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(54) Title: METHOD AND APPARATUS FOR PATCHING A TIRE

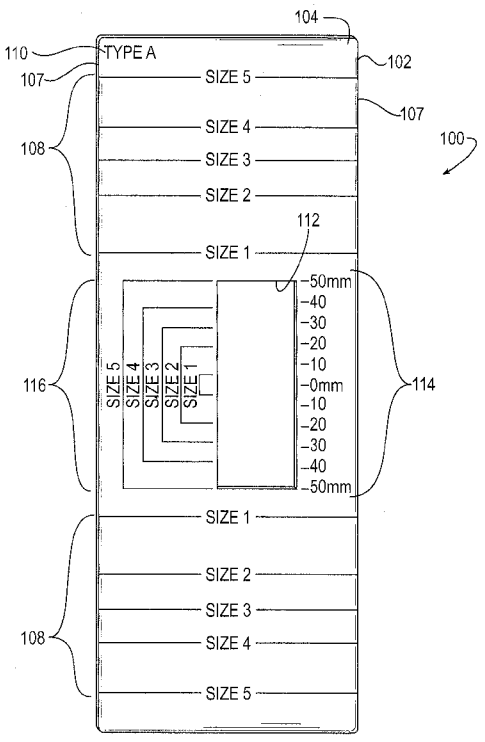

FIG. 1

(57) Abstract: The present invention includes methods and apparatus for repairing a tire. Particular embodiments provide a template for determining an offset distance, where an installation location is obtained by shifting the patch from a default installation location along an inside surface of the tire by the offset distance away from a bead toe or away from a shoulder area of the tire. In particular embodiments, the template comprises a template body having a first side and a second side; a plurality of first patch identifiers arranged in spaced relation along a transverse dimension of the first side, one or more of the first patch identifiers each defining a pre-determined transverse dimension of differently sized patches of the first patch type; a plurality of offset distance identifiers being arranged in spaced relation along a transverse dimension of the first side and relative to the plurality of first patch identifiers.

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METHOD AND APPARATUS FOR PATCHING A TIRE

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates generally to tire repair patches and methods of repairing a damaged tire portion or area, and more specifically, to tire repair patches and methods of tire repair that facilitate more durable tire repairs.

Description of the Related Art

[0002] It is commonly known to apply repair patches to a damaged portion of a tire. To facilitate such repairs, it is also customary to prepare the damaged area prior to application of any such patch by substantially removing the damaged portions of any tire reinforcements within the damaged area. Subsequently, the interior surface of a tire surrounding the damaged area, which is associated with an air-impermeable layer called an innerliner, may be cleaned and/or lightly buffed to promote adhesion between the tire and the patch. The patch is then applied to the prepared interior surface of the tire by way of an adhesive.

[0003] Various types of tire patches have been designed, the tire patches having different shapes, sizes and dimensions. Each patch has a transverse dimension, such as a length or width, and a pre-determined patch coverage area arranged within the transverse dimension, where the coverage area is a desired area within the total patch area where the damaged portion may be located when the patch is installed on the tire. The pre-determined patch coverage area is generally set inward from a perimeter defining the total patch area so that a portion of the total patch area surrounds the pre-determined patch coverage area for the purpose of creating a bonding area along the patch surrounding the damaged area. Generally larger patches cover a larger damaged area. A patch is selected so that the effective patch area corresponds to the size of the damaged area.

[0004] Usually a tire patch is centered on the damaged area of the tire. However, in certain instances, it may be desired to maintain the tire patch a certain distance from a bead toe and/or a shoulder of the tire, such as when repairing a tire along a sidewall portion of the tire. In such instances, the patch is manually offset without use of any template or other assistance on a case-by-case basis to locate the patch a minimum distance from the bead toe or the shoulder while still ensuring that the damaged area is covered by the pre-determined patch coverage area. In some cases this may require selecting a larger tire patch to account for the offset.

[0005] The damaged area may be prepared for patch installation by a manual or automatic process. In a manual process, the size of the damaged section is measured and a tire patch having an appropriately

sized coverage area is selected. If the patch is too close to the bead toe or the tire shoulder, the patch is moved to allow for sufficient clearance. The patch may then be traced, marking the location on the tire. A portion of the tire within the marked area is then prepared, such as by cleaning, grinding or buffing the area, for patch installation.

[0006] In an automatic process, the size and location of a damaged section of tire is inputted into or determined by a computer processor, such that an abrasion tool, such as a grinder or buffer, is employed to prepare the damaged area for patch installation. The appropriate size of the patch may be determined by the computer processor based on the size and location of the damaged section or may be determined by an operator and input into the computer. The computer processor then locates the area to be covered by the patch and automatically grinds the tire for patch installation. As with the manual process, the location of the damaged area may be too close to the bead toe or shoulder for a patch to be commonly centered overtop the damaged portion. In this case, an operator will manually offset each patch individually by first measuring the offset distance and subsequently inputting the offset distance into the computer memory for use by the computer processor. The computer processor will then guide the automatic grinder to prepare this offset location for patch installation.

[0007] The additional steps of locating and measuring the distance between the default installation location and the offset installation location individually for each tire patch are time consuming and subject to error. There is therefore a need in the art for an improved method and apparatus for locating a tire patch near the bead toe or shoulder of a tire. The present invention improves upon the prior art methods to improve efficiency and accuracy of the prior art methods, while also reducing the investment in resources to accomplish the prior art methods.

SUMMARY OF THE INVENTION

[0008] The present invention includes methods and apparatus for repairing a tire. Particular embodiments of the invention include methods of patching a sidewall of a tire. In more specific embodiment of such methods, a method includes the step of identifying a damaged area of the sidewall to be patched by a selected patch, the sidewall extending between a bead toe and a shoulder of the tire. A further step includes selecting a first patch type from a plurality of patch types for use in patching said damaged area, the first patch type comprising a plurality of differently sized patches of the first patch type each having a different pre-determined transverse dimension from which the selected patch is chosen. Yet a further method includes providing a template to determine an offset distance by which the selected patch is to be offset from a default installation location in a radial direction of the tire, where a transverse dimension of the selected patch is centered overtop the damaged area in the radial direction of the tire. In particular embodiments, the template comprises: (1) a template body having a first side and a second side

and a thickness extending there between; (2) a plurality of first patch identifiers arranged in spaced relation along a transverse dimension of the first side, one or more of the first patch identifiers each defining a pre-determined transverse dimension of differently sized patches of the first patch type; and, (3) a plurality of offset distance identifiers for determining the offset distance, the plurality of offset distance identifiers being arranged in spaced relation along a transverse dimension of the first side and relative to the plurality of first patch identifiers such that the offset distances identified by the offset distance identifiers are substantially parallel to the patch transverse dimensions identified by the plurality of first patch identifiers. A further step includes positioning the template on an interior surface of the tire such that the plurality of first patch identifiers are spaced apart in the radial direction of the tire, and such that one of the first patch identifiers is either: (1) arranged at a minimum distance from the bead toe of the tire if the edge of the selected patch corresponding to the one of the first patch identifiers would be positioned a distance from the bead toe less than the minimum distance to the bead toe when the selected patch is in the default installation location, or (2) arranged at a minimum distance from the shoulder of the tire if the edge of the selected patch corresponding to the one of the first patch identifiers would be positioned a distance from the shoulder less than the minimum distance to the shoulder when the selected patch is in the default installation location. Yet a further step includes determining from the plurality of offset identifiers the offset distance by which the selected patch is to be moved in a radial direction of the tire from the default installation location such that the one of the first patch identifiers would be positioned either: a distance from the bead toe at least equal to the minimum distance to the bead toe, or a distance from the shoulder at least equal to the minimum distance to the shoulder. An additional step includes determining an installation location of the selected patch by shifting the default installation location by the offset distance in the radial direction of the tire. Furthermore, such methods may include the steps of preparing the installation location for application of the selected patch, and installing the patch to the installation location.

[0009] Further embodiments of the invention include a template for determining an offset distance for a tire repair patch. In particular embodiments, the template comprises: a template body having a first side and a second side and a thickness extending there between; a plurality of first patch identifiers arranged in spaced relation along a transverse dimension of the first side, one or more of the first patch identifiers each defining a pre-determined transverse dimension of differently sized patches of the first patch type; and, a plurality of offset distance identifiers for determining the offset distance, the plurality of offset distance identifiers being arranged in spaced relation along a transverse dimension of the first side and relative to the plurality of first patch identifiers such that the offset distances identified by the offset distance identifiers are substantially parallel to the patch transverse dimensions identified by the plurality of first patch identifiers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a top plan view of the template;

[0011] FIG. **2** is a bottom plan view of the template illustrated in FIG. **1**;

[0012] FIG. **3** is a top plan view of an alternative template;

[0013] FIG. **4** is a top plan view of another alternative template;

[0014] FIG. **5** is a side cutaway view of a tire;

[0015] FIG. **6** is a front cutaway view of an interior surface of the tire and template;

[0016] FIG. **7** is a front cutaway view of the interior surface of the tire and offset template;

[0017] FIG. **8** is a perspective view of a system including a controller and an abrasion tool for preparing an installation location along the tire for installation of a patch, in accordance with an exemplary embodiment of the invention.

[0018] FIG. **9** is a front cutaway view of the interior surface of the tire after being ground; and

[0019] FIG. **10** is a front cutaway view of the tire with a patch applied.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Described in this application is an inventive method and apparatus for locating and applying a patch to a tire. The apparatus comprises a template useful for locating the offset distance from the bead toe and/or shoulder when patching a damaged area along a sidewall of a tire.

[0021] In the present invention, a method of patching a sidewall of a tire is disclosed. The method includes a step of identifying a damaged area of the sidewall to be patched by a selected patch, the sidewall extending between a bead toe and a shoulder of the tire. The damaged area may comprise any defect in a tire sidewall, such as an abrasion, rip, tear, cut, or puncture, for example, in need of repair.

[0022] A further step of such methods includes selecting a first patch type from a plurality of patch types for use in patching said damaged area, the first patch type comprising a plurality of differently sized patches of the first patch type each having a different pre-determined transverse dimension from which a selected patch is chosen. Various types of patches are available, which may comprise different constructions based upon arrangement and/or material. Accordingly, patch type selection may be based upon any desired rationale, including performance, damage location and/or size, and cost. The pre-determined size includes a transverse dimension, such as a length or width, for example. Subsequently, such methods include the step of selecting a particularly sized patch of the first patch type for use in

repairing the tire. In particular embodiments, the size of the damaged area is measured and an appropriately sized patch of a first type of patch is selected. In other embodiments, the template may be employed to determined a particular patch size from the first patch type to be used in the for repairing the tire, which is discussed further herein. The particularly sized path selected is referred to herein as the selected patch, which has a particular transverse dimension referenced by a template.

[0023] A further step of such methods includes providing a template to determine an offset distance by which the selected patch is to be offset (shifted, moved) from a default installation location in a radial direction of the tire, where a transverse dimension of the selected patch is centered overtop the damaged area in the radial direction of the tire. As described herein, the template allows a user to determine how far a patch is to be shifted from a default installation location (that is, a default installation configuration) along the tire sidewall, which, in a particular embodiment, is where a transverse dimension of the patch arranged in a radial direction of the tire is centered over top the damaged area. While it may be desirous to install the patch in the default installation location, it may also be desirous to move or shift the patch from the default installation location when the patch, in the default installation location, is arranged too closely to the bead or shoulder areas of the tire. Each patch often has a central coverage area providing a desired distance range along the transverse dimension where the damaged area may be located for patch installation. In the default installation location, the damaged area is centered within the central coverage area and the desired distance range along the transverse dimension. However, when the damaged area is sized less than the desired range, the patch may be shifted from the default installation location as desired if the damaged area remains within the desired distance range. The distance the template is shifted in the radial direction of the tire is referred to as the offset distance.

[0024] In particular embodiments, the template comprises a template body having a first side and a second side and a thickness extending there between. The template body may comprise any desired shape and may be formed of any suitable material, including any plastic or elastomeric material. In such embodiments, the template further comprises a plurality of first patch identifiers arranged in spaced relation along a transverse dimension of the first side, one or more of the first patch identifiers each at least defining a pre-determined transverse dimension of differently sized patches of the first patch type. The first patch identifiers in essence at least define a transverse dimension of each differently sized patch, which may be, for example, a patch length or width, and which will extend in the radial direction of the tire or tire sidewall. In arranging the plurality of first patch identifiers in a spaced relation along a transverse dimension of the first side, the spaced relation can be said to be arranged in a direction of transverse dimension of the first side. It is understood that a pair of first patch identifiers may be employed to identify a

[0025] Yet further in such embodiments, the template further includes a plurality of offset distance identifiers for determining the offset distance, the plurality of offset distance identifiers being arranged in spaced relation along, or, in other words, in a direction of, a transverse dimension of the first side and relative to the plurality of first patch identifiers such that the offset distances identified by the offset distance identifiers are substantially parallel to the patch transverse dimensions identified by the plurality of first patch identifiers. The plurality of offset distance identifiers are provided for the purpose of ascertaining an offset distance by which the patch should be installed from its default installation position. Therefore, it is understood that the plurality of offset distance identifiers as arranged may be configured to represent any desired distances in any desired unit of measure. Accordingly, it can be said that the plurality of offset distance identifiers define distance increments, which may represent any unit of measure at full scale or at any other scale, for measuring an offset distance. Furthermore, in more specific embodiments, the plurality of offset distance identifiers include a reference identifier, which can represent a zero reference or origin for measuring the offset distance relative the other offset distance identifiers. The reference identifier may also, in additionally or in the alternative, represent a center or centerline of each patch represented by the plurality of first patch identifiers. It is noted that a transverse dimension of the first side, or even the second side when applicable, may be any dimension of the template side, such as a length or width of the side, for example.

[0026] It is understood that the patch identifiers indentify different pre-sized patches for a certain type of patch. Accordingly, the first patch identifiers indentify different pre-sized patches for a first type of patch. In further embodiments, the template includes one or more additional plurality of patch identifiers, which includes a plurality of second patch identifiers and even further patch identifiers, such as third, fourth, fifth, etc., which identify different pre-sized patches of a second or otherwise subsequent patch type. Each differently pre-sized patch has a different transverse dimension, which again may comprise a length or width, for example.

[0027] Because the offset distance identifiers and the patch identifiers need to be visible to a user of the template, the patch identifiers may comprise any identifier visible to a user. For example, each identifier may comprise a marking, such as a line, alpha-numeric labeling, and/or a bracket, for example, which may be impregnated or molded into the template or applied to a surface of the template. Furthermore, the marking may be arranged along an exterior side or an interior side, such as when the template is formed of a plurality of layers or laminates. By further example, each marking may form an impression or projection arranged along a surface of either first or second side of the template. An identifier may also comprise a structural feature of the template, such as jog or alteration, which includes a recess or a protrusion, arranged along an edge of the first or second side, such as along an outer edge extending along

a perimeter of any first or second side or along an edge defining an aperture or a recessed or protruding area arranged along any first or second side of the template.

[0028] While the plurality of patch identifiers, whether first, second, or any subsequent, indicate a transverse dimension of the patch, such as a length or width, in addition thereto, in particular embodiments, the plurality of first patch identifiers indicate the minimum distance to the bead toe and the minimum distance to the shoulder in addition to each patch transverse dimension. This may be useful to avoid the need to measure a corresponding minimum distance from the bead toe or from the shoulder to locate the patch identifier associated with the patch of pre-determined size. In particular embodiments, for example, each minimum distance is equal to 15 millimeters (mm). In other embodiments, minimum distances greater or less than 15 mm maybe employed as desired. It is also understood that the minimum distances corresponding to the bead toe and the shoulder may be different or unequal. To achieve the same purposes, in other embodiments, where the patch identifiers represent only a pre-determined size of a patch, the template further includes a minimum bead toe distance identifier spaced by the minimum distance from the bead toe from each of the plurality of first patch identifiers away from a center of the patch in a direction of the transverse dimension (that is, the transverse dimension as identified by the plurality of first patch identifiers or the transverse dimension of the template), and a minimum shoulder distance identifier spaced by the minimum distance from the shoulder from each of the plurality of first patch identifiers away from a center of the patch in a direction of the transverse dimension (that is, the transverse dimension as identified by the plurality of first patch identifiers or the transverse dimension of the template), where in the step of positioning the template on an interior surface of the tire, the minimum bead toe distance identifier is aligned overtop the bead toe or the minimum shoulder distance identifier is aligned overtop the shoulder. In an exemplary embodiment, each of the minimum bead toe distance identifier and the minimum shoulder distance identifier are equal 15 millimeters (mm) from the bead toe and the tire shoulder, respectively. As stated above, in other embodiments, minimum distances greater or less than 15 mm maybe employed as desired. It is also understood that the minimum distances corresponding to the bead toe and the shoulder may be different or unequal. It is also noted that in any embodiment, the minimum distance from the shoulder may extend as far as or beyond the equator of the tire, which is defined to be location along each tire sidewall where the tire width is at its maximum in a direction perpendicular to a plane extending perpendicular to the rotational axis of the tire and through a midpoint or centerline of the tire width.

[0029] While the offset distance identifiers may be located along or adjacent an edge of any first or second side of the patch, the offset distance identifiers may be arranged more centrally inward from any such edge. In doing so, it may otherwise render more difficult obtaining an offset distance when the

offset distance identifiers are arranged sufficiently from any such edge and the damaged area. Therefore, in particular embodiments, a window is arranged within the template body adjacent to (near or in close relation to) the offset distance identifiers to better allow a user to associate the offset distance identifiers with the damaged area. The window may comprise any mechanism for better viewing the damaged area relative the offset distance identifiers, and any coverage area identifiers as may be provided in other embodiments. For example, in particular embodiments, the window is an aperture extending though the thickness of the template body. The aperture may be a hole arranged more centrally along the first or second side a distance away from any edge arranged along a perimeter of the first or second side. The aperture may also form a recess or indentation formed into an edge arranged along a perimeter of the first or second side. In yet a further embodiment, the window may comprise a transparent portion of the template body, the transparent portion being transparent through the thickness of the template body. In such instances, the offset distance identifiers may be placed overtop the transparent window, which is considered to be arranging the window adjacent the offset distance identifiers. While not necessary, in particular embodiments the aperture is equal to or larger than the damaged area. It is understood that the entire template body may be transparent.

[0030] In further embodiments of the template, the template further comprises a plurality of second patch identifiers, one or more of the second patch identifiers each at least defining a pre-determined transverse dimension of differently sized patches of the second patch type. Each of the second patch identifiers may comprise any embodiment of the first patch identifiers discussed above and elsewhere herein. In certain embodiments, the plurality of second patch identifiers are arranged on the second side of the template, while in other embodiments, the plurality of second patch identifiers are arranged on the first side of the template with the plurality of first patch identifiers. Accordingly, the plurality of first patch identifiers may be distinguishable from the plurality of second patch identifiers. For example, in particular embodiments, the plurality of first patch identifiers comprise a first style type and the plurality of second patch identifiers consist of a second style type, the first style type being visibly different than the second style type. Different style types may comprise, for example, different shapes, colors, or arrangements of identifiers. By further example, when the plurality of first and second patch identifiers are arranged for viewing from different sides of the template body (whether the first and second patch identifiers are arranged on the same or different sides of the template), and the identifiers are markings arranged on a transparent portion of the tread body, the markings may be formed such that first patch identifiers for use and viewing from a first side of the template body are at least less prominent and noticeable, even not readily observable or discernable, or as much as being unrecognizable, relative the second patch identifiers when viewing the second patch identifiers from the second side of the template body so not to confuse a user as to which identifiers should be used. For example, the markings may comprise stacked

layers of colors, whereby a bottom of the markings residing closest to the template body comprise a first color, such as black or any other dark color like brown, blue, or grey, that is generally unrecognizable when laid along a tire, although it is understood that any color suitable for the intended purpose may be employed depending upon the color of the tire. Thereafter, a second, more recognizable color, such as a lighter color, is placed atop the first color.

[0031] Yet a further step of such methods includes positioning the template on an interior surface of the tire such that the plurality of first patch identifiers are spaced apart in the radial direction of the tire, and such that one of the first patch identifiers is either: arranged at a minimum distance from the bead toe of the tire if the edge of the selected patch corresponding to the one of the first patch identifiers would be positioned a distance from the bead toe less than the minimum distance to the bead toe when the selected patch is in the default installation location (that is, when the transverse dimension of the selected patch is centered overtop the damaged area in the radial direction of the tire), or arranged at a minimum distance from the shoulder of the tire if the edge of the selected patch corresponding to the one of the first patch identifiers would be positioned a distance from the shoulder less than the minimum distance to the shoulder when the selected patch is in the default installation location (that is, when the transverse dimension of the selected patch is centered overtop the damaged area in the radial direction of the tire). As discussed above, in certain instances, it is desired that the extent of a patch be located no less than a minimum distance from the bead toe and/or from the shoulder when patching a damaged area along a tire sidewall. In particular embodiments, for example, each minimum distance is equal to 15 millimeters (mm). Accordingly, when positioning the template along the interior tire surface, the desire is to determine whether the extent of a patch in its default installation position, which comprises centering the tire patch overtop the damaged area, would be located no closer than the minimum distance to the bead toe or the shoulder. In particular embodiments, this step may be accomplished by measuring the minimum distance from each of the bead toe and the shoulder using a ruler, measuring tape, or any other measuring tools or device. In other embodiments, the step may be performed by using the minimum bead toe distance identifier and the minimum shoulder distance identifier arranged on the template as discussed above and elsewhere herein.

[0032] If it is determined that, when centering the transverse dimension of the patch extending in the radial direction of the tire or tire sidewall that the patch encroaches, breaches, or extends beyond the minimum distance towards the bead toe or the shoulder, it is determined that the installation location of the patch is moved or offset from the bead toe or shoulder such that the patch is positioned away from the bead toe and shoulder by the minimum distance. Should the patch breach the minimum distance for both the bead toe and the shoulder, a larger patch should be selected. Accordingly, in certain embodiments,

prior to performing the prior step, such methods include the steps of centering the plurality of first patch identifiers relative to the damaged area such that the patch transverse dimensions identified by the plurality of first patch identifiers are centered along the damaged area in the radial direction of the tire and which represents the default installation location of each such patch and determining whether any one of the plurality of first patch identifiers identifying the transverse dimension of the selected patch corresponding is either arranged a distance from the bead toe less than the minimum distance from the bead toe of the tire or arranged a distance from the shoulder less than the minimum distance from the shoulder of the tire, and if any one of the plurality of first patch identifiers corresponding to the selected patch is arranged closer to the bead toe or the shoulder than is desired by the corresponding minimum distance, the template is shifted away from the bead toe or shoulder as is appropriate and positioned along the interior tire surface according to the step of positioning the template on an interior surface of the tire.

[0033] In particular embodiments, the template includes a plurality of first patch coverage identifiers, each of the first patch coverage identifiers identifying a pre-determined range (that is, a distance) along the transverse dimension of a corresponding patch within which the damaged section may be arranged. By doing so, in certain embodiments, such methods include the steps of: centering the plurality of first patch identifiers relative the damaged area such that the patch transverse dimensions identified by the plurality of first patch identifiers are centered along the damaged area in the radial direction of the tire; determining whether the damaged area is substantially within the predetermined range identified by one or more first patch coverage identifiers corresponding to any patch of the plurality of differently sized patches; and, selecting any patch from the plurality of differently sized patches where it is determined in the prior step that the damaged area is substantially within the predetermined range identified by one or more first patch coverage identifiers. The first patch coverage identifiers, or any other patch coverage identifiers, which may comprise identifiers for any other patch type (second, third, etc.) may comprise any marking contemplated for the plurality of (first) patch identifiers, including a bracket with or without any alpha-numeric labeling.

[0034] Before shifting the template from the arrangement where the first plurality of patch identifiers are centered along the damaged area, particular embodiments of such methods include a step of identifying a radial center of the damaged area as ascertained in the radial direction of the tire such that in the step of determining the offset distance, the offset distance is measured using the offset identifiers relative the identified radial center of the damaged area. For example, identifying may comprise marking the radial center for subsequent reference when measuring the offset distance.

[0035] Once the template is arranged along the interior tire surface for the purpose of locating a new installation location for the patch different from the default installation arrangement, such methods further

comprise the step of determining from the plurality of offset identifiers the offset distance by which the selected patch is to be moved in a radial direction of the tire from the default installation location such that the one of the first patch identifiers would be positioned either: (1) a distance from the bead toe at least equal to the minimum distance to the bead toe (when the default installation location for the patch was previously found to breach the minimum distance to the bead toe), or (2) a distance from the shoulder at least equal to the minimum distance to the shoulder (when the default installation location for the patch was previously found to breach the minimum distance to the shoulder).

[0036] Once an offset distance has been determined, such methods comprise the step of determining an installation location of the selected patch by shifting the default installation location by the offset distance in the radial direction of the tire. As it has been explained above, the installation location of the patch will shift away from the bead toe if it was determined that the patch would have breached the minimum distance from which the patch is to be located from the bead toe in the default installation location. Likewise, the installation location of the patch will shift away from the shoulder if it was determined that the patch would have breached the minimum distance from which the patch is to be located from the shoulder in the default installation location.

[0037] Subsequently, in such methods, a further step includes preparing the installation location for application of the selected patch, which may occur manually or automatically as noted above.

[0038] In particular embodiments of such methods, a further step includes inputting the offset distance into an automated grinder subsequent to the step of determining the offset distance for the purpose of performing the step of determining an installation location, where the step of determining an installation location is performed by a processor in communication with the automated grinder, where the step of preparing the installation location comprises automatically grinding the interior surface of said tire sidewall at the installation location.

[0039] Once the patch installation location has been prepared, as needed, such methods include the step of installing the patch to the installation location.

[0040] These methods will now be discussed and described in accordance with exemplary embodiments shown in the drawings.

[0041] FIGS. **1-4** illustrate various embodiments of the template **100** according to a first embodiment of the invention.

[0042] With reference to FIG. **1**, the template **100** has a template body **102** with a first side **104.** With reference to FIG. 2, the template has a second side **106** arranged opposite the first side **104** and separated by a thickness of the template body. The first side **104** includes a plurality of first patch identifiers **108**

and may also include a first label **110** identifying the first type of patch. The plurality of first patch identifiers **108** comprise markings including alpha-numeric labels (e.g. Size 1, Size 2, Size 3, etc.) arranged adjacent associated lines correspond to a transverse dimension, such as the total length, of differently sized patch of the first patch type. As discussed above, any identifier may comprise markings or a structural feature of the template body, such one or more recesses or protrusions arranged along an outer edge **107** of the template perimeter, for example.

[0043] With further reference to FIG. **1**, the template **100** also includes a window **112** comprising an aperture for viewing the tire damaged area **206** (see FIG. **6**) when the template **100** is positioned on a tire sidewall **200** (see FIG. **6**). The template **100** also includes a plurality of offset distance identifiers **114** adjacent the window **112** for determining the offset distance of the patch **216** (FIG. **9**) relative a default installation location. Finally, the template includes a plurality of patch coverage identifiers **116** that indicate the effective patch coverage area of each size patch **216**. The patch coverage identifiers are shown to each embody markings comprising brackets with alpha-numeric labels to associate each bracket with a particular patch size. In this embodiment, the plurality of first patch identifiers **108** are positioned both above and below the window **112** so the template may be alternately used for offsetting the patch **216** from the bead toe **202** or shoulder **204** of the tire sidewall **200**.

[0044] FIG. **2** illustrates the second side **106** of the template **100**, which includes a plurality of second patch identifiers **118** that correspond to particular patch sizes of a second patch type. A second label **120** is provided that informs an operator as to which type of patch **216** (FIG. **9**) the plurality of second patch identifiers **118** corresponds. The second side further includes a plurality of offset distance identifiers **114** and a plurality of patch coverage identifiers **122** positioned adjacent the window **112** for locating the damaged area **206** (FIG. **6**) for ultimately determining the offset and whether a patch may properly cover the damaged area when offset.

[0045] Another embodiment of the template **100** is illustrated in FIG. **3**. This embodiment illustrates several different alternatives which may be employed in any other embodiment of the invention. First, rather than an aperture, the template body **100** as shown is transparent so that the tire damaged area **206** (FIG. **6**) can be viewed through the template. Whether the template body is completely or partially transparent, a transparent window is provided for viewing the damaged area, where the offset distance identifiers are arranged adjacent to, along, or overtop the transparent window. This improvement reduces manufacturing cost as it does not require an aperture to be cut through the template. This may also improve ease of use as the damaged area **206** can be located through the entire template, rather than only through the aperture.

[0046] A second variation illustrated in FIG. **3** is that the first side **104** of the template **100** includes multiple (in this instance two) pluralities of patch identifiers (in this instance, first and second patch identifiers **108**, **118**), as well as labels **110**, **120** and patch coverage identifiers **116**, **122** corresponding to each of the multiple types of patches. The first and second patch identifiers **108**, **118** may be side-by-side as illustrated in FIG. **3** or may be interleaved with one another.

[0047] In a third variation, as with the markings **108**, **118**, the template **100** includes a plurality of patch coverage identifiers **116**, **122**, each of which is a bracket formed as a stepped, recessed bracket along both opposing sides of the window **112**. Each bracket **116**, **122** includes alpha-numeric label corresponding each bracket with a particularly sized patch of a particular patch type. However, unlike the illustrated in FIGS. **1-2**, the brackets **116**, **122** illustrated in FIG. **3** are stepped away from the center of the template **100**. The stepped progression may improve readability for users of the template.

[0048] One embodiment of the template **100** having a stepped aperture is illustrated in FIG. **4**. Unlike the embodiment illustrated in FIG. **3**, window **112** consists of an aperture, where an edge **113** of a first side of the aperture is stepped to define the plurality of offset distance identifiers **114** while the edge **113** on the opposing side of the aperture is stepped to define a plurality of patch coverage identifiers **116**. As with the stepped brackets illustrated in FIG. **3**, this arrangement may improve readability for operators to determine the offset and whether the effective patch area of the offset patch will cover the tire damaged area.

[0049] With continued reference to the embodiment of FIG. **4**, in addition to the plurality of first patch identifiers **108**, a minimum bead toe distance identifier **109A** is spaced by the minimum distance **208** from each of the plurality of first patch identifiers toward a side of the template associated with the bead toe in a direction of the transverse dimension away from a center of the template. Further, a minimum shoulder distance identifier **109B** is spaced by the minimum distance **210** from each of the plurality of first patch identifiers toward a side of the template associated with the shoulder in a direction of the transverse dimension away from a center of the template. In such embodiments, instead of measuring manually the any minimum distance 2**08**, **210** by which the template is to be arranged from the bead toe or the shoulder, respectively, in the step of positioning the template on an interior surface of the tire, the minimum bead toe distance identifier is aligned overtop the bead toe or the minimum shoulder distance identifier is aligned overtop the shoulder to achieve a proper arrangement of the template. In yet other embodiments, in lieu of providing the minimum distance identifiers **208**, **210**, each of the plurality of first patch identifiers 208 may represent the sum of the transverse patch dimension for each particularly sized patch, the minimum distance from the bead toe, and the minimum distance from the shoulder. This way, in the step of positioning the template on an interior surface of the tire, the corresponding first patch

identifier arranged on the template side associated with the bead toe is aligned overtop the bead toe or the corresponding first patch identifier arranged on the template side associated with the shoulder is aligned overtop the shoulder to achieve a proper arrangement of the template.

[0050] It is understood that the template maybe formed out of any suitable material. For example, the template may be formed of any natural or synthetic rubber or plastic. Furthermore, the template may be opaque or at least partially transparent. Furthermore, the template body may be formed of a single thickness layer of material, or may be formed and assembled from a plurality of material layers. Various colors, finishes, thicknesses, and coatings are also contemplated. Other exemplary materials from which the template body may be formed include paper, cardboard, or other flexible materials. The first and second sides of the template may comprise different colors to indicate different types of patches. This may be accomplished by painting or coating each side a different color, or may be achieved by providing materials of different colors to each side (e.g. different colored rubbers or plastics bonded to one another).

[0051] FIGS. **5-9** illustrate the method of using the template **100** to repair a damaged section of a tire sidewall **200**. The tire sidewall **200** extends between a bead toe **202** and a shoulder **204**. The damaged area **206** is located away from both the bead toe **202** and shoulder **204**. The patch must be positioned such that the patch is not within a minimum distance **208** from the bead toe or a minimum distance **210** from the shoulder **204**. It is noted that the minimum distances corresponding to the bead toe and the shoulder may be equal or unequal (that is, different). It is also noted that in any embodiment, the minimum distance from the shoulder may extend any distance between the shoulder and the equator of the tire, including up to the equator, and beyond. As identified in FIG. **5**, the equator **205** is defined to be location along each tire sidewall where the tire width **W** is at its maximum in a direction perpendicular to a plane **P** extending perpendicular to the rotational axis of the tire and through a midpoint or centerline of the tire width.

[0052] FIG. **6** illustrates a first step of the method. Prior to this step, the size of the damaged area **206** has been measured and an appropriately sized patch of a first type of patch has been selected. In this first step, the template **100** has been positioned in its default installation location so that the damaged area **206** is visible through the window **112** and centered on the offset distance identifiers **114** and on the plurality of first patch identifiers **108**. As shown, the first patch identifier **108** indicating the bottom edge of the Size 5 patch is located within the minimum bead toe distance **208**. Accordingly, it is desired to move the patch away from the bead toe by an offset distance at least to the minimum bead toe distance.

[0053] FIG. **7** shows a next step of the method. The template **100** has been moved in a radial direction of the tire away from the bead toe **202** so that the bottom edge of the Size 5 patch is outside the minimum distance **208** from the bead toe **202**. The tire damaged area **206** is located lower in the aperture **112** and

the reference mark **212** aligns with the 20 mm offset distance **114,** which identifies the distance by which the patch is to be moved from the default installation location so that the template is located a minimum distance **208** from the bead toe **202**. Accordingly, the offset distance has now been determined for moving the tire patch from its default installation location to a subsequent, offset installation location, which may be first prepared for patch installation.

[0001] While preparation and installation may be done manually, in particular embodiments, the offset distance is input into a processor by an operator, which then automatically alters the installation location from the default installation location by the offset distance by a set of instructions, and subsequently controls the preparation of the new installation location. With reference to FIG. **8**, an exemplary system **10** is shown having an abrasion tool **12**, a programmable logic controller **14** or other device having a processor that can execute programmed instructions, such as, for example, a personal computer or main frame computer, and a user interface **18**, which enables a user to input the offset distance for subsequent use in preparing the installation location for patch installation. Abrasion tool **12** removes surface contamination and/or material from the inside surface of the tire to prepare the installation location for receiving the patch, and may comprise any device capable of achieving such purposes, including, without limitation, abrading devices, such as rasps, grinding wheels, and wire brushes, and cylindrical cutters or "peelers." Controller **14** includes a logic processor **15**, which may be a microprocessor and a memory storage device **16**, such as RAM (random access memory), ROM (read-only memory), or PROM (programmable read-only memory). Memory storage device **16** may comprise any commercially known storage device, such as such as hard disk drives, optical storage devices, flash memory, and the like, which at least stores inputs and maintains programmed instructions to determine the new installation location and to control preparation of the new installation area. Processor **15** executes programmed instructions and may perform the distance calculations and measurements, as wells as other operations, discussed herein. Controller **14** may communicate with abrasion tool **12** in any known manner, such as by use of at least one input/output (I/O) cable **20** or wirelessly.

[0054] FIG. **9** shows a next step of the method. The offset, patch type and size, and location and size of the damaged area have all been input or determined either manually or by an automatic grinding machine. Subsequently, the installation area **214** of the sidewall **200** has been prepared by a grinder or other preparation tool to receive the tire patch **216** (see FIG. **10**) so as to cover the damaged area **206**.

[0055] FIG. **10** shows a final step of the method. In this step, a tire patch **216** has been applied to the prepared installation area **214** according to the method specified by the selected tire patch. The tire patch **216** is a sufficient distance from the bead toe **202** as desired. In other variations, the same methods may

be employed to shift a patch from a default installation location and away from a tire shoulder when the patch would arranged closer to the shoulder than the desired minimum distance **210** to the shoulder **204**.

[0056] The above described method assumes that the effective patch area of the offset tire patch **216** fully covers the tire damaged area **206**. However, in some situations the offset may be so great that the effective patch area of the patch will not cover the damaged area. As described above, brackets **116** may be provided adjacent the window **112** of the template. When the template is adjusted to the offset position (see FIG. **7**), the operator may check that the entire tire damaged area **206** is located within the bracketed area for the selected patch size. If the tire damaged area **206** is not entirely located within the bracketed area, then a larger template should be selected and the process repeated. This process ensures that the tire patch properly covers the tire damaged area **206** to effectively repair the tire sidewall **200**.

[0057] While the invention has been described with reference to particular embodiments thereof, it shall be understood that such description is by way of illustration and not by way of limitation. Accordingly, the scope and content of the invention are to be defined by the terms of the claims as allowed.

CLAIMS

What is claimed is:

1. A method of patching a sidewall of a tire, the method comprising the steps of:

identifying a damaged area of the sidewall to be patched by a selected patch, the sidewall extending between a bead toe and a shoulder of the tire;

selecting a first patch type from a plurality of patch types for use in patching said damaged area, the first patch type comprising a plurality of differently sized patches of the first patch type each having a different pre-determined transverse dimension from which a selected patch is chosen;

providing a template to determine an offset distance by which the selected patch is to be offset from a default installation location in a radial direction of the tire, where a transverse dimension of the selected patch is centered overtop the damaged area in the radial direction of the tire, the template comprising:

a template body having a first side and a second side and a thickness extending there between;

a plurality of first patch identifiers arranged in spaced relation along a transverse dimension of the first side, one or more of the first patch identifiers each defining a pre-determined transverse dimension of differently sized patches of the first patch type;

a plurality of offset distance identifiers for determining the offset distance, the plurality of offset distance identifiers being arranged in spaced relation along a transverse dimension of the first side and relative to the plurality of first patch identifiers such that the offset distances identified by the offset distance identifiers are substantially parallel to the patch transverse dimensions identified by the plurality of first patch identifiers;

positioning the template on an interior surface of the tire such that the plurality of first patch identifiers are spaced apart in the radial direction of the tire, and such that one of the first patch identifiers is either:

arranged at a minimum distance from the bead toe of the tire if the edge of the selected patch corresponding to the one of the first patch identifiers would be positioned a distance from the bead toe less than the minimum distance to the bead toe when the selected patch is in the default installation location, or

arranged at a minimum distance from the shoulder of the tire if the edge of the selected patch corresponding to the one of the first patch identifiers would be positioned a distance from the shoulder less than the minimum distance to the shoulder when the selected patch is in the default installation location;

determining from the plurality of offset identifiers the offset distance by which the selected patch is to be moved in a radial direction of the tire from the default installation location such that the one of the first patch identifiers would be positioned either:

a distance from the bead toe at least equal to the minimum distance to the bead toe, or

a distance from the shoulder at least equal to the minimum distance to the shoulder;

determining an installation location of the selected patch by shifting the default installation location by the offset distance in the radial direction of the tire;

preparing the installation location for application of the selected patch; and,

installing the patch to the installation location.

2. The method of claim 1 further comprising the step of:

inputting the offset distance into an automated grinder subsequent to the step of determining the offset distance for the purpose of performing the step of determining an installation location, where the step of determining an installation location is performed by a processor in communication with the automated grinder,

where the step of preparing the installation location comprises automatically grinding the interior surface of said tire sidewall at the installation location.

3. The method of claim 1, where the template further includes:
a window arranged within the template body adjacent the plurality of offset distance identifiers.

4. The method of claim 1, where the template further comprises:

a plurality of second patch identifiers, one or more of the second patch identifiers each at least defining a pre-determined transverse dimension of differently sized patches of the second patch type.

5. The method of claim 4, where the plurality of second patch identifiers are located on the second side of the template.

6. The method of claim 1, where the plurality of first patch identifiers are markings.

7. The method of claim 1, prior to the step of positioning the template on an interior surface of the tire, such method comprises the steps of:

centering the plurality of first patch identifiers relative to the damaged area such that the patch transverse dimensions identified by the plurality of first patch identifiers are centered along the damaged area in the radial direction of the tire and which represents the default installation location of each such patch; and,

determining whether any one of the plurality of first patch identifiers identifying the transverse dimension of the selected patch corresponding is either arranged a distance from the bead toe less than the minimum distance from the bead toe of the tire or arranged a distance from the shoulder less than the minimum distance from the shoulder of the tire, and if any one of the plurality of first patch identifiers corresponding to the selected patch is arranged closer to the bead toe or the shoulder than is desired by the corresponding minimum distance, the template is shifted away from the bead toe or shoulder as is appropriate and positioned along the interior tire surface according to the step of positioning the template on an interior surface of the tire.

8. The method of claim 5, where the template further comprises:

identifying a radial center of the damaged area as ascertained in the radial direction of the tire such that in the step of determining the offset distance, the offset distance is measured using the offset identifiers relative the identified radial center of the damaged area.

9. The method of claim 1, where the template further comprises:

a plurality of first patch coverage identifiers, each of the first patch coverage identifiers identifying a pre-determined range along the transverse dimension of a corresponding patch within which the damaged section may be arranged, and where the method further comprises the steps of:

determining whether the damaged area is substantially within the predetermined range identified by one or more first patch coverage identifiers corresponding to any patch of the plurality of differently sized patches, where the template is arranged along the interior surface of the tire according to the step of positioning the template; and,

selecting the selected patch from the plurality of differently sized patches where it is determined in the prior step that the damaged area is substantially within the predetermined range identified by one or more first patch coverage identifiers.

10. The method of claim 1, where the plurality of first patch identifiers indicate each patch transverse dimension in addition to the minimum distance to the bead toe and the minimum distance to the shoulder.

11. The method of claim 1, the template further including:

a minimum bead toe distance identifier spaced by the minimum distance from the bead toe from each of the plurality of first patch identifiers away from a center of the patch in a direction of the transverse dimension; and,

a minimum shoulder distance identifier spaced by the minimum distance from the shoulder from each of the plurality of first patch identifiers away from a center of the patch in the direction of the transverse dimension,

where in the step of positioning the template on an interior surface of the tire, the minimum bead to distance identifier is aligned overtop the bead toe or the minimum shoulder distance identifier is aligned overtop the shoulder.

12. The method of claim 1, where the template further comprises:

a plurality of first patch coverage identifiers, each of the first patch coverage identifiers identifying a pre-determined range along the transverse dimension of a corresponding patch within which the damaged section may be arranged, and where the method further comprises the steps of:

centering the plurality of first patch identifiers relative the damaged area such that the patch transverse dimensions identified by the plurality of first patch identifiers are centered along the damaged area in the radial direction of the tire; and,

determining whether the damaged area is substantially within the predetermined range identified by one or more first patch coverage identifiers corresponding to any patch of the plurality of differently sized patches; and,

selecting any patch from the plurality of differently sized patches where it is determined in the prior step that the damaged area is substantially within the predetermined range identified by one or more first patch coverage identifiers.

13. A template for determining an offset distance for a tire repair patch, the template comprising:

a template body having a first side and a second side and a thickness extending there between;

a plurality of first patch identifiers arranged in spaced relation along a transverse dimension of the first side, one or more of the first patch identifiers each defining a pre-determined transverse dimension of differently sized patches of the first patch type;

a plurality of offset distance identifiers for determining the offset distance, the plurality of offset distance identifiers being arranged in spaced relation along a transverse dimension of the first side and relative to the plurality of first patch identifiers such that the offset distances identified by the offset distance identifiers are substantially parallel to the patch transverse dimension identified by the plurality of first patch identifiers.

14. The template of claim 13 further comprising a window arranged within the template body adjacent the plurality of offset distance identifiers.

15. The template of claim 14, where the window is an aperture extending though the thickness of the template body.

16. The template of claim 14, where the aperture is adjacent the plurality of offset distance identifiers.

17. The template of claim 14, where the window is a transparent portion of the template body.

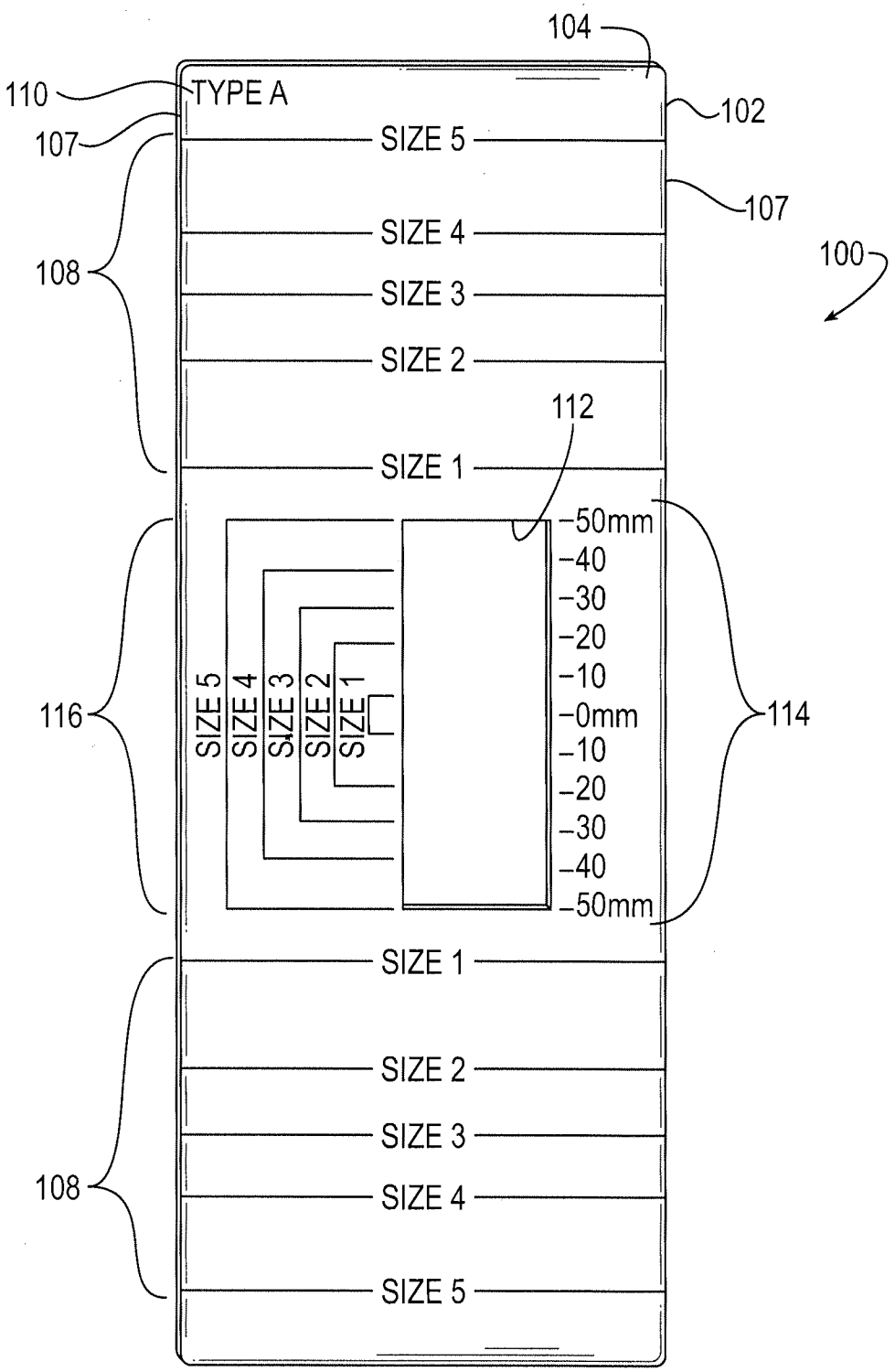
18. The template of claim 14 further comprising:

a plurality of second patch identifiers, each of the second patch identifiers corresponding to a pre-determined size of a second patch type.

19. The template of claim 18, where the plurality of second patch identifiers are located on the second side of the template.

20. The template of claim 14 further comprising:

a plurality of first patch coverage identifiers, each of the first patch coverage identifiers identifying a pre-determined range along the transverse dimension of a corresponding patch within which the damaged section may be arranged.


104
110
TYPE A
102
107
SIZE 5
107
SIZE 4
108
SIZE 3
100
SIZE 2
112
SIZE 1
-50mm
-40
-30
-20
-10
-0mm
-10
-20
-30
-40
-50mm
SIZE 5
SIZE 4
SIZE 3
SIZE 2
SIZE 1
116
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SIZE 1
SIZE 2
SIZE 3
108
SIZE 4
SIZE 5

FIG. 1

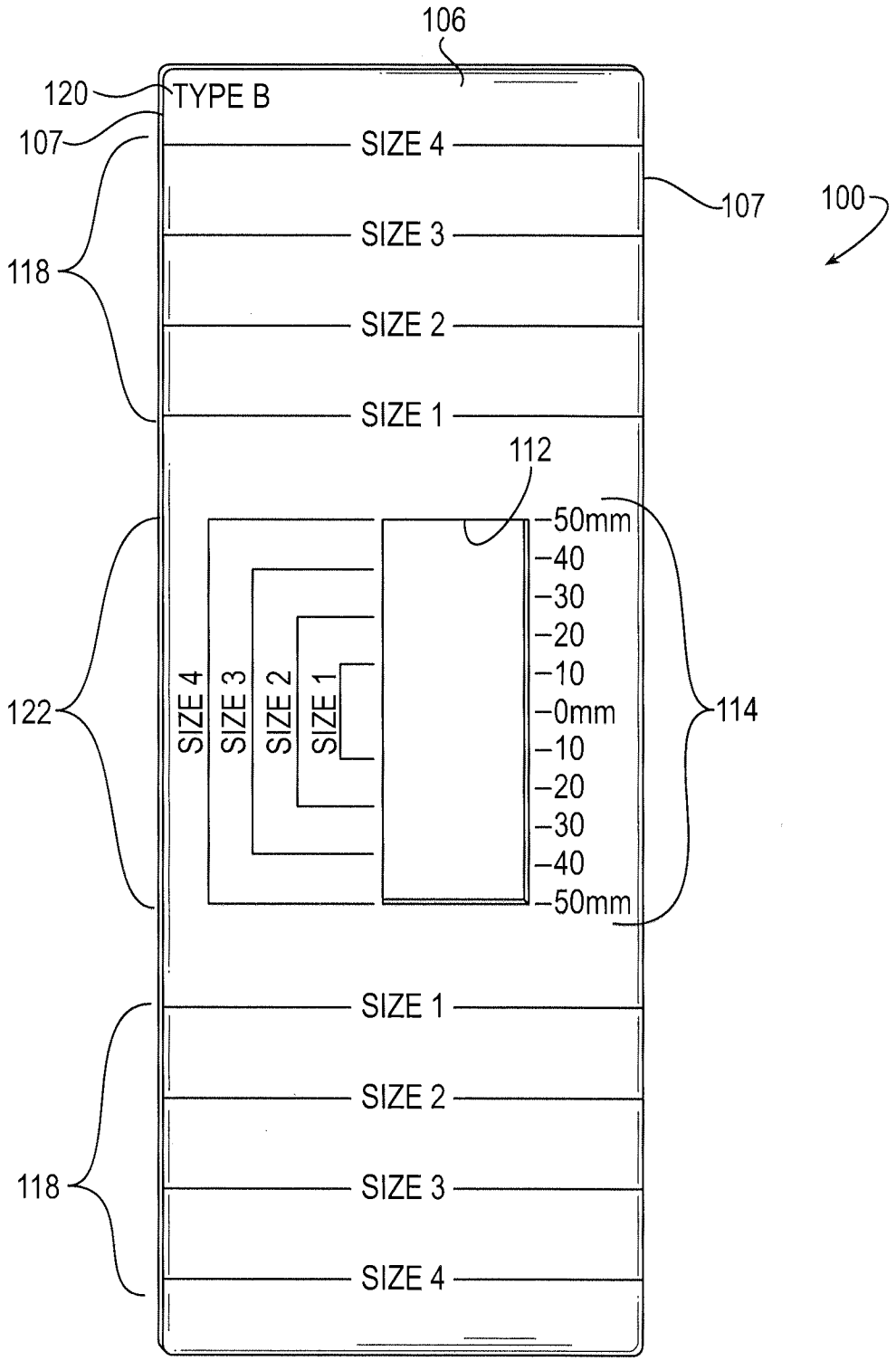
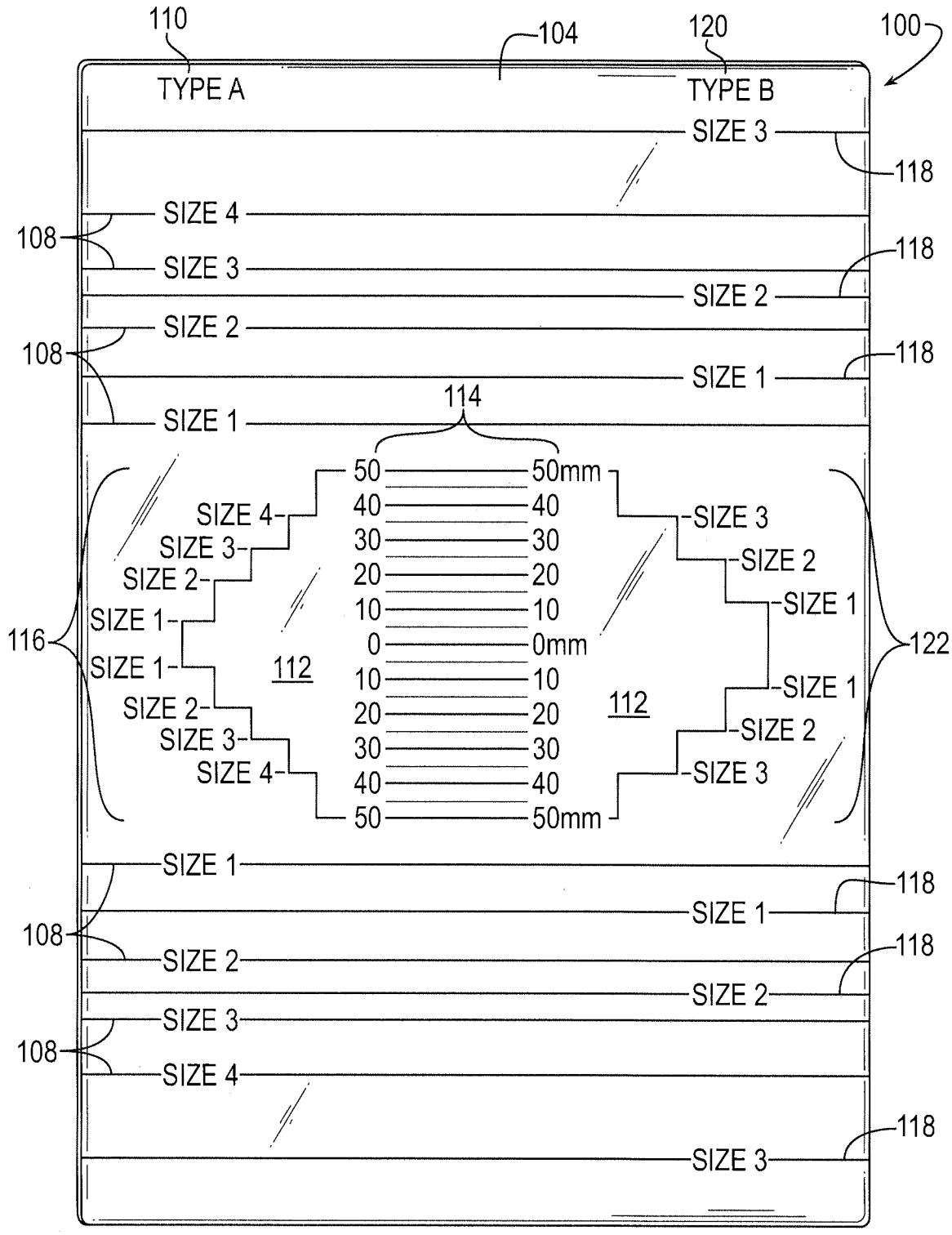

106
120
TYPE B
107
SIZE 4
107
100
SIZE 3
118
SIZE 2
SIZE 1
112
50mm
40
30
20
10
0mm
10
20
30
40
50mm
SIZE 4
SIZE 3
SIZE 2
SIZE 1
122
114
SIZE 1
SIZE 2
SIZE 3
SIZE 4
118

FIG. 2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120
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TYPE A
TYPE B
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SIZE 4
108
SIZE 3
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SIZE 2
SIZE 2
108
SIZE 1
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114
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50mm
SIZE 4
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SIZE 3
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30
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20
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SIZE 1
SIZE 1
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116
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SIZE 1
112
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10
SIZE 1
SIZE 2
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112
SIZE 2
SIZE 3
30
30
SIZE 3
SIZE 4
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SIZE 3
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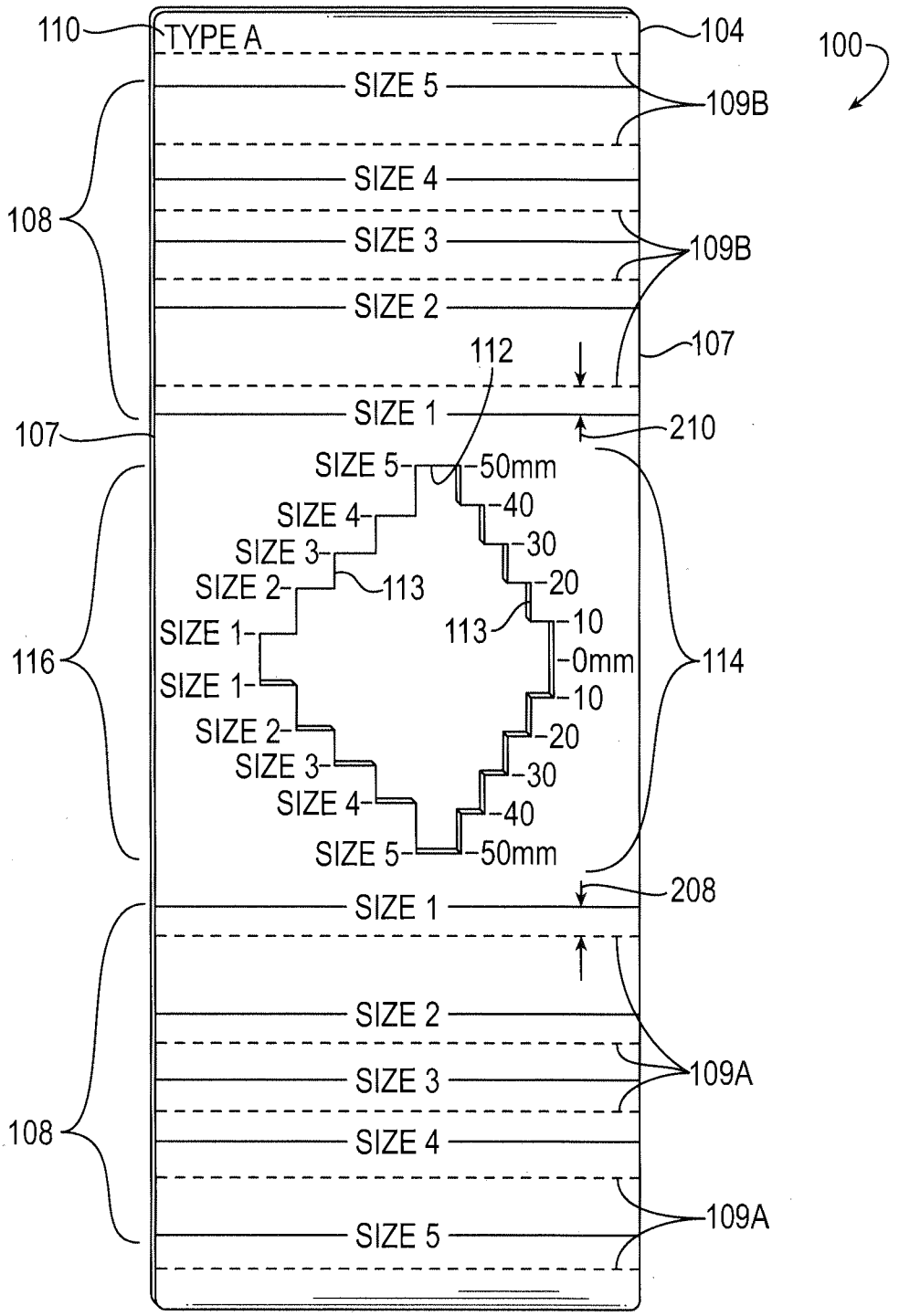
118
SIZE 3

FIG. 3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TYPE A
104
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SIZE 5
109B
SIZE 4
108
SIZE 3
109B
SIZE 2
112
107
SIZE 1
107
210
SIZE 5
50mm
SIZE 4
40
SIZE 3
30
SIZE 2
113
20
SIZE 1
113
10
116
0mm
114
SIZE 1
10
SIZE 2
20
SIZE 3
30
SIZE 4
40
SIZE 5
50mm
208
SIZE 1
SIZE 2
SIZE 3
109A
108
SIZE 4
SIZE 5
109A

FIG. 4

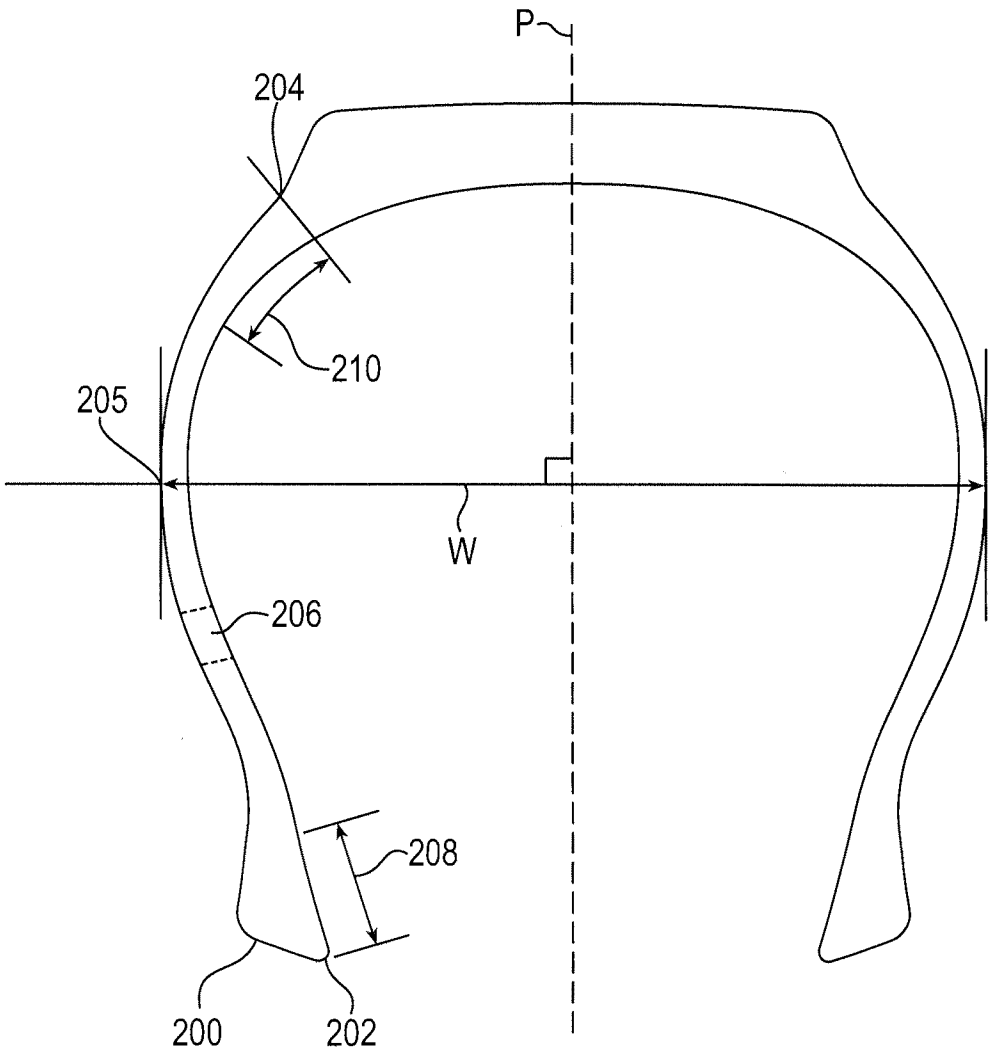
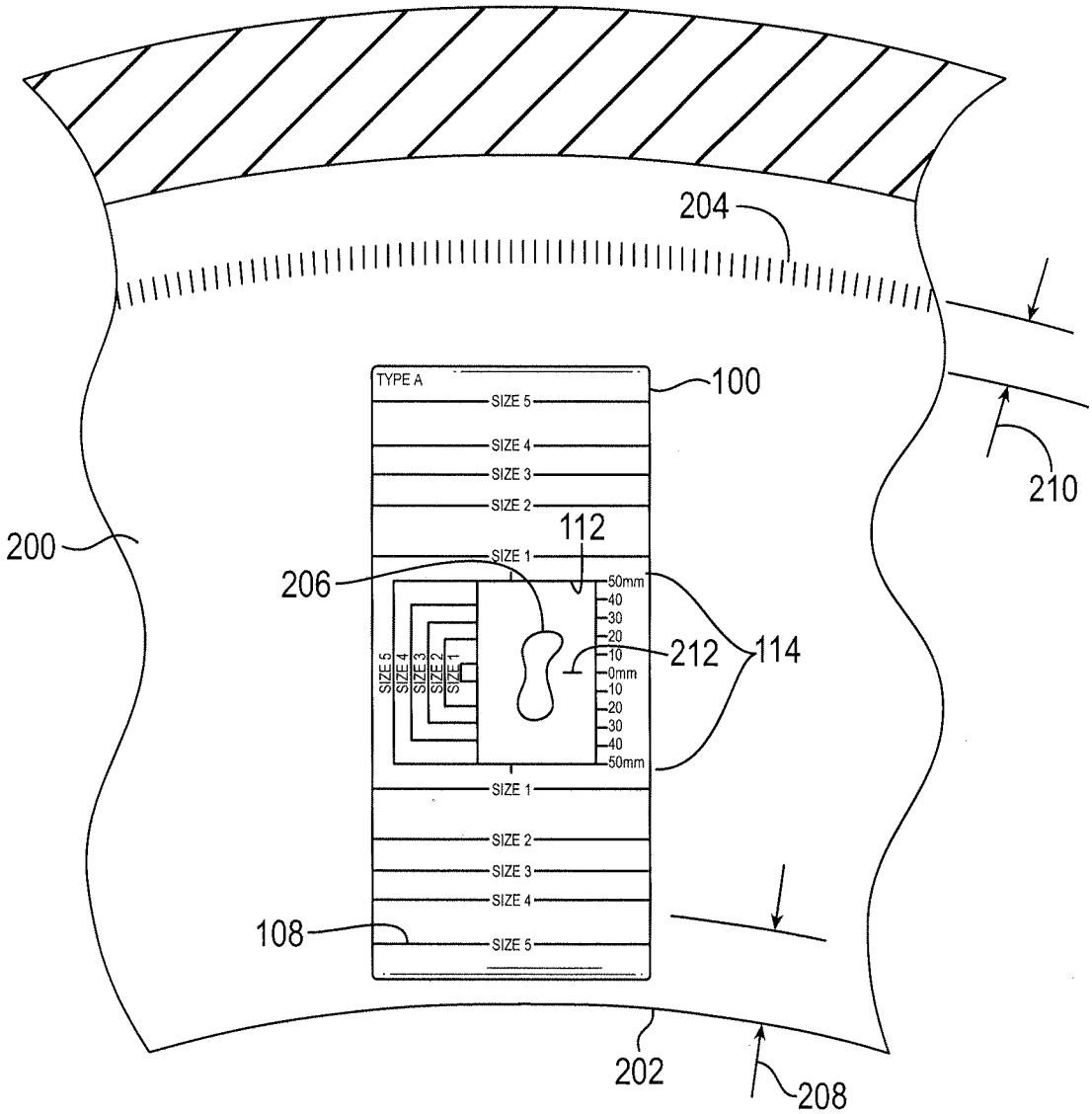


FIG. 5


204
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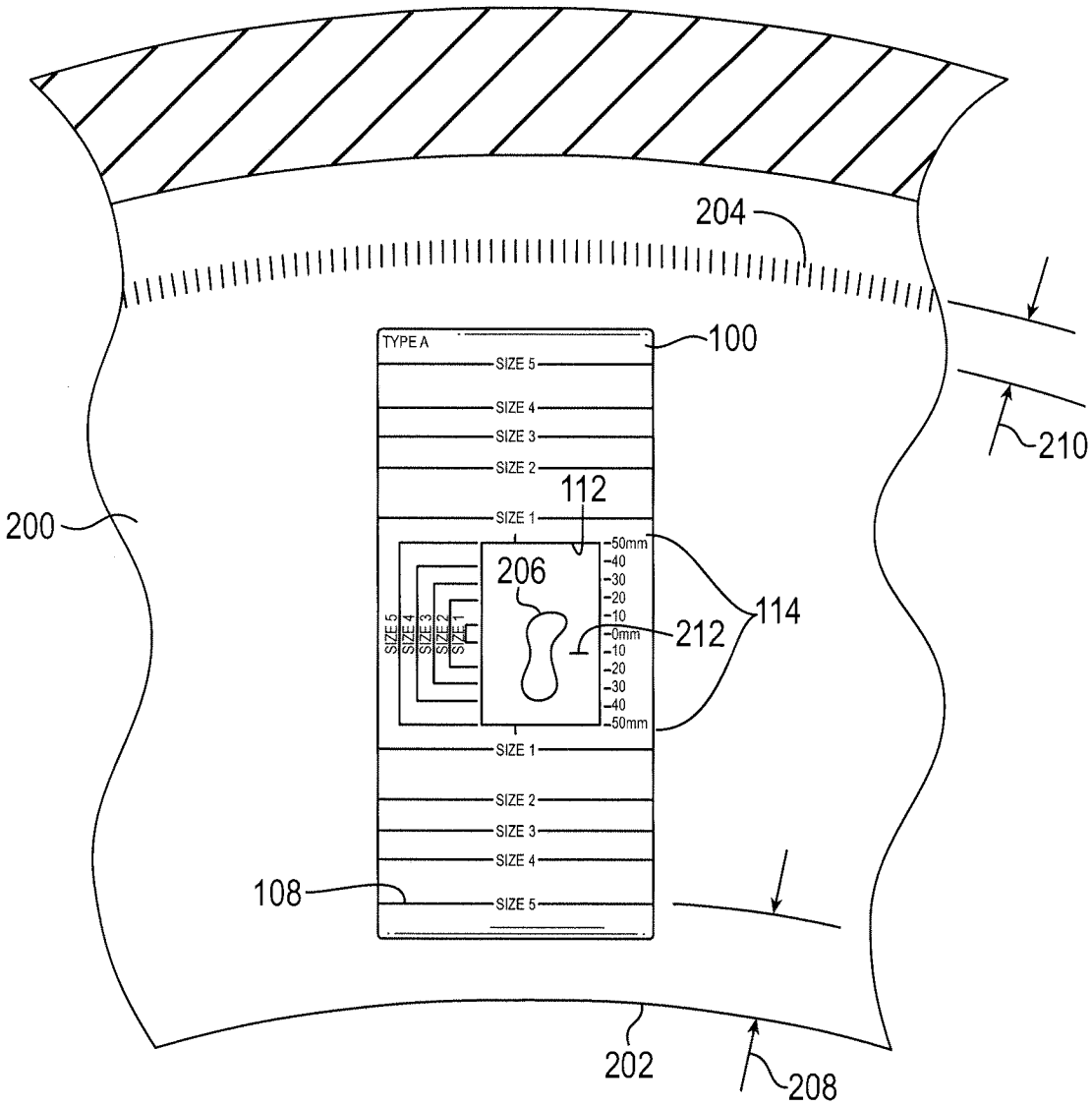
SIZE 4
SIZE 3
SIZE 2
SIZE 1
112
206
50mm
40
30
20
10
0mm
10
20
30
40
50mm
212
114
210
200
108
202
208

FIG. 6


204
100
TYPE A
SIZE 5
SIZE 4
SIZE 3
SIZE 2
SIZE 1
112
200
206
50mm
40
30
20
10
0mm
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50mm
212
114
210
SIZE 1
SIZE 2
SIZE 3
SIZE 4
SIZE 5
108
202
208

FIG. 7

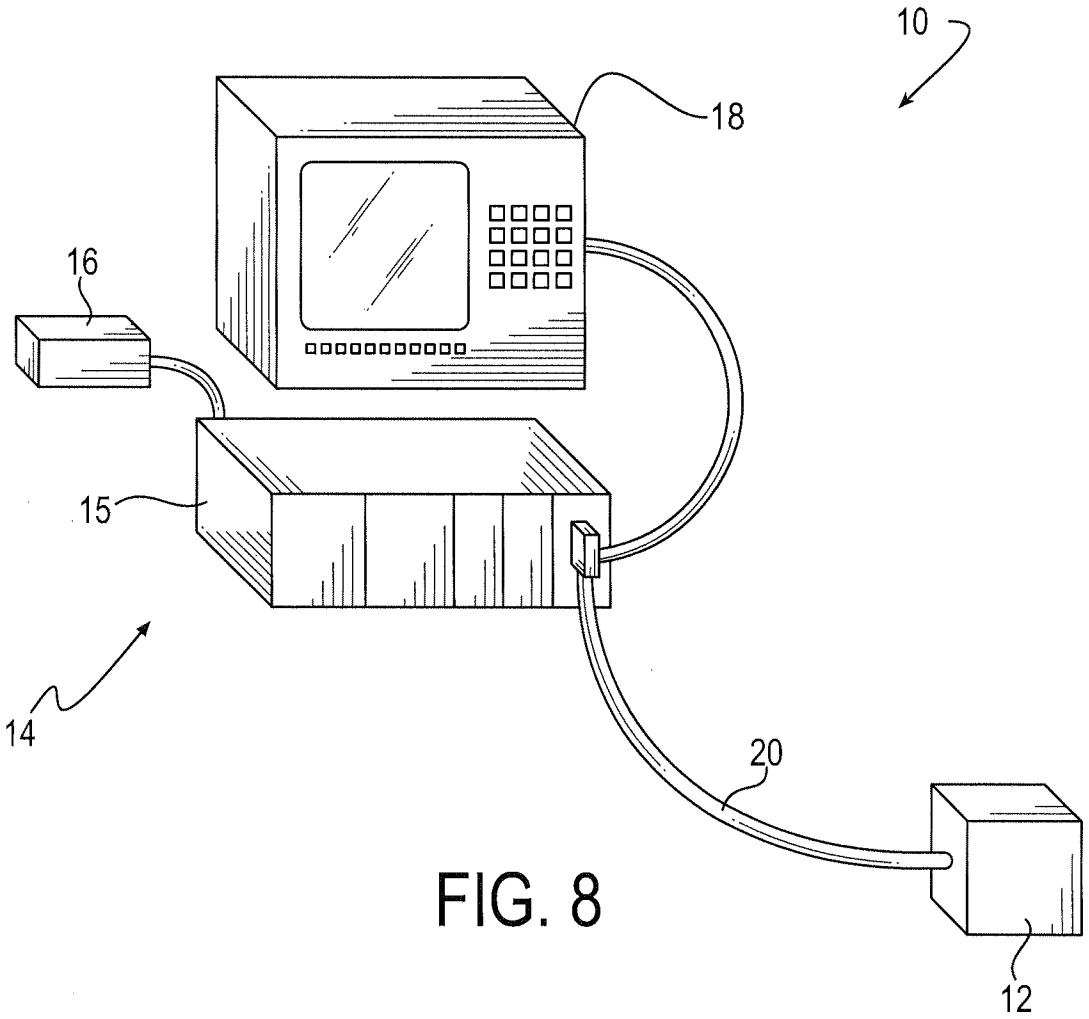

FIG. 8

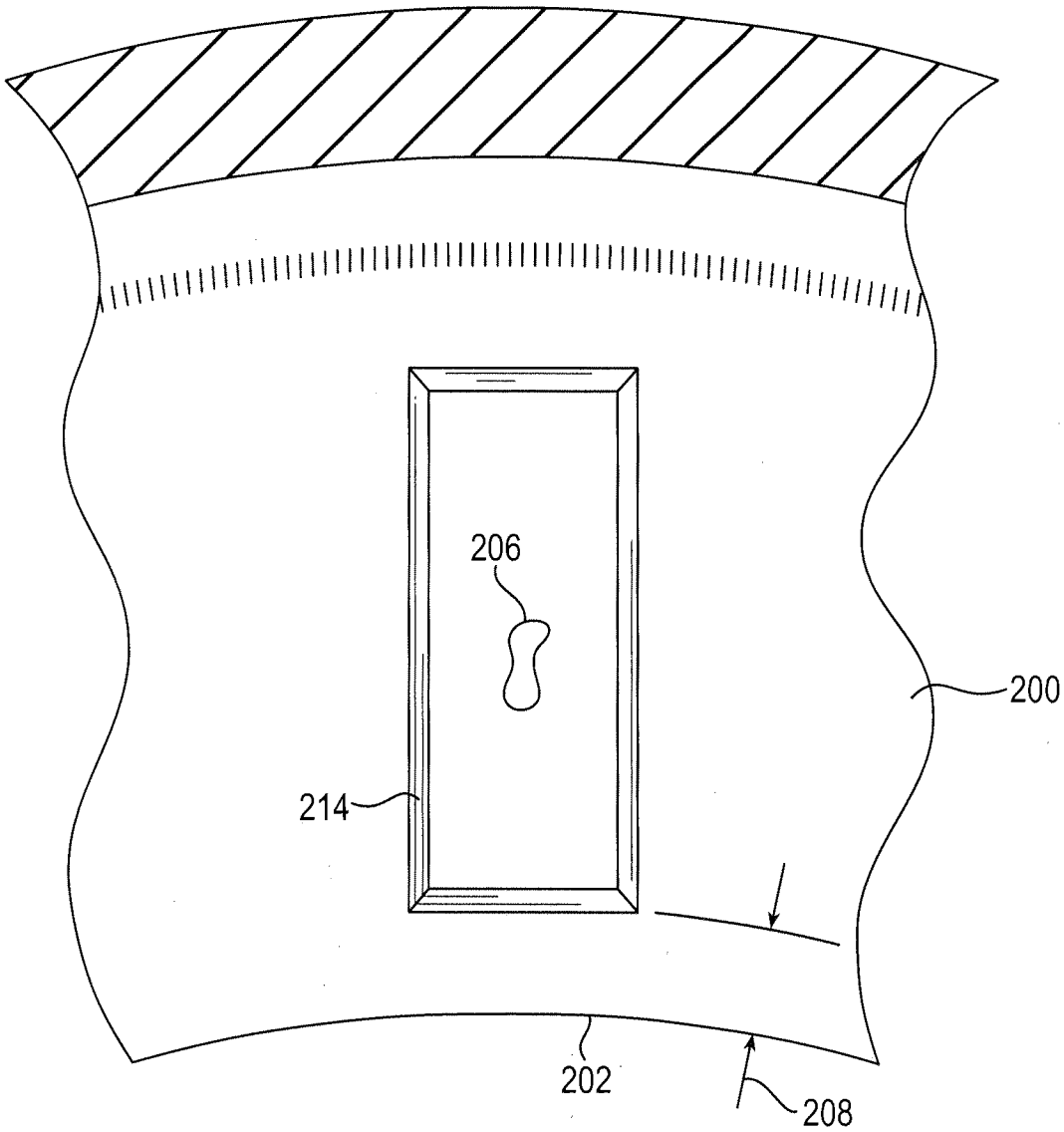

FIG. 9

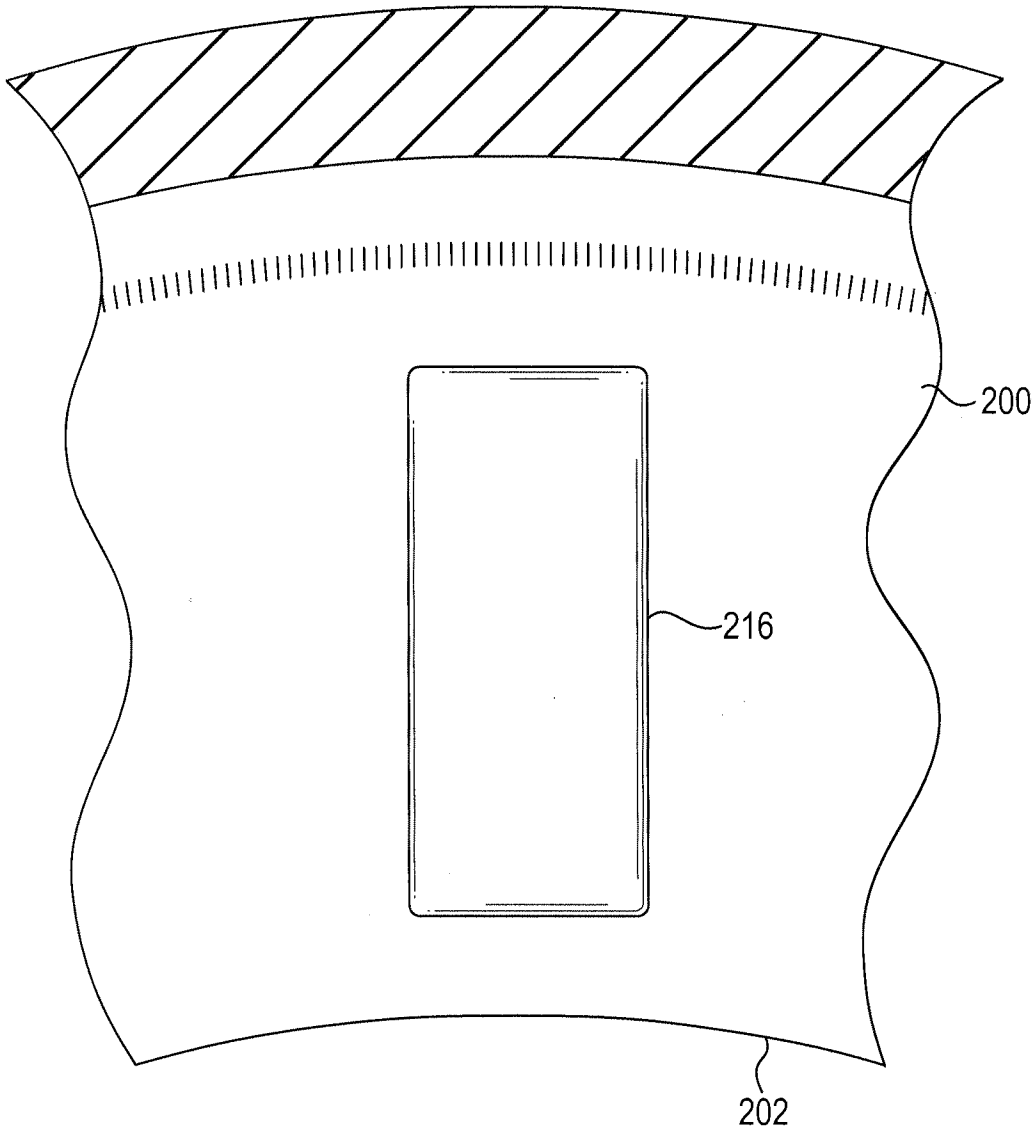

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US13/52991

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B29C 73/10 (2013.01)
USPC - 152/367; 156/94
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)
IPC(8): B29C 73/10; B24B 27/00; B29C 73/00 (2013.01)
USPC: 152/367, 430; 156/64, 94, 97, 98; 451/1, 17, 22, 25, 26

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)
MicroPatent (US Granted, US Applications, EP-A, EP-B, WO, JP, DE-G, DE-A, DE-T, DE-U, GB-A, FR-A); Google; Google Scholar; ProQuest; IP.com; keywords: tire, tyre, sidewall, repair, patch. template, dimension, bead, offset, computer, control, graduation

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Cetech Section Repair of A Radial Earthmover Tire With Sidewall Damage. Repair Manual RM-12 [online]. Tech Tire Repairs, May 5, 2010 [retrieved on 2013-11-19]. Retrieved from the Internet: <URL: https://web.archive.org/web/20100525055920/http://www.techtirerepairs.com/_assets/documents/RepairManuals/RM-12%20%20Radial%20Earthmover%20Tire%20Repair.pdf>; entire document	1-20
A	Cetech Crown Section Repair Manual. Repair Manual RM-10 [online]. Tech Tire Repairs, October 11, 2010 [retrieved on 2013-11-19]. Retrieved from the Internet: <URL: https://web.archive.org/web/20101011101050/http://www.techtirerepairs.com/_assets/documents/RepairManuals/RM-10%20%20%20Centech%20Crown%20Repair.pdf>; entire document	1-20
A	US 2007/0232195 A1 (REPPEL E. W.) October 4, 2007; entire document	1-20
A	US 4,333,508 A (DIROCCO J. et al.) June 8, 1982; entire document	1-20
A	US 8,442,670 B2 (CHEBLI A. et al.) May 14, 2013; entire document	1-20
A	WO 2009/157947 A1 (COLBY E. B. et al.) December 30, 2009; entire docuemnt	1-20
A	WO 2012/057795 A1 (IKONOMOV M. L. et al.) May 3, 2012; entire docuement	1-20

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

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Date of the actual completion of the international search	Date of mailing of the international search report
01 December 2013 (01.12.2013)	24 DEC 2013
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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