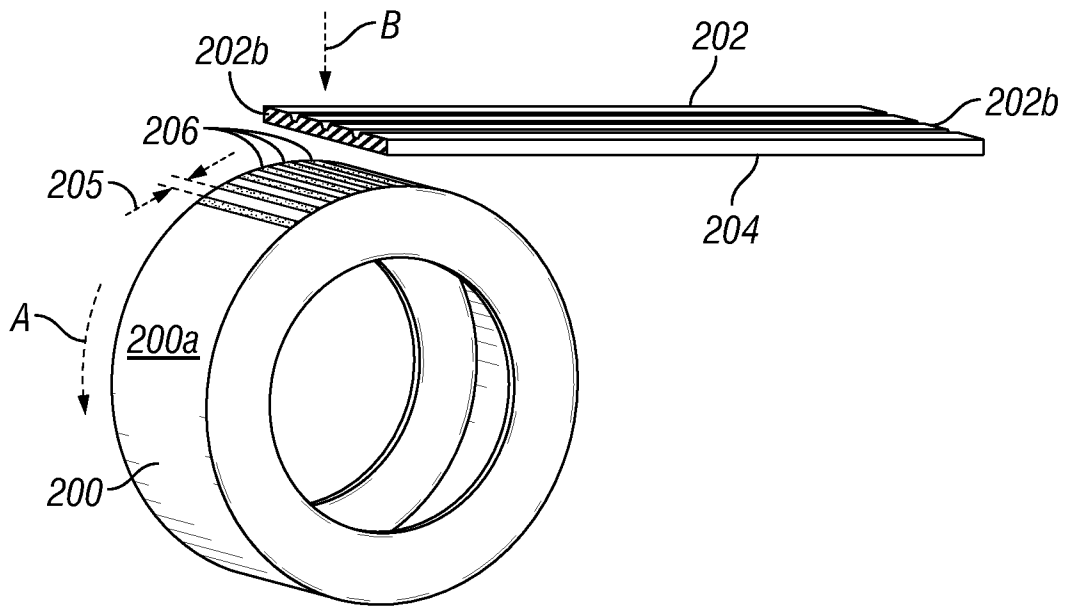


FIG. 3

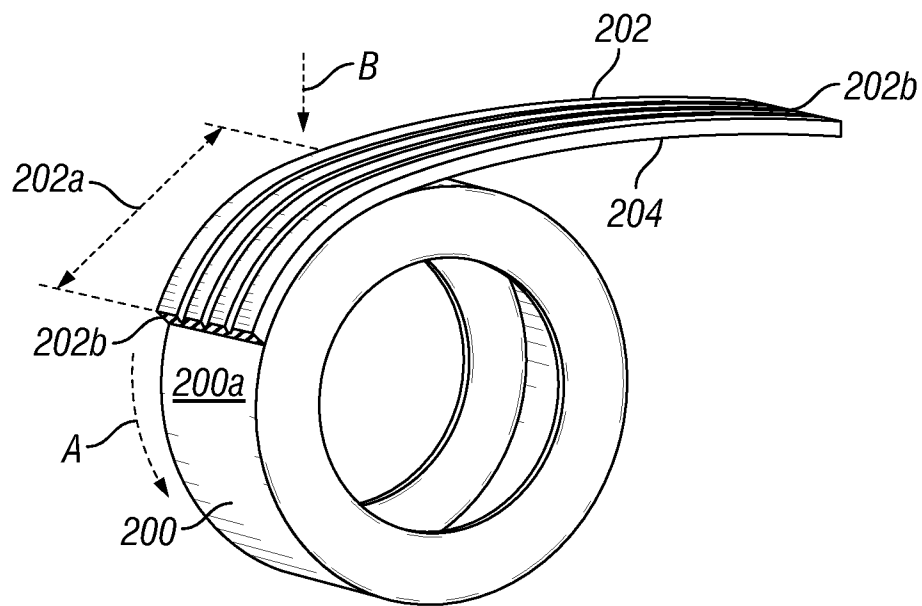


FIG. 4

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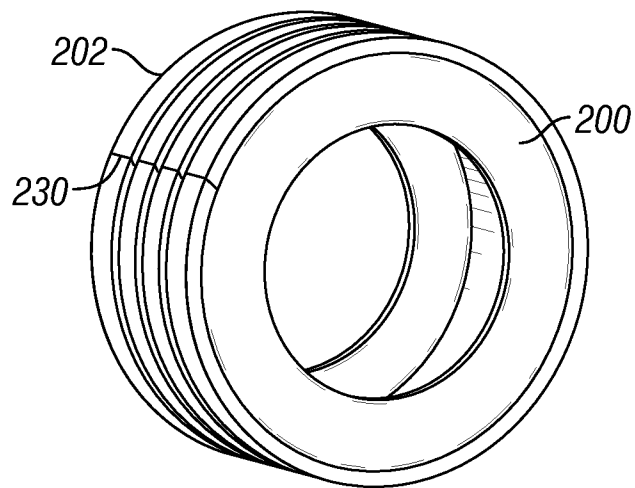


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/034918

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29D30/56
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)
B29D

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)

EP0-Internal

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Y	page 2, lines 9-19; figures page 24, line 19 - page 25, line 14 page 27, paragraph 1 - paragraph 2; claims 1,2	11, 12
Y	----- WO 2014/070173 A2 (MICHELIN & CIE [FR]; MICHELIN RECH TECH [CH]; PAN CHINGLIN [US]; CRESS) 8 May 2014 (2014-05-08) paragraph [0018] - paragraph [0020]	11, 12
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Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

2 August 2016

Date of mailing of the international search report

12/08/2016

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/034918

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Y	EP 0 715 948 A1 (EDLER KURT [AT]) 12 June 1996 (1996-06-12) claim 1; figure 2a -----	11,12
Y	WO 2015/047340 A1 (MICHELIN & CIE [FR]; MICHELIN RECH TECH [CH]; COLBY E BRUCE [US]; ZARA) 2 April 2015 (2015-04-02) claim 16; figures -----	11,12

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International application No

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