The tread-casing combination can be made in such a way as to improve one or more performance properties of a final tire. These performance characteristics can be individually selected, providing a more individualized manufacturing process.

The components and raw materials for the casings are pre-selected to optimize performance characteristics, such as strength and durability. These materials are then cured separately to ensure proper rigidity and flexibility. The cured treads are then combined with the casings to form the final tire.

This decentralized manufacturing method allows for improved performance and flexibility in the tire manufacturing process, enabling the creation of tires with tailored characteristics.

FIG. 8

---

**Title:** SYSTEM AND METHOD FOR DECENTRALIZED MANUFACTURE OF NEW TIRES ENABLING IMPROVED PERFORMANCE CHARACTERISTICS

**Abstract:** Systems and methods for decentralized tire manufacturing permit the pre-selection of properties of a new casing (90) by individually selecting properties of the casing (90). The components and raw materials are pre-selected to provide improved and individualized performance characteristics when combined with separately-manufactured new cured treads (140). The new cured treads (140) are manufactured separately in such a manner that pre-selected processing and raw materials may be used to selectively improve performance characteristics. The pre-selected materials and processing used in the separate manufacture of the cured treads (140) from the casing (90) are chosen so as to provide an improved final result that is coordinated through the pre-selections. In this manner, a final tread-casing combination can be made in such a way as to improve one or more performance properties of a final tire.
SYSTEM AND METHOD FOR DECENTRALIZED MANUFACTURE OF NEW TIRES
ENABLING IMPROVED PERFORMANCE CHARACTERISTICS

BACKGROUND OF THE INVENTION

[0001] A new tire is constructed from many separate components including typically a tread, subtread, undertread, reinforcing belts or belt plies, sidewalls, abrasion strips, beads, bead fillers, one or more body plies and a relatively air-impermeable inner liner. The components are themselves constructed from different raw materials such as different rubber compounds, fibrous cords, steel belts, etc. The rubber compounds are typically made of differing formulations including different natural and synthetic rubbers and chemical additives. Such rubber compounds and the other raw materials used in the components have different physical properties that can affect the performance of the new tire. Further, such physical properties often change as a result of the manufacturing process used with the development of the rubber compounds and in the forming and curing of the new tire.

[0002] The components of a new tire are conventionally brought together on a tire builder. A new tire is typically built on a drum by first wrapping the drum with the inner liner. The first body ply is then wrapped on top followed by the second body ply. The bead assemblies are then brought into position on the outside of the inner liner and body plies. The inner liner and the body plies are then typically forced to roll over onto the bead assemblies. The sidewalls are also pressed into position.

[0003] Next, steel belts, a nylon cap ply, a tread, etc. are applied to the assembly. The tread also may have associated with it, a subtread and an undertread. The final assembly forms a green tire. The green tire is then subjected to heat and pressure which causes a chemical reaction between the rubber and the additives to vulcanize the rubber and bond the assembly together. As an assembly of different materials and compounds, each component affects the final properties of the new tire.

[0004] As a result of the variation in new tire performance characteristics that occurs through factors such as the composition of raw materials and the processing and assembly of the tires, the manufacture of tires is typically centralized in a new tire manufacturing plant. By centralizing
the manufacture, the manufacturer is able to maintain control over the assembly of the components into green tires, and the processing and curing of those green tires to form new tires. By controlling the components and the manufacturing process, new tire manufacturers are able to effect changes in performance such as relating to wear, weather performance, rolling resistance, noise, etc. These performance characteristics are subject to multiple variations that are attractive to customers. Since there are many attractive performance characteristics, new tire manufacturers often make many different versions of tires. Further, customers demand different sizing and other physical variations. The result is that the inventory of new tires made at a central manufacturing facility can grow to be very large, in the order of one hundred different versions of tires. Such multiple variations of tires are then delivered to stores where they may be inventoried until they are purchased and installed.

Much work has been done in attempts to improve the efficiency and properties of green tires including the casing of such green tires. However, such processes and methods of manufacturing green tires, and the resultant new tires, have certain limitations including that the green tire is processed and manufactured as a whole. Such prior systems have failed to overcome the inherent limitations that are imputed to the process because some processes are beneficial for some parts of the green tire, but detrimental to others.

Borrowing from the retreading process for worn treads, some have suggested that a retreading process could be applied to a new tire. See, e.g., U.S. Patent Application Publication Nos. US 2009/0183812 ("Universal Body-Support For Pneumatic Tread") and US 2009/0203278 ("Separate Toroidal Body Support For Pneumatic Coverings"). However, such processes do not provide any means for improved performance characteristics. At best, such retreading simply reconstructions an original tire. At worst, such processes might compromise the performance characteristics by mismatching components. Furthermore, such suggestions fail to address or overcome problems that arise in the combinations of treads with varying physical dimensions with a standard casing. No synergies are possible because there is no improvement of properties that are preselected to coincide and amplify individual properties. The result fails to recognize improved performance characteristics and therefore provides further support for the notion that manufacture of new tires should be centralized and carefully controlled. Since there is no preselected improvement process, there is no optimized combination possible that results in a tire
with improved properties. As a result, such efforts tended to develop methods that would lead to
deficient design and manufacture of tires.

**SUMMARY OF THE DISCLOSURE**

[0008] In one embodiment, a decentralized tire manufacturing system is described. A casing
manufacturing facility is adapted to manufacture a set of different types of cured casings. A
tread manufacturing facility is adapted to manufacture a set of different types of cured treads.
An assembly facility is adapted to assemble multiple tread-casing combinations to for new tires
made from the different types of cured casings and the different types of cured treads. Each type
of cured casing is made so as to be specifically made for combination with at least one type of
the set of different types of cured treads to provide a new tire with a desired tire characteristic.

[0009] In another embodiment, a method of decentralized tire manufacturing is described. A
casing is made that has casing properties pre-selected to create a cured casing configured for
combination with at least one type of cured tread. The casing is cured using a first curing profile
to form the cured casing. A tire tread is separately made that has tread properties pre-selected to
create a cured tread configured for combination with the cured casing to form a new tire with a
desired tire characteristic. The tire tread is cured using a second curing profile to form the cured
tire tread. The cured casing and the separate cured tread are delivered to an assembly facility.
The cured casing and the cured tread are combined at the assembly facility to form the new tire
with the desired tire characteristic.

[0010] Further and alternative aspects and features of the disclosed principles will be
appreciated from the following detailed description and the accompanying drawings. As will be
appreciated, the principles related to systems and methods for decentralized tire manufacturing
disclosed herein are capable of being carried out in other and different embodiments, and capable
of being modified in various respects. Accordingly, it is to be understood that the foregoing
general description and the following detailed description is exemplary and explanatory only and
does not restrict the scope of the disclosed principles.
BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0011] FIG. 1 is a graphical schematic representation of an exemplary new casing manufacturing process.

[0012] FIG. 2 is a graphical schematic representation of an exemplary new casing manufacturing process.

[0013] FIG. 3 is a graphical schematic representation of an exemplary new casing manufacturing process.

[0014] FIG. 4 is a graphical schematic representation of an exemplary intermediate, in transverse section, in a new casing manufacturing process.

[0015] FIG. 5 is a graphical schematic representation of an exemplary new casing.

[0016] FIG. 6 is a graphical schematic representation of exemplary new casings.

[0017] FIG. 7 is a graphical schematic representation of exemplary new tread.

[0018] FIG. 8 is a graphical schematic representation of an exemplary new tire manufacturing process including decentralization.

[0019] FIG. 9 is a graphical schematic representation of an exemplary new tire manufacturing process including decentralization.

[0020] FIG. 10 is a graphical schematic representation of an exemplary new tire manufacturing process.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0021] In one exemplary embodiment, a decentralized tire manufacturing process is provided which permits the pre-selection of properties of a new casing by individually selecting properties of the casing. Such pre-selected processing and properties are facilitated by the separate and decentralized manufacture of a green casing. The components and raw materials of the green casing are chosen and assembled under pre-selected conditions that facilitate enhanced performance of a final new tire. The components and raw materials are pre-selected to provide improved and individualized performance characteristics when combined with separately-manufactured new tire treads. The new tire treads are manufactured separately in such a manner that pre-selected processing and raw materials may be used to selectively improve performance characteristics. The pre-selected materials and processing used in the separate manufacture of
the tire treads from the casing are chosen so as to provide an improved final result that is coordinated through the preselections. In this manner, a final combination of tire tread and casing can be made in such a way as to improve one or more performance properties of a final tire.

[0022] To facilitate the improved manufacture of new tires, the manufacturing of the components is decentralized so that treads and casings are brought together for the customer on or near location. The raw materials and the manufacturing processes for the tire treads and the casings are pre-selected and coordinated so that the final improved performance characteristics are quantified and provided to the customer or service representative as part of the selection process for the final tire manufacture.

[0023] Further, the separate manufacture of the tire tread and the casing permits for inventory of the separate new tire components to be maintained. Since the inventory is separately maintained, supply can be controlled based upon the characteristics that are being selected by the customers or service representatives. For example, based on the pre-selection of properties in the separate manufacture of the treads from the casings, the final combination can provide improved performance characteristics that would not be possible if the tread and the casing were not manufactured separately. Further, since the raw materials and the processing for the separate parts are pre-selected to provide complementary predetermined combinations, the ultimate performance characteristics of the tires may be maintained.

[0024] By coordinating the pre-selection of the improved properties of the various components of the new tire, the inventory is controlled to provide for maximum interaction towards improved performance characteristics. As a result of the decentralized manufacture and the pre-selection, the inventory of a given service outlet can be improved so as to reduce unutilized inventory. For example, a given placement of new tires may be chosen to provide a given selection of performance characteristics such as noise, wear, skid, etc. These properties are determined and potentially improved by the manner in which the new tire and its components are manufactured. Manufacturing the tread and the casing separately permits the pre-selected improvement of their respective characteristics. In an exemplary embodiment, the processing and raw materials for the components are pre-selected so that their ultimate combination
provides for a desired improved performance characteristic. Furthermore, the variations of the
pre-selected properties are determined so that the combinations are improved.

[0025] In contrast to typical green tire manufacture, the raw materials and the processing of
an exemplary embodiment includes the selection of raw materials and processing that would be
detrimental to other components of the tire. For example, the vulcanization and curing of a green
tire may be optimized for the casing or the tire tread. Since the optimization of one often results
in some detriment to the other, a unitary green tire is usually cured and vulcanized in a manner
that is a compromise. In an exemplary embodiment, such processing conditions are separately
optimized.

[0026] Further, in an exemplary embodiment, the separate processing is not done entirely
separately, disregarding other processing characteristics and other manufacturing selections, such
as raw materials and other components. Instead, the processing and materials selections are pre-
selected to provide improved combinations with components that are also developed under
preselected conditions. This offers the unexpected and significant advantage that the resulting
new tires are of improved performance characteristics which may be beyond the characteristics
that result from entirely separately manufactured components might offer. As a result, new tires
of an exemplary embodiment have pre-determined improved performance characteristics.

[0027] Turning now to the Figures, there is shown in FIGS. 1 (a, b, c), 2, and 3 an exemplary
embodiment where components 10 of a green casing are placed upon a tire builder 20. The raw
materials for the components are pre-selected on the basis of ultimate combinations with tire
treads that are separately manufactured. As shown in FIG. 1B, multiple components 10 may be
wrapped upon the tire builder 20. As shown in FIG. 1C, a bead 30 is brought into place over the
component assemblage 40 on the tire builder 20. As depicted in FIG. 2, the ends of the
component assemblage 40 are wrapped over the bead 30. Each of the raw materials used in the
component assemblage 40 and the bead materials are pre-selected in order to improve
performance in combination with a separately-manufactured and cured tire tread.

[0028] As depicted in FIG. 3, after the component assemblage is wrapped over the beads
300, the materials are inverted to make a green intermediate 50. The green intermediate then
receives further components such as undertread, reinforcing belts, or belt plies, etc. These
materials for a green casing which is depicted in FIG. 4. The outermost layer 70 of the green
casing 60 between the sidewalls is formed in a pre-selected manner in light of tire treads that will be joined in decentralized manufacture. For example, in one exemplary embodiment the outermost layer 70 of the green casing 80 is provided with a thickness that is much larger than might otherwise be utilized in a new green tire manufacture. Such pre-selection facilitates the improved properties and performance characteristics for the new tire. The thickness may be selected so that depending upon the thickness of the separately manufactured treads, the profile of the tire (i.e., the outer diameter) may be maintained at a predetermined level.

[0029] In tire manufacture, the proper alignment and assembly of the components can be significant so that such pre-selection provides significant advantages relating to feasibility of the final new tire. Specifically, new tire profiles that are inconsistent or fail to meet predetermined specifications can result in unusable tires.

[0030] FIG. 5 is a breakaway of the components of an exemplary embodiment of a casing 90 formed by curing the green casing 80. The casing 90 includes such components as a crown area 100 (where the separately-manufactured cured tread is ultimately located) 92, sidewall areas 80 and bead areas 30. The crown area 95 may include multiple distinct components such as steel belts 94, a nylon cap ply 96, a sub-tread 98 and an undertread 100 for example. The casing 90 also includes a body ply 102 and an inner liner 104. The bead area 30 may include among other components a steel bead bundle 106 and a bead filler 108. These components are selected and processed in a manner preselected to improve performance characteristics when joined with treads separately manufactured.

[0031] In addition to utilization of specialized manufacturing processes such as utilizing increased or decreased curing temperatures and modifying characteristics of the green and final casing, in some embodiments, other characteristics can be modified. For example, as shown in FIG. 6, the outer surface of layer 70 may be specially treated so as to enhance the interrelationship with similarly-treated or compatibly-treated tire treads. The surface 120 of the casing 90 may be a substantially smooth surface 120 or, in other embodiments, have a surface 130 of varying degrees of roughness. In some embodiments, the smooth surface 120 can be converted to the rough surface 130 using an operational step, such as, buffing, for example. Furthermore, other properties can be modified in conjunction with properties from separately manufactured tire treads including surface modifications and other improvements.
FIG. 7 depicts an exemplary tire tread 140, which is itself separately manufactured with preselected materials and processes to optimize ultimate assemblage with one or more casings 90. In particular, the tire tread 140 can, in some embodiments, undergo alternative processing such as vulcanization and curing under different heating parameters and/or with different additives from the green casing. In this manner, properties of the resulting cured tread 104 can be improved, particularly when combined with pre-selected, separately manufactured casings which have been specially-made for combination with that tread (and, in some embodiments, with a set of different types of treads). In addition to pre-selecting processing parameters, the tire tread 140 may include an underside 150 that has modified properties that are pre-selected to complement one or more casings to promote the bonding between the tread and the casing and/or to enhance one or more performance characteristic. Such parameters may include, for example, surfaces of differing roughness determined in relation to the surfaces such as in relation to the casing surfaces 120 and 130.

Referring to FIG. 8, an embodiment of a decentralized, distributed tire manufacturing system 200 is shown. A casing manufacturing facility 210 is configured to make a set of different types of cured casings. Each type of casing can be made so as to be specifically made for combination with at least one type cured tread to provide enhanced performance characteristics, and in some embodiments with a set of different types of cured treads so that when respectively combined with the different types of cured treads, a new tire is obtained with different enhanced performance characteristics. A tread manufacturing facility 220 is configured to make a set of different types of cured treads. Each type of cured tread can be made so as to be specifically made for combination with at least one type of casing to provide enhanced performance characteristics, and in some embodiments with a set of different types of casings so that when respectively combined with the different types of casings, a new tire is obtained with different enhanced performance characteristics. A single manufacturing facility 230 can comprise both a casing manufacturing facility and a tread manufacturing facility 220 for supplying different types of casings and different types of cured treads made specifically so that certain tread-casing combinations result in new tires with enhance performance characteristics. The casings and treads can be configured such that certain types of tire casings are combinable.
with certain types of treads to produce finished tires having customizable performance characteristics.

[0034] The exemplary decentralized tire manufacturing system 200 includes a pair of assembly facilities 240, 250, which are both configured to assemble various tread-casing combinations received from the manufacturing facilities 210, 220, 230 and form new tires therefrom. In some embodiments, on or more of the assembly facilities 240, 250 can be associated with a point-of-sale facility which is in the form of a brick-and-mortar storefront in which a customer can purchase a custom-selected tire for on-demand assembly by the facility using a predetermined tread-casing combination to obtain a new tire with the performance characteristics selected by the customer. In other embodiments, the assembly facility can comprise a regional assembly facility which service a number of point-of-sale facilities.

[0035] In other embodiments, the decentralized tire manufacturing system 200 can include a different number of manufacturing and/or assembly facilities. In still other embodiments, the decentralized tire manufacturing system 200 can include additional facilities as part of the tire supply chain, such as inventory facilities and different kinds of point-of-sale facilities.

[0036] Referring to FIGS. 9 and 10, each assembly facility 240, 250 can include various machines, including a tire builder 270, for example, and skilled technicians 280 that can use a predetermined casing 90 and tread 140 to build a new tire 300 having enhanced performance characteristics obtained by the separate manufacture of the casing and the tread. At each assembly facility 240, 250, the casing 90 and the tread 140 are combined in a process that may include various operations, such as buffing of the crown area 95 of the casing 90 to remove oxidation, deposition of cushion gum on the crown area 95 of the casing 90, fitting, pressing and stitching of the tread 140 around the casing 90, and the like. After the tread 140 and the casing 90 have been assembled, the tread-casing combination can undergo a pressing and vulcanization operation to complete the tire 130. A customer can complete a tire transaction with the point-of-sale facility to receive the finished tire.

[0037] In some embodiments, the outermost layer 70 of the casing 90 can be made of a thickness that is thicker than a subtread of a conventional tire to accommodate tire treads 140 of varying thicknesses. Different types of tire treads 140 can vary in thickness based on certain performance characteristics related to the tread. To ensure that the final tire 300 is the desired
overall size, the outermost layer 70 can be buffed using known buffers to reduce the outer
diameter of the casing to that necessary to combine the casing 90 with the selected tread 140 and
achieve a new tire 300 having a desired outer dimension. Buffing the excess outermost layer 70
additionally exposes a layer of unoxidized rubber which can promote the seal between the tread
140 and the casing 90.

[0038] All references, including publications, patent applications, and patents, cited herein
are hereby incorporated by reference to the same extent as if each reference were individually
and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

[0039] The use of the terms "a" and "an" and "the" and similar referents in the context of
describing the invention (especially in the context of the following claims) are to be construed to
cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted
by context. The terms "comprising," "having," "including," and "containing" are to be
construed as open-ended terms (i.e., meaning "including, but not limited to.") unless otherwise
noted. Recitation of ranges of values herein are merely intended to serve as a shorthand method
of referring individually to each separate value falling within the range, unless otherwise
indicated herein, and each separate value is incorporated into the specification as if it were
individually recited herein. All methods described herein can be performed in any suitable order
unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any
and all examples, or exemplary language (e.g., "such as") provided herein, is intended merely to
better illuminate the invention and does not pose a limitation on the scope of the invention unless
otherwise claimed. No language in the specification should be construed as indicating any non-
claimed element as essential to the practice of the invention.

[0040] Preferred embodiments of this invention are described herein, including the best
mode known to the inventors for carrying out the invention. Variations of those preferred
embodiments may become apparent to those of ordinary skill in the art upon reading the
foregoing description. The inventors expect skilled artisans to employ such variations as
appropriate, and the inventors intend for the invention to be practiced otherwise than as
specifically described herein. Accordingly, this invention includes all modifications and
equivalents of the subject matter recited in the claims appended hereto as permitted by applicable
law. Moreover, any combination of the above-described elements in all possible variations
thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.
What is claimed is:

1. A decentralized tire manufacturing system (200) comprising:
   a casing manufacturing facility (210) adapted to manufacture a set of different types of cured casings (90);
   a tread manufacturing facility (220) adapted to manufacture a set of different types of cured treads (140);
   an assembly facility (240, 250) adapted to assemble multiple tread-casing combinations to form new tires made from the different types of cured casings (90) and the different types of cured treads (140);
   wherein each type of cured casing (90) is made so as to be specifically made for combination with at least one type of the set of different types of cured treads (140) to provide a new tire (300) with a desired tire characteristic.

2. The decentralized, distributed tire manufacturing system (200) according to claim 1, wherein at least one of the different types of cured treads (140) is made so as to be specifically made for combination with at least one other type of the set of different types of cured casings (90) to provide a new tire (300) with a different desired tire characteristic.

3. The decentralized, distributed tire manufacturing system (200) according to claim 1 or claim 2, wherein at least one of the different types of cured casings (90) is made so as to be specifically made for combination with at least one other type of the set of different types of cured treads (140) to provide a new tire (300) with a different desired tire characteristic.
4. The decentralized, distributed tire manufacturing system (200) according to any one of claims 1 to 3, wherein at least one type of the different types of cured casings (90) includes cured casings (90) with an outer circumferential surface layer (70) treated so as to enhance the interrelationship with at least one type of the different types of cured treads (140), said cured treads (140) including an underside (150) similarly-treated or compatibly-treated with respect to the outer circumferential layer of the cured casing (90).

5. The decentralized, distributed tire manufacturing system (200) according to any one of claims 1 to 4, wherein at least one type of the different types of cured treads (140) includes tire treads having an underside (150) with modified properties that are pre-selected to complement at least one type of the different types of cured casings (90) to promote the bonding between the cured tread (140) and the cured casing (90) in a given tread-casing combination.

6. The decentralized, distributed tire manufacturing system (200) according to any one of claims 1 to 5, wherein at least one type of the different types of cured casings (90) is made so as to be specifically made for combination with at least one type of different types of cured treads (140) to provide a new tire with a desired tire characteristic, wherein said cured treads (140) include at least one different additive from said cured casings (90).

7. A method of decentralized tire manufacturing comprising:
   making a casing (90) having casing properties pre-selected to create a cured casing (90) configured for combination with at least one type of cured tread (140);
   curing the casing (90) using a first curing profile to form the cured casing (90);
   separately making a tire tread (140) having tread properties pre-selected to create a cured tread (140) configured for combination with the cured casing (90) to form a new tire with a desired tire characteristic;
   curing the tire tread (140) using a second curing profile to form the cured tire tread (140);
   delivering the cured casing (90) and the separate cured tread to an assembly facility;
   combining the cured casing (90) and the cured tread (140) at the assembly facility (240, 250) to form the new tire with the desired tire characteristic.
8. The method of decentralized tire manufacturing according to claim 7, further comprising:
   treating an outer circumferential surface layer (70) of the casing (90) so as to enhance the interrelationship of the cured casing (90) with the cured tread (140).

9. The method of decentralized tire manufacturing according to claim 7 or claim 8, wherein the tread (140) is made with an underside (150) having modified properties that are pre-selected to promote the bonding between the cured tread (140) and the cured casing (90).

10. The method of decentralized tire manufacturing according to any one of claims 7 to 9, wherein the tread (140) is made with at least one different additive from the casing (90).

11. The method of decentralized tire manufacturing according to any one of claims 7 to 10, wherein the casing (90) is made with at least one different additive from the tread (140).

12. The method of decentralized tire manufacturing according to any one of claims 7 to 11, wherein the first curing profile is different than the second curing profile.

13. The method of decentralized tire manufacturing according to any one of claims 7 to 12, wherein at least one of the first curing profile and the second curing profile comprises zoned curing.

14. The method of decentralized tire manufacturing according to any one of claims 7 to 13, further comprising:
   after delivering the cured casing (90) and the separate cured tread (140) to the assembly facility and before combining the cured casing (90) and the cured tread (140) at the assembly facility, buffing an outer circumferential surface layer of the casing (90) to form a textured surface.

15. The method of decentralized tire manufacturing according to any one of claims 7 to 14, wherein the cured casing (90) and the cured tread (140) are combined at the assembly facility to form the new tire with the desired tire characteristic in response to an order from a customer through a point-of-sale facility (240, 250).
## A. CLASSIFICATION OF SUBJECT MATTER

**B29D 30/20(2006.01)i, B29D 30/08(2006.01)1, B29D 30/52(2006.01)1**

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 30/20; B29D 30/38; B29C 59/14; B29D 30/00; B29D 30/60; B29C 33/02; B29D 30/08

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 database consulted during the international search (name of database and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: decentralized, tire, casing, facility, tread, assembly, interrelationship, modify

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>See abstract; claims 1-13; figure 1.</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>KR 20-0395389 Y1 (KUMHO TIRE CO., INC.) 8 September 2005</td>
<td>8,9</td>
</tr>
<tr>
<td>A</td>
<td>See abstract; claim 1.</td>
<td>1-3,7</td>
</tr>
<tr>
<td>A</td>
<td>JP 11-227065 A (BRIDGESTONE CORP.) 24 August 1999</td>
<td>1-3,7-9</td>
</tr>
<tr>
<td>A</td>
<td>See abstract; claim 1.</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>See abstract; claim 1.</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>EP 1106335 B1 (THE YOKOHAMA RUBBER CO., LTD.) 22 September 2004</td>
<td>1-3,7-9</td>
</tr>
<tr>
<td></td>
<td>See abstract; claim 1.</td>
<td></td>
</tr>
</tbody>
</table>

* 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 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

15 May 2013 (15.05.2013)

### Date of mailing of the international search report

15 May 2013 (15.05.2013)

### Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
189 Cheongsar-ri, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

### Authorized officer

HONG, Sung Ran

### Telephone No. 82-42-481-5405

Form PCT/ISA/210 (second sheet) (July 2009)
**INTERNATIONAL SEARCH REPORT**

**Box No. II** Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. □ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ● Claims Nos.: 4-6, 10-15
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III** Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

- □ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- □ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- □ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>WO 2006-048924 A1</td>
<td>11.05.2006</td>
<td>DE 112004003006 T5</td>
<td>11.10.2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 4523601 B2</td>
<td>11.08.2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2009-01 33808 A1</td>
<td>28.05.2009</td>
</tr>
<tr>
<td>KR 20-0395389 Y1</td>
<td>08.09.2005</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>JP 11-227065 A</td>
<td>24.08.1999</td>
<td>DE 69823312 D1</td>
<td>27.05.2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 69823312 T2</td>
<td>12.05.2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 0922561 A2</td>
<td>16.06.1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 0922561 A3</td>
<td>15.03.2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ES 2218777 T3</td>
<td>16.11.2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 04115601 B2</td>
<td>09.07.2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 6702912 B1</td>
<td>09.03.2004</td>
</tr>
<tr>
<td>KR 10-1998-0065528 A</td>
<td>15.10.1998</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 60014010 T2</td>
<td>17.11.2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 1106335 A2</td>
<td>13.06.2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 1106335 A3</td>
<td>19.03.2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 200L-162694 A</td>
<td>19.06.2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KR 10-0696901 B1</td>
<td>20.03.2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2001-0002608 A1</td>
<td>07.06.2001</td>
</tr>
</tbody>
</table>