



(51) International Patent Classification:

B60B 17/00 (2006.01)

(21) International Application Number:

PCT/US2020/020908

(22) International Filing Date:

04 March 2020 (04.03.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/814,044 05 March 2019 (05.03.2019) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: CONDUCTIVE RUBBER BLOCK FOR A RAIL WHEEL AND ASSOCIATED METHODS

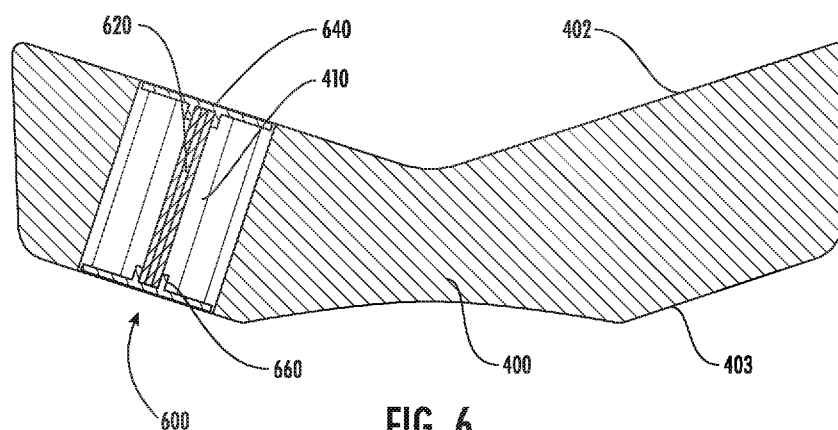


FIG. 6

(57) Abstract: Electrical grounding devices, systems, and methods of manufacture and use thereof are advantageously implemented in providing electrical grounding between electrically conductive elements between when it is desired to maintain a continuous and uninterrupted gap during normal operation. One example embodiment for the implementation of such electrical grounding devices, systems, and methods of manufacture and use is in a railcar wheel assembly. Such systems can include inner and outer wheel portions arranged concentrically about each other, with rubber blocks having one or more grounding shunts passing through a thickness thereof being arranged between the inner and outer wheel portions in a compression-fit manner, the grounding shunts being in electrical contact with each of both of the inner and outer wheel portions to conduct an electrical current therebetween.



Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

CONDUCTIVE RUBBER BLOCK FOR A RAIL WHEEL AND ASSOCIATED METHODS

CROSS-REFERENCE TO RELATED APPLICATIONS

- 5 **[0001]** This application claims priority to U.S. Provisional Patent Application Serial No. 62/814,044, filed March 5, 2019, the disclosure of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

- 10 **[0001]** The subject matter disclosed herein relates to systems and methods for electrical current discharge. In particular, the presently disclosed subject matter relates to systems for electrical current discharge across an insulating element installed in a railcar wheel, as well as associated methods of use and manufacture thereof.

BACKGROUND

- 15 **[0002]** Rail transport has been used throughout modern history as a way of moving people and cargo over large distances. At first, solid wheels were used to move railcars along the rails. However, owing to the metal-to-metal contact between the wheels and the rails, significant vibration was transmitted into the railcars by these solid wheels. It is now known, as shown in the example illustrations of FIGS. 1-3, for wheels, generally designated **10**, used in rail transportation to have a multi-part design, having at least concentric inner and outer wheel portions **20**, **30** that are separated from, and connected to, each other by one or more rubber blocks **40** that are retained within a channel defined between the outer circumferential edges of the inner and outer wheel portions. These rubber blocks **40** act, typically in conjunction with a suspension installed on the railcar itself, to dissipate or otherwise damp vibratory or other force inputs into the outer wheel portion **30** from the rail with which the wheel **10** is in contact. The compliance of the rubber blocks **40** enables relative radial deflections of the inner wheel portion **20** relative to the outer wheel portion **30** when a force input is received from the rail by the outer wheel portion **30**. Furthermore, the compliant aspects allow for reduced motion transfer between the inner and outer wheel portions **20**, **30**. As shown in the example arrangement shown in FIGS. 1-3, the rubber blocks **40** are shown being retained within respective “C” channels formed
- 25
- 30

between the inner and outer wheel portions **20**, **30**. Each rubber block **40** is pre-compressed when installed between the inner and outer wheel portions **20**, **30** and a small gap **50** (e.g., a continuous and uninterrupted seam) is present between the inner and outer wheel portions **20**, **30**, such that the inner wheel portion **20** does not contact
5 the outer wheel portion **30** (e.g., by translator movement in the radial direction) during normal operation of the wheel **10**.

[0003] During normal operation, it is necessary to dissipate static electricity that accumulates in/on the wheel **10** through a grounding path. For this electrical grounding to be effective, potentially large amounts of electrical current must be
10 transferred from the railcar into the rail, via the rail wheels **10**, in order to ensure safe operation of the railcar. In solid wheel systems, the conductive metal wheel acts as a conduction path to ground the railcar, but in modern-day compliant railcar wheel systems, such as in wheel **10** in FIGS. 1-3, where the inner and outer wheel portions **20**, **30** are separated by an insulative damper, for example, the plurality of rubber
15 blocks **40**, no direct conduction path exists between the inner and outer wheel portions **20**, **30**, which would otherwise allow for the electric current to be transmitted from the inner wheel portion **20**, into the outer wheel portion **30**, and ultimately into the rail with which the outer wheel portion **30** is in direct (e.g., rolling) contact. As such, it has been necessary to electrically connect the inner wheel portion **20** to the outer
20 wheel portion **30**. Presently known designs require a grounding shunt **60** to be electrically connected, at a first end thereof, to the inner wheel portion **20** and, at a second end thereof, to the outer wheel portion **30**, thereby establishing an electrical conduction path between the inner and outer wheel portions **20**, **30**. These grounding shunts **60** are typically made of braided copper wire **62**, with stainless steel end flanges
25 **64** attached at the ends of the wire **62** by a wire-flange coupler **66** to allow for mechanical and electrical connection to the respective outer faces of the inner and outer wheel portions **20**, **30**.

[0004] However, these grounding shunts **60** are prone to failure, for example, by breaking off at one or more of the surfaces of the inner and/or outer wheel portions
30 **20**, **30** to which the grounding shunts **60** are connected, leading to increases in maintenance costs for railcar operators due to the need to routinely inspect and replace broken grounding shunts **60** in order to allow for safe operation of the railcar to which

the wheel **10** is attached. In most instances, the end flanges **64** are screwed, welded, soldered, *etc.* onto the outer face of the inner and outer wheel portions **20, 30**. In some instances, the attachment points formed on the inner and outer wheel portions **20, 30** act as stress concentration points, such that the structural integrity of the respective
5 inner and/or outer wheel portions **20, 30** themselves can become compromised, e.g., by vibration of, and relative movement between, the inner and outer wheel portions **20, 30** that can cause metal fatigue. It is known that such metal fatigue can introduce micro cracks and the like during normal operation of the railcar wheel **10**. In some other instances, where the mechanical attachment of the end flange **64** to the
10 respective inner or outer wheel portion **20, 30** fails due to a foreign object striking it, whichever of the inner and/or outer wheel portion **20, 30** to which the end flange **64** of the grounding shunt **60** was attached may also experience significant damage due to the rupturing of the mechanical attachment between the grounding shunt **60** and the inner and/or outer wheel portions **20, 30**. Regardless of the particular failure
15 mechanism, it is known from the prior art that the outer faces of the inner and outer wheel portions **20, 30** on which the end flanges **64** of the grounding shunts **60** are mechanically attached can suffer significant damage upon a failure of the mechanical retention of the end flange **64** to the respective one of the inner and/or outer wheel portions **20, 30**, which requires removal and replacement or disassembly and
20 refurbishment of the entire wheel **10** of the railcar. Considering the size and costs associated with installation, removal, and servicing of a wheel **10** of a railcar, as well as the costs of the wheel itself, the failure of even a single grounding shunt **60** as disclosed in the prior art can result in a significant financial impact, both in terms of the labor and costs associated with removal and repair/replacement of such a wheel
25 **10**, but also from the associated downtime of the railcar to which the wheel **10** is attached while the maintenance service is performed.

[0005] As such, a need exists for a system for electrical current discharge across an insulating element installed in a wheel of a railcar and associated methods of use and manufacture.

30

SUMMARY

[0006] An electrical grounding device for a railcar wheel assembly is provided. The electrical grounding device comprises: a rubber block comprising a through-hole formed through an entirety of a thickness of the rubber block, wherein the rubber
5 block is configured to be compressively arranged between an inner wheel portion and an outer wheel portion of a railcar wheel assembly and provide vibrational isolation between the inner and outer wheel portions; and a grounding shunt comprising: a cable disposed through the through-hole; a first flange attached to a first end of the cable; and a second flange attached to a second end of the cable; wherein the first flange is
10 configured to electrically contact the inner wheel portion and the second flange is configured to electrically contact the outer wheel portion; and wherein the cable is configured to conduct an electrical current between the inner wheel portion and the outer wheel portion through the rubber block.

[0007] In some embodiments of the device, the cable is a flexible cable
15 comprising braided strands of electrically conductive wire.

[0008] In some embodiments of the device, the through-hole has a diameter that is larger than a diameter of the cable.

[0009] In some embodiments of the device, the grounding shunt has a length that is substantially similar to an uncompressed thickness of the rubber block.

20 [0010] In some embodiments of the device, the cable is configured to flex, bend, and/or deflect within the through-hole when the rubber block is compressed by relative movement between the inner and outer wheel portions, so that effectively no stiffness is added to the rubber block by the grounding shunt.

[0011] In some embodiments of the device, the first and/or second flanges
25 comprise one or more keyed portions, at least one flange insertion slot is provided in the rubber block, the at least one flange insertion slot being radially connected to the through-hole, and the at least one flange insertion slot is configured such that the first and/or second flanges can be inserted through the rubber block so that the cable is installed in the through-hole only when the first and/or second flanges are oriented

such that the one or more keyed portions can pass through the at least one flange insertion slot.

[0012] In some embodiments of the device, the first and second flanges each comprise a collar, each collar being rigidly connected to the cable at one of the first
5 and second ends thereof.

[0013] In some embodiments of the device, the rubber block comprises, on both a radially inner surface and on a radially outer surface of the rubber block, a flange recess configured such that one of the first and second flanges rest within the flange recess on whichever of the radially inner or outer surfaces that the first or second
10 flange is arranged when the grounding shunt is installed within the rubber block.

[0014] In some embodiments of the device, the flange recesses have a depth in a direction of the thickness of the rubber block such that, when the grounding shunt is installed within the rubber block, a surface of the first flange by which the first flange contacts the inner wheel portion is substantially coplanar to the radially inner surface
15 of the rubber block and a surface of the second flange by which the second flange contacts the outer wheel portion is substantially coplanar to the radially outer surface of the rubber block.

[0015] An electrical grounding system for a railcar wheel assembly is provided. The electrical grounding system comprises: an inner wheel portion; an outer wheel
20 portion arranged concentrically around the inner wheel portion to define a channel between the inner and outer wheel portions; a plurality of rubber blocks, each of which comprises a through-hole formed through an entirety of a thickness of the rubber block, wherein the rubber blocks are arranged radially about the railcar wheel assembly within the channel by compression to provide vibrational isolation between
25 the inner and outer wheel portions and to space the inner wheel portion apart from the outer wheel portion, thereby defining an annular gap between the inner and outer wheel portions when the inner and outer wheel portions are in an undeflected position; and a plurality of grounding shunts, each of the grounding shunts being arranged to pass through a corresponding through-hole of one of the plurality of rubber block,
30 each of the grounding shunts comprising: a cable disposed through the through-hole; a first flange attached to a first end of the cable; and a second flange attached to a

second end of the cable; wherein each of the first flanges is configured to electrically contact the inner wheel portion and each of the second flanges is configured to electrically contact the outer wheel portion; and wherein each cable is configured to conduct an electrical current between the inner wheel portion and the outer wheel
5 portion through the rubber block in which the cable is disposed.

[0016] In some embodiments of the system, each cable is a flexible cable comprising braided strands of electrically conductive wire.

[0017] In some embodiments of the system, each through-hole has a diameter that is larger than a diameter of the cable arranged therein.

10 [0018] In some embodiments of the system, each grounding shunt has a length that is substantially similar to an uncompressed thickness of the rubber block through which the grounding shunt is installed.

[0019] In some embodiments of the system, each cable is configured to flex, bend, and/or deflect within the through-hole when the rubber block is compressed by
15 relative movement between the inner and outer wheel portions, so that effectively no stiffness is added to the rubber block by the grounding shunt.

[0020] In some embodiments of the system, the first and/or second flanges comprise one or more keyed portions, at least one flange insertion slot is provided in each rubber block, the at least one flange insertion slot being radially connected to the
20 through-hole, and the at least one flange insertion slot is configured such that the first and/or second flanges can be inserted through the rubber block so that the cable is installed in the through-hole only when the first and/or second flanges are oriented such that the one or more keyed portions can pass through the at least one flange insertion slot.

25 [0021] In some embodiments of the system, the first and second flanges each comprise a collar, each collar being rigidly connected to the cable at one of the first and second ends thereof.

[0022] In some embodiments of the system, each rubber block comprises, on both a radially inner surface and on a radially outer surface of the rubber block, a flange

recess configured such that one of the first and second flanges rest within the flange recess on whichever of the radially inner or outer surfaces that the first or second flange is arranged when the grounding shunt is installed within a respective one of the plurality of rubber blocks.

5 **[0023]** In some embodiments of the system, the flange recesses have a depth in a direction of the thickness of the rubber block such that, when the grounding shunt is installed within the rubber block, a surface of each first flange by which each such first flange contacts the inner wheel portion is substantially coplanar to the radially inner surface of a respective one of the rubber blocks and a surface of each second
10 flange by which each such second flange contacts the outer wheel portion is substantially coplanar to the radially outer surface of a respective one of the rubber blocks.

[0024] A method of manufacturing an electrical grounding device for a railcar wheel assembly is provided. The method comprises: providing a rubber block that can
15 be compressively arranged between an inner wheel portion and an outer wheel portion of a railcar wheel assembly and provide vibrational isolation between the inner and outer wheel portions; forming a through-hole and at least one flange insertion slot radially connected to the through-hole through an entirety of a thickness of the rubber block; forming a grounding shunt by attaching a first electrically conductive flange to
20 a first end of an electrically conductive cable and by attaching a second electrically conductive flange to a second end of the cable, wherein the first end is an opposite end of the cable from the second end; inserting the first flange into the rubber block via the at least one flange insertion slot and the through-hole; and passing the first flange through the thickness of the rubber block, so that the cable is located
25 substantially entirely within the through-hole and the second flange is on an opposite side of the rubber block from the first flange, wherein the first and second flanges are arranged proximate to a respective outer surface of the rubber block when the grounding shunt is installed within the rubber block.

[0025] In some embodiments of the method, the cable is a flexible cable
30 comprising braided strands of electrically conductive wire.

[0026] In some embodiments of the method, the through-hole has a diameter that is larger than a diameter of the cable.

[0027] In some embodiments of the method, the grounding shunt has a length that is substantially similar to an uncompressed thickness of the rubber block.

5 [0028] In some embodiments of the method, the cable is configured to flex, bend, and/or deflect within the through-hole when the rubber block is compressed by relative movement between the inner and outer wheel portions, so that effectively no stiffness is added to the rubber block by the grounding shunt.

[0029] In some embodiments of the method, the rubber block is compressed and
10 inserted within a channel formed between the inner and outer wheel portions of the railcar wheel assembly.

[0030] In some embodiments of the method, the first and/or second flanges comprise one or more keyed portions, and the at least one flange insertion slot has a cross-sectional shape that is compatible with the one or more keyed portions, such
15 that the cable can only be installed in the through-hole when the first and/or second flanges are oriented such that the one or more keyed portions can pass through the at least one flange insertion slot.

[0031] In some embodiments of the method, the first and second flanges each comprise a collar, each collar being rigidly connected to the cable and the first and
20 second ends thereof.

[0032] In some embodiments, the method comprises: forming flange recesses in the rubber block at opposing ends of the through-hole, on respective radially inner and outer surfaces of the rubber block; and arranging the first and second flanges within one of the flange recesses when the grounding shunt is installed within the rubber
25 block.

[0033] In some embodiments of the method, the flange recesses have a depth in a direction of the thickness of the rubber block, such that, when the grounding shunt is installed within the rubber block, a surface of the first flange by which the first flange contacts the inner wheel portion is substantially coplanar to the radially inner surface

of the rubber block and a surface of the second flange by which the second flange contacts the outer wheel portion is substantially coplanar to the radially outer surface of the rubber block.

[0034] A method of electrically grounding a railcar wheel assembly is provided.

- 5 The method comprises: arranging an outer wheel portion concentrically around an inner wheel portion to define a channel between the inner and outer wheel portions of the railcar wheel assembly; inserting a plurality of rubber blocks within the channel radially about the railcar wheel assembly, wherein one or more of the plurality of rubber blocks are electrical grounding devices comprising a rubber block comprising
- 10 a through-hole formed through an entirety of a thickness of the rubber block, wherein the rubber block is configured to be compressively arranged between an inner wheel portion and an outer wheel portion of a railcar wheel assembly and provide vibrational isolation between the inner and outer wheel portions; and a grounding shunt comprising: a cable disposed through the through-hole; a first flange attached to a first
- 15 end of the cable; and a second flange attached to a second end of the cable; wherein the first flange is configured to electrically contact the inner wheel portion and the second flange is configured to electrically contact the outer wheel portion; and wherein the cable is configured to conduct an electrical current between the inner wheel portion and the outer wheel portion through the rubber block, and wherein a
- 20 radial distance between surfaces by which the rubber blocks contact the inner and outer wheel portions is smaller than a thickness of the rubber blocks, so that the plurality of rubber blocks are compressed within the channel; and conducting an electrical current between the inner wheel portion and the outer wheel portion via the grounding shunts to dissipate and electrical charge generated by a railcar to which the
- 25 railcar wheel assembly is rotatably attached.

[0035] In some embodiments of the method, each cable is a flexible cable comprising braided strands of electrically conductive wire.

[0036] In some embodiments of the method, each through-hole has a diameter that is larger than a diameter of the cable arranged therein.

[0037] In some embodiments of the method, each grounding shunt has a length that is substantially similar to an uncompressed thickness of the rubber block through which the grounding shunt is installed.

5 [0038] In some embodiments of the method, each cable is configured to flex, bend, and/or deflect within the through-hole when the rubber block is compressed by relative movement between the inner and outer wheel portions, so that effectively no stiffness is added to the rubber block by the grounding shunt.

[0039] In some embodiments, the method comprises: forming one or more keyed portions on the first and/or second flanges; forming at least one flange insertion slot
10 in each rubber block, the at least one flange insertion slot being radially connected to the through-hole, and inserting the first flange and/or the second flange through one of the rubber blocks, so that the cable is installed in the through-hole, wherein the cable can only be installed in the through-hole when the first and/or second flanges are oriented such that the one or more keyed portions can pass through the at least one
15 flange insertion slot.

[0040] In some embodiments of the method, the first and second flanges each comprise a collar, each collar being rigidly connected to the cable at one of the first and second ends thereof.

[0041] In some embodiments of the method, each rubber block comprises, on both
20 a radially inner surface and on a radially outer surface of the rubber block, a flange recess in which one of the first and second flanges rest when the grounding shunt is installed within a respective one of the plurality of rubber blocks.

[0042] In some embodiments of the method, the flange recesses have a depth in a direction of the thickness of the rubber block such that, when the grounding shunt is
25 installed within the rubber block, a surface of each first flange by which each such first flange contacts the inner wheel portion is substantially coplanar to the radially inner surface of the rubber block and a surface of each second flange by which each such second flange contacts the outer wheel portion is substantially coplanar to the radially outer surface of a respective one of the rubber blocks.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0043] FIG. 1 shows an embodiment from the prior art of a grounding shunt connected across a multi-part rail wheel.
- [0044] FIG. 2 shows an embodiment from the prior art of the grounding shunt shown in FIG. 1, according to the prior art.
- [0045] FIG. 3 schematically shows a cross-sectional view of embodiment of the grounding shunt connected across the multi-part rail wheel of FIG. 1.
- [0046] FIG. 4 shows an embodiment of a grounding shunt capable of passing through the thickness of a rubber block in a multi-part rail wheel assembly.
- 10 [0047] FIG. 5 shows an embodiment of a rubber block that is installed between the inner and outer portions of a multi-part rail wheel, the rubber block being able to have the grounding shunt of FIG. 4 installed therein.
- [0048] FIG. 6 shows an embodiment of the grounding shunt of FIG. 4 installed within the rubber block of FIG. 5.
- 15 [0049] FIG. 7 schematically shows a cross-sectional view of embodiment of the grounding shunt connected across a multi-part rail wheel.
- [0050] FIGS. 8A-8D show respective side profiles of rubber blocks suitable for use in a multi-part rail wheel assembly.
- [0051] FIG. 9 is an example embodiment showing the multi-part wheel assembly, including the rubber block and the grounding shunt, in an assembled configuration.
- 20 [0052] FIGS. 10A and 10B are cross-sectional views of the example embodiment of the multi-part wheel assembly of FIG. 9.

DETAILED DESCRIPTION

- [0053] This disclosure relates to devices, systems, and methods for providing electrical grounding between two (e.g., inner and outer) railcar wheel portions **20, 30** that are physically and electrically isolated from each other by a plurality of

electrically insulating rubber blocks **400** arranged circumferentially between the inner and outer wheel portions **20, 30** of a railcar wheel assembly **100**. Unlike in such wheels **10** as are known from the prior art and shown in FIGS. 1-3, which require connections of a grounding shunt **60** external to the respective inner and outer wheel portions **20, 30**, the presently disclosed electrical grounding devices comprise a flexible grounding shunt **600** that is installed through a thickness of one or more of (e.g., a plurality of, or all of) the rubber blocks **400**, such that the grounding shunts **600** are substantially fully enclosed within a cavity formed through the rubber block **400** and enclosed on each end by the radial surfaces of the inner and outer wheel portions **20, 30**, respectively, thereby substantially isolating the grounding shunts **600** from degradation due to environmental conditions (e.g., moisture, heat, etc.). Additionally, by virtue of being positioned internal to the railcar wheel assembly **100**, the grounding shunts **600** also are in a position less likely to experience mechanical failure, whether from foreign object impacts or metal fatigue that occurs during normal use of such prior art electrical grounding shunts **60**.

[0054] Unlike the rigid attachments of the end flanges (e.g., **64**, FIG. 2) to the inner and outer wheel portions **20, 30** known from the prior art, the presently disclosed electrical grounding shunt **600** shown in at least FIG. 4 comprises a flange **640** at each end that is not rigidly connected to either of the inner or outer wheel portions **20, 30**. The flange **640** may be formed as a substantially flat washer that is formed by any suitable forming process, such as, for example, stamping. As shown, each flange comprises a collar **660**, or any other suitable structure, that connects each flange **640** to an end of a wire, or cable **620**, of the grounding shunt **600** that extends between the opposing flanges **640** and defines substantially the entire length of the grounding shunt **600**. In some embodiments, the collar **660** may be omitted and the cable **620** can be directly attached, for example, by brazing, to the flange **640**. In some other embodiments, a hole may be formed through at least a thickness of the flange **640**, such that the cable **620** passes through, or is disposed at least partially through (e.g., entirely through) the flange **640** to facilitate sufficiently precise attachment of the cable **620** to the flange **640**. In embodiments having a hole entirely through the thickness of the flange **640**, it is advantageous to subsequently remove (e.g., by grinding, cutting, melting, and the like) any portion of the cable **640** that extends beyond the outer surface of the flange **640** (e.g., prior to the protruding portion of the

cable **640** being removed) to ensure a sufficient contact area between the flange **640** and whichever of the inner or outer wheel portions **20, 30** against which the flange **640** will be arranged when the grounding shunt **600** is in an installed position within the railcar wheel assembly **100**.

- 5 **[0055]** In the embodiment shown, the flange **640** has a substantially planar outer surface area, but it may be advantageous in some embodiments for the flange **640** to have a curved profile that is substantially similar to, or the same as, the curvature of the radial surface of the inner or outer wheel portion **20, 30** against which the flange **640** will be in contact when installed in the railcar wheel assembly **100**. In some
- 10 embodiments, the flange **640** may have a thickness and/or be made of a sufficiently ductile material that the flange **640** will conform to (e.g., assume substantially the same shape as) the curvature of the inner or outer wheel portion **20, 30** against which the flange **640** will be in contact when installed in the railcar wheel assembly **100**, such that the flange **640** is a substantially planar surface prior to installation and has a
- 15 curvature (e.g., is bent) after being installed within the railcar wheel assembly **100**. The cable **620** is formed as individual conductors (e.g., electrically conductive wires) that are braided together so that the cable **620** is flexible and can deflect within a deflection region **420** provided within the rubber block **400** more freely than a substantially similarly sized solid conductor wire, which would be significantly stiffer
- 20 and would therefore suffer from premature wear and, ultimately, premature failure. The deflection region **420** can be provided along a length of, or one or more portions of the length of, the through-hole **410**. The cable **620** may be formed from any suitably electrically conductive material, such as, for example, copper. The flanges **620** may be formed from any suitably electrically conductive material, such as, for example,
- 25 steel or stainless steel. The flanges **640** may be secured to the cable **620** using any sufficiently rigid type of mechanical attachment, including, for example, brazing, crimping, welding, and the like. As such, while the flanges **640** are rigidly connected to the cable **620**, the cable **620** remains flexible (e.g., can be bent and/or deflected into a curved, or nonlinear, shape) between the attachment regions defined generally by
- 30 the collar **660** of each of the flanges **640**. In some embodiments, the cable **620** and/or flanges **640** are plated with any suitable metallic coating to provide additional corrosion resistance.

[0056] As shown in FIGS. 5 and 6, the example embodiment of one or more of the rubber blocks **400** of the railcar wheel assembly **100** has, on each side relative to the thickness direction thereof, a flange recess **440** formed therein to accommodate the flange **640** of the grounding shunt **600**. In the embodiment shown, the flange
5 recesses **440** are substantially axially aligned about a through-hole **410** passing through the entire thickness of the rubber block **400** and defining a passage through the thickness of the rubber block **400**. The through-hole **410** has a larger diameter than the diameter of the cable **620** so that the cable **620** can flex, be bent, and/or be deformed by a compression of the rubber block **400** and, therefore, also of the
10 grounding shunt **600**, between the inner and outer wheel portions **20**, **30** while the cable **620** is installed within the through-hole **410**. The deflection region **420** can be provided along a length of, or one or more portions of the length of, the through-hole **410**. In some embodiments, the deflection region **620** is oriented longitudinally to the length of extension of the through-hole **410** and is attached to the through-hole within
15 the rubber block **400**.

[0057] Due to the diameter of the through-hole **410** being larger than the diameter of the cable **620** passing through the through-hole **410** and also because the of the provision of the deflection region **420**, the flexing, bending, and/or deformation of the cable **620** of the grounding shunt **600** during compression of the rubber block **400** as
20 the inner wheel portion **20** moves relative to the outer wheel portion **30** adds no additional effective stiffness to the stiffness provided by the rubber block **400** itself. The relatively enlarged diameter of the through-hole **410** through the thickness of the rubber block **400** also acts to mitigate and/or reduce the creation of pinch points between the rubber block **400** and the cable **620**, which could otherwise cause a
25 decrease in the life of the grounding shunt **620** and/or of the rubber block **400**. As such, the opposing flange recesses **440** are connected through the thickness of the rubber block **400** by the through-hole **410** formed therethrough.

[0058] In some embodiments, the flange recesses **440** may be axially offset from each other, such that the through-hole **410** is inclined, relative to the thickness
30 direction of the rubber block **400**. In such embodiments, it can be advantageous to have the cable **620** be connected to one or both of the flanges **640** at an inclined angle, such that, when the cable **620** is not in a deflected position, the cable **620** is vertically

inclined, and not perpendicular, relative to one or both of the flanges 640. In some such embodiments, the engagement angle between the cable 620 and a first flange 640 at a first end of the grounding shunt 600 can be different from the engagement angle between the cable 620 and a second flange 640 at a second end of the grounding shunt 600. The flange recess 440 has a shape corresponding substantially to the perimeter of the flange 640, as measured, for example, in a plane perpendicular to the axial direction of the cable 620, to accommodate the contact surface of the flange 640 within the flange recess 440. The depth of the flange recess 440 is advantageously substantially the same as the thickness of the flange 640, excluding the height of the collar 660, but the depth of the flange recess 440 may be any value as long as the flange 640 will contact the corresponding radial contact surface of the inner or outer wheel portion 20, 30.

[0059] In order to allow for one of the flanges 640 to be able to be inserted through the through-hole 640, such that the grounding shunt passes through a thickness of the rubber block 400, lateral flange insertion slots 430 are formed on substantially opposing sides of the through-hole 410. Thus, each of the flange insertion slots 430 extend through the entire thickness of the rubber block 400. The dimensions of each flange insertion slot 430, including the through-hole 410, is are sufficiently large to allow for the flange 640, as well as the collar 660 and the cable 620 to pass therethrough during installation of the grounding shunt 600 in the rubber block 400. In some embodiments, it is advantageous for the flange insertion slots 430 and the through-hole 410 to have a width that is at least the width of the keyed portion 645 of the flanges. In some embodiments, the dimensions of the flange insertion slots 430 and the through-hole 410 remain substantially constant throughout the thickness of the rubber block 400. It is advantageous for the flange insertion slots 430 to be arranged on diametrically opposite sides of the through-hole 410 so that the dimensions of the flange insertion slots 430 can be minimized. In embodiments where the flanges 640 have a contoured (e.g., non-planar) surface, it is advantageous for the flange insertion slots 430 to be arranged offset about the through-hole 410 from a diametrically opposite arrangement, the degree of offset corresponding to the shape of the contour of the profile of the flange 640. In such embodiments, the flange insertion slots 430 may have a curved profile to better accommodate the curved profile shape of the flange 640. The grounding shunt 600 has a length that is substantially the

same as the thickness of the uncompressed rubber block **400**, such that the rubber block **400** is not pre-compressed by the grounding shunt **600** and the grounding shunt **600** does not protrude substantially from the inner and outer surfaces of the rubber block **400** prior to assembly of the railcar wheel assembly **100**.

5 **[0060]** The rubber block **400** comprises a deflection region **420** that extends through at least a portion of the thickness of the rubber block **400**. In some embodiments, the deflection region **420** can be provided to accommodate the portion of the cable **620** adjacent to and connected to the flange **640** that must flex, bend, and/or deflect when the flanges **640** of the grounding shunt **600** are compressed
10 together during and after the installation of the rubber block(s) **400** between the inner and outer wheel portions **20**, **30**. In some embodiments, the deflection region **420** extends through the entire thickness of the rubber block **400**. The deflection region **420** is formed as a radial protrusion from the through-hole, separate from the radial protrusions embodied by the flange insertion slots **430**, into which the cable **620** can
15 be deflected when the grounding shunt **600** is compressed and the effective length thereof is decreased when the rubber block **400** in which the grounding shunt **600** is inserted is installed within a railcar wheel assembly **100**. In some embodiments, the deflection region **420** can be formed as a part of one or both of the flange insertion slots **430**, such that flange insertion slots **430** into which the deflection region **420** is
20 integrated can have a non-uniform cross-sectional width. When the rubber block **400** is compressed between the circumferential contact surfaces of the inner and outer wheel portions **20**, **30** during assembly of the railcar wheel assembly **100**, the grounding shunt **600** itself is also compressed, thereby resulting in a “bowing” or “bending” lateral deflection of the cable **620** into the deflection region **420**. Depending
25 on the dimensions of the deflection region **420**, the length of the cable **620**, and the degree of compression of the grounding shunt **600** within the rubber block **400**, the cable **620** may experience a single bowing deflection or multiple deflections, an example of which can be seen in a sine wave. In some embodiments, an abrasion resistant coating can be applied over all, substantially all, or portions of the length of
30 the cable **620** to reduce frictional wear between the cable **620** and the rubber block **400**, such that the through-hole **410** is not substantially enlarged over a period of time by frictional contact between the cable **620** and the rubber block **400** during normal operation of the railcar wheel assembly **100**.

[0061] When the rubber block(s) **400** are compressed within the circumferential space between the inner and outer portions **20, 30**, the flanges **640** of the grounding shunt **600** are pressed against the circumferential contact surfaces of the respective inner and outer wheel portions **20, 30**, with the rubber block **400** exerting a radially outwardly directed pressure on the flanges **640** of the grounding shunt **600** to enable the flanges **640** to contact the inner or outer wheel portions **20, 30** over a larger surface area. Through this radially outwardly directed pressure acting on the flanges **640**, a curvature may be induced, through either plastic or elastic deformation, in one or more of the flanges **640** that can have an outer surface that is substantially planar prior to compression of the grounding shunt **600** within the rubber block **400**.

[0062] FIG. 7 is a schematic cross-sectional view of an example embodiment of a railcar wheel assembly **100** in an assembled state. To more clearly illustrate the arrangement of the elements in the railcar wheel assembly **100**, gaps are shown between structural elements that are actually in contact with each other when in an assembled and non-deflected configuration of the railcar wheel assembly **100**. The inner wheel portion **20** and the outer wheel portion **30** each comprise a channel having a “C” shape. The inner and outer wheel portions **20, 30** are arranged opposite each other to form a substantially rectangular region in which the rubber blocks **400** are installed. In an installed position, the opposing lateral flanges **640** of the channels of the inner and outer wheel portions **20, 30** are spaced apart from each other by the rubber block **400** to define a gap **50** that is continuous and uninterrupted along the entire outer circumference of the inner wheel portion **20** and along the entire inner circumference of the outer wheel portion **30**. As such, the inner wheel portion **20** is isolated from, and does not contact, the outer wheel portion **30** during normal operation of the railcar wheel assembly **100**. In some aspects, the outer wheel portion **30** may come in contact with the inner wheel portion **20** temporarily when a force of significant magnitude is imparted to the outer wheel portion **30** in a radially inwardly-directed direction, the force having a magnitude sufficiently large enough to cause a radial subset of each of the rubber blocks **400** adjacent to the location of the input force to be compressed to a sufficient degree that the inner and outer wheel portions **20, 30** contact each other, resulting in a temporary loss of the compliant aspects of the railcar wheel assembly. Just as the rubber block **400** exerts a radially-oriented force on the inner and outer wheel portions **20, 30** when compressed, so does the grounding

shunt **600** when the cable **620** is deformed within the through-hole **410** due to the compression and installation of the rubber block **400** within the cavity formed between the channels of the inner and outer wheel portions **20**, **30**. This radially-oriented force exerted by the grounding shunt **600**, pressing each flange **640** against the respective
5 circumferential contact surface of the inner or outer wheel portions **20**, **30**, acts to ensure adequate electrical contact between the flange **640** and the circumferential contact surface of the inner or outer wheel portion **20**, **30** against which the flange **640** is arranged.

[0063] FIGS. 8A through 8D show various example profile shapes of rubber
10 blocks **400A** through **400D**, into which the presently disclosed grounding shunt **600** can be integrated to provide the amount of electrical grounding disclosed herein. In addition to the examples shown herein, the rubber blocks **400** of a wheel **100** may be formed in any suitable profile shape, without limitation, and grounding shunts **600** may be installed within the rubber blocks **400** as disclosed elsewhere herein.

15 [0064] The number of rubber blocks **400** needed for a railcar wheel assembly can vary based on the load capable of being supported by the railcar and also based on the size of the railcar wheel assembly **100** itself. In any given railcar wheel assembly **100**, as few as one and as many as all of the rubber blocks **400** that are needed to mechanically connect the inner and outer wheel portions **20**, **30** together may be
20 provided with the grounding shunts **600** disclosed herein, which pass through the bodies of all of the rubber blocks **400** that are provided with features for the insertion of such grounding shunts **600**. In some embodiments, a single rubber block **400** may have a plurality of grounding shunts **600** installed therein, each such rubber block **400** having the same number of through-holes **410** and other associated features needed
25 for installation and retention of the quantity of grounding shunts **600** that are to be installed within such a rubber block **400**. The number of grounding shunts **600** that may be installed in a single rubber block **400** will generally be determined by the size of the grounding shunts **600** being installed, the size of the rubber block **400**, and the degree to which the mechanical properties of the rubber block **400** are altered, for
30 example, made less stiff, by the inclusion of further grounding shunts **600** and their associated installation features. The number of grounding shunts **600** needed for a given railcar wheel assembly is dictated, for example, by the amount of electric

current that must be dissipated, the uncompressed length of the grounding shunt **600**, and the required amount and/or degree of flexibility of the cable **620** of the grounding shunt **600**, which is largely dictated by the degree of compression the rubber block **400** will experience during installation and normal use of the railcar wheel assembly.

- 5 The wire gauge of the cable **620** and the number of grounding shunts **600** should be selected to ensure that, given a known flow of electrical current that must be dissipated between the inner and outer wheel portions **20**, **30** for a specified railcar, each grounding shunt **600** will experience a temperature rise of an acceptable magnitude, based on ambient environmental conditions in which the railcar wheel assembly will
- 10 be operable, such that the rubber blocks **400** will not prematurely degrade from being exposed to excessively high temperatures, for example, temperatures in excess of 180 °F. As such, since railcar wheel assemblies typically must be capable of being used in arid climates, where temperatures could reach 120 °F, it may be advantageous to select a wire gauge and number of grounding shunts **600** so that the temperature rise due to
- 15 current flowing through each grounding shunt **600** does not exceed 60 °F. It is particularly advantageous to apply a safety factor to the number of grounding shunts **600** and/or the wire gauge selected to ensure that failure of a predetermined number of electrical shunts will not cause catastrophic damage to the railcar wheel assembly, the railcar electrical system, occupants of the railcar, and the like.

- 20 **[0065]** FIGS. 9, 10A, and 10B show perspective assembly and cross-sectional views of an example embodiment of a multi-part wheel assembly, as also discussed elsewhere herein, including the rubber block **400** and the grounding shunt **600**, in an assembled configuration. The inner wheel portion **20** is shown being spatially separated from the outer wheel portion **30** by a gap **50**, with a plurality of rubber
- 25 blocks **400** being installed between the inner and outer wheel portions **20**, **30** to maintain the gap **50**. FIGS. 10A and 10B are respective cross-sectional and detailed sectional views of the example multi-part wheel assembly embodiment shown in FIG. 9, specifically showing an installed position of the grounding shunt **600** providing an electrical connection between the inner and outer wheel portions **20**, **30**, through the
- 30 rubber block **400**.

[0066] A method of manufacturing an electrical grounding device, such as a grounding shunt (**600**, FIG. 7) within a rubber block (**400**, FIG. 7) for a railcar wheel

assembly (100, FIG. 7) is provided. The method comprises: providing a rubber block 400 for providing vibration isolation between inner and outer wheel portions (20, 30, FIG. 7) of the railcar wheel assembly 100; forming a through-hole (410, FIG. 7) and at least one flange insertion slot (430, FIG. 5) connected to the through-hole 410 through a thickness of the rubber block 400; attaching electrically conductive flanges (640, FIG. 7) to opposing ends of an electrically conductive cable (620, FIG. 7) to form a grounding shunt 600; inserting a first flange 640 of the flanges 640 into the rubber block 400 via the at least one flange insertion slot 430 and the through-hole 410; and passing the first flange 640 through the thickness of the rubber block 400 so that the cable 620 is located within the through-hole 410 and a second flange 640 of the flanges 640 is on an opposite side of the rubber block 400 from the first flange 640, wherein the first and second flanges 640 are arranged proximate to an inner surface 402 and an outer surface 403, respectively, of the rubber block 400.

[0067] In some embodiments of the method, the cable 620 is a flexible cable comprising braided strands of electrically conductive wire. In some embodiments of the method, the through-hole 410 has a diameter that is larger than a diameter of the cable 620. In some embodiments of the method, the grounding shunt 600 has a length that is substantially similar to the thickness of the rubber block 400, as measured when the rubber block 400 is in an uncompressed state. In some embodiments of the method, the cable 620 is configured to bend within the through-hole 410 when the rubber block 400 is compressed so that effectively no stiffness is added to the rubber block 400 by the grounding shunt 600. In some embodiments of the method, the rubber block 400 is compressed and inserted within a channel formed between inner and outer wheel portions (20, 30, FIG. 7) of the railcar wheel assembly 100. In some embodiments of the method, the first and/or second flanges 640 comprise a keyed portion 645, and the at least one flange insertion slot 430 has a cross-sectional shape that is compatible with the keyed portion 645 and is radially connected to the through-hole 410. In some embodiments of the method, the first and second flanges 640 each comprise a collar (660, FIG. 4), which is rigidly connected to the cable 620 at the first and second ends thereof, respectively. In some embodiments, the method comprises forming flange recesses (440, FIG. 7) in the rubber block 400 at opposing ends of the through-hole 410; and arranging the first and second flanges 640 to rest in the flange recesses 440 when the grounding shunt 600 is installed within the rubber block 400. In some

embodiments of the method, the flange recesses **440** are formed such that the first flange **640** is substantially coplanar to the radially inner surface (**402**, FIG. 7) of the rubber block **400** and the second flange **640** is substantially coplanar to the radially outer surface (**403**, FIG. 7) of the rubber block **400**. In some embodiments, the method

5 comprises forming a deflection region (**420**, FIG. 5) in the rubber block **400**, connected to, and oriented longitudinally with, the through-hole **410**, such that, when the rubber block **400** is compressed by relative movement between the inner and outer wheel portions **20**, **30**, the cable **620** is flexed, bent, and/or deflected such that a portion of the cable **620** is located within the deflection region **420** while the rubber

10 block **400** is compressed.

[0068] A method of electrically grounding a railcar wheel assembly (**100**, FIG. 7) is provided. The method comprises: arranging an outer wheel portion **30** concentrically around an inner wheel portion **20** to define a channel between the inner and outer wheel portions **20**, **30** of the railcar wheel assembly **100**; inserting a plurality

15 of rubber blocks **400** within the channel radially about the railcar wheel assembly **100**, wherein one or more of the plurality of rubber blocks **400** are electrical grounding devices comprising a rubber block **400** comprising a through-hole **410**; and a grounding shunt **600** comprising a cable **620** that passes or is disposed within and through the through-hole **410**; a first flange **640** attached to a first end of the cable

20 **620**; and a second flange **640** attached to a second end of the cable **620**; and wherein a radial distance between the inner and outer wheel portions **20**, **30** is smaller than a thickness of the plurality of rubber blocks **400**, so that the plurality of rubber blocks **400** are compressed within the channel; and conducting an electrical current between the inner wheel portion **20** and the outer wheel portion **30** via each of the grounding

25 shunts **600**.

[0069] In some embodiments of the method, each cable **620** is a flexible cable **620** comprising braided strands of electrically conductive wire. In some embodiments of the method, each through-hole **410** has a diameter that is larger than a diameter of the cable **620** arranged therein. In some embodiments of the method, each grounding

30 shunt **600** has a length that is substantially similar to a thickness of the plurality of rubber blocks **400**, as measured when the rubber blocks **400** are in an uncompressed state. In some embodiments of the method, each cable **620** is configured to bend

within the through-hole **410** when the rubber block **400** is compressed so that no effective stiffness is added to the rubber block **400** by the grounding shunt **600**. In some embodiments, the method comprises: forming a keyed portion **645** on the first and/or second flanges **640**; forming at least one flange insertion slot **430** in each rubber block **400**, the at least one flange insertion slot **430** being radially connected to the through-hole **410**, and inserting the first flange **640** and/or the second flange **640** through the rubber block **400** so that the cable **620** is installed in the through-hole **410**. In some embodiments of the method, the first and second flanges each comprise a collar **660**, which is rigidly connected to the cable **620** and the first and second ends thereof, respectively. In some embodiments of the method, each rubber block **400** comprises a flange recess **440** on the radially inner and outer surfaces **402**, **403** thereof, each flange recess **440** being configured such that the first or second flanges **640** rest therein when each grounding shunt **600** is installed within a respective one of the plurality of rubber blocks **400**. In some embodiments of the method, the flange recesses **440** are formed such that each first flange **604** is substantially coplanar to the radially inner surface **402** of the rubber block **400** and each second flange **640** is substantially coplanar to the radially outer surface **403** of the rubber block **400**. In some embodiments, the method comprises forming a deflection region (**420**, FIG. 5) in the rubber block **400**, connected to, and oriented longitudinally with, the through-hole **410**, such that, when the rubber block **400** is compressed by relative movement between the inner and outer wheel portions **20**, **30**, the cable **620** is flexed, bent, and/or deflected such that a portion of the cable **620** is located within the deflection region **420** while the rubber block **400** is compressed.

[0070] The embodiments described herein are examples only and are not limiting. Many variations and modifications of the systems, apparatus, and processes described herein are possible and are within the scope of the disclosure. Accordingly, the scope of protection is not limited to the embodiments described herein, but is only limited by the claims that follow, the scope of which shall include all equivalents of the subject matter of the claims.

30

CLAIMS

What is claimed is:

1. An electrical grounding device for a railcar wheel assembly, the electrical
5 grounding device comprising:
 - a rubber block comprising a through-hole formed through an entirety of a thickness of the rubber block, wherein the rubber block is configured to be compressively arranged between an inner wheel portion and an outer wheel portion of a railcar wheel assembly and provide vibrational isolation between the inner and
10 outer wheel portions; and
 - a grounding shunt comprising:
 - a cable disposed through the through-hole;
 - a first flange attached to a first end of the cable; and
 - a second flange attached to a second end of the cable;
 - 15 wherein the first flange is configured to electrically contact the inner wheel portion and the second flange is configured to electrically contact the outer wheel portion; and
 - wherein the cable is configured to conduct an electrical current between the inner wheel portion and the outer wheel portion through the
20 rubber block.
2. The electrical grounding device of claim 1, wherein the cable is a flexible cable comprising braided strands of electrically conductive wire.
- 25 3. The electrical grounding device of claim 2, wherein the through-hole has a diameter that is larger than a diameter of the cable.
4. The electrical grounding device of claim 3, wherein the grounding shunt has a length that is substantially similar to an uncompressed thickness of the rubber block.
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5. The electrical grounding device of claim 4, wherein the cable is configured to flex, bend, and/or deflect within the through-hole when the rubber block is compressed by relative movement between the inner and outer wheel portions, so that

effectively no stiffness is added to the rubber block by the grounding shunt.

6. The electrical grounding device of claim 1, wherein:
the first and/or second flanges comprise one or more keyed portions,
5 at least one flange insertion slot is provided in the rubber block, the at least one flange insertion slot being radially connected to the through-hole, and
the at least one flange insertion slot is configured such that the first and/or second flanges can be inserted through the rubber block so that the cable is installed in the through-hole only when the first and/or second flanges are oriented such that
10 the one or more keyed portions can pass through the at least one flange insertion slot.

7. The electrical grounding device of claim 1, wherein the first and second flanges each comprise a collar, each collar being rigidly connected to the cable at one of the first and second ends thereof.

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8. The electrical grounding device of claim 1, wherein the rubber block comprises, on both a radially inner surface and on a radially outer surface of the rubber block, a flange recess configured such that one of the first and second flanges rest within the flange recess on whichever of the radially inner or outer surfaces that the
20 first or second flange is arranged when the grounding shunt is installed within the rubber block.

9. The electrical grounding device of claim 8, wherein the flange recesses have a depth in a direction of the thickness of the rubber block such that, when the
25 grounding shunt is installed within the rubber block, a surface of the first flange by which the first flange contacts the inner wheel portion is substantially coplanar to the radially inner surface of the rubber block and a surface of the second flange by which the second flange contacts the outer wheel portion is substantially coplanar to the radially outer surface of the rubber block.

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10. An electrical grounding system for a railcar wheel assembly, the electrical grounding system comprising:
an inner wheel portion;

an outer wheel portion arranged concentrically around the inner wheel portion to define a channel between the inner and outer wheel portions;

5 a plurality of rubber blocks, each of which comprises a through-hole formed through an entirety of a thickness of the rubber block, wherein the rubber blocks are arranged radially about the railcar wheel assembly within the channel by compression to provide vibrational isolation between the inner and outer wheel portions and to space the inner wheel portion apart from the outer wheel portion, thereby defining an annular gap between the inner and outer wheel portions when the inner and outer wheel portions are in an undeflected position; and

10 a plurality of grounding shunts, each of the grounding shunts being arranged to pass through a corresponding through-hole of one of the plurality of rubber block, each of the grounding shunts comprising:

a cable disposed through the through-hole;

a first flange attached to a first end of the cable; and

15 a second flange attached to a second end of the cable;

wherein each of the first flanges is configured to electrically contact the inner wheel portion and each of the second flanges is configured to electrically contact the outer wheel portion; and

20 wherein each cable is configured to conduct an electrical current between the inner wheel portion and the outer wheel portion through the rubber block in which the cable is disposed.

11. The electrical grounding system of claim 10, wherein each cable is a flexible cable comprising braided strands of electrically conductive wire.

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12. The electrical grounding system of claim 11, wherein each through-hole has a diameter that is larger than a diameter of the cable arranged therein.

13. The electrical grounding system of claim 12, wherein each grounding shunt has a length that is substantially similar to an uncompressed thickness of the rubber block through which the grounding shunt is installed.

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14. The electrical grounding system of claim 13, wherein each cable is configured

to flex, bend, and/or deflect within the through-hole when the rubber block is compressed by relative movement between the inner and outer wheel portions, so that effectively no stiffness is added to the rubber block by the grounding shunt.

- 5 15. The electrical grounding system of claim 10, wherein:
 the first and/or second flanges comprise one or more keyed portions,
 at least one flange insertion slot is provided in each rubber block, the at least
 one flange insertion slot being radially connected to the through-hole, and
 the at least one flange insertion slot is configured such that the first and/or
10 second flanges can be inserted through the rubber block so that the cable is installed
 in the through-hole only when the first and/or second flanges are oriented such that
 the one or more keyed portions can pass through the at least one flange insertion slot.
- 15 16. The electrical grounding system of claim 10, wherein the first and second
 flanges each comprise a collar, each collar being rigidly connected to the cable at one
 of the first and second ends thereof.
- 20 17. The electrical grounding system of claim 10, wherein each rubber block
 comprises, on both a radially inner surface and on a radially outer surface of the rubber
 block, a flange recess configured such that one of the first and second flanges rest
 within the flange recess on whichever of the radially inner or outer surfaces that the
 first or second flange is arranged when the grounding shunt is installed within a
 respective one of the plurality of rubber blocks.
- 25 18. The electrical grounding system of claim 17, wherein the flange recesses have
 a depth in a direction of the thickness of the rubber block such that, when the
 grounding shunt is installed within the rubber block, a surface of each first flange by
 which each such first flange contacts the inner wheel portion is substantially coplanar
 to the radially inner surface of a respective one of the rubber blocks and a surface of
30 each second flange by which each such second flange contacts the outer wheel portion
 is substantially coplanar to the radially outer surface of a respective one of the rubber
 blocks.

19. A method of manufacturing an electrical grounding device for a railcar wheel assembly, the method comprising:
- providing a rubber block that can be compressively arranged between an inner wheel portion and an outer wheel portion of a railcar wheel assembly and provide
 - 5 vibrational isolation between the inner and outer wheel portions;
 - forming a through-hole and at least one flange insertion slot radially connected to the through-hole through an entirety of a thickness of the rubber block;
 - forming a grounding shunt by attaching a first electrically conductive flange to a first end of an electrically conductive cable and by attaching a second electrically
 - 10 conductive flange to a second end of the cable, wherein the first end is an opposite end of the cable from the second end;
 - inserting the first flange into the rubber block via the at least one flange insertion slot and the through-hole; and
 - passing the first flange through the thickness of the rubber block, so that the
 - 15 cable is located substantially entirely within the through-hole and the second flange is on an opposite side of the rubber block from the first flange, wherein the first and second flanges are arranged proximate to a respective outer surface of the rubber block when the grounding shunt is installed within the rubber block.
20. The method of claim 19, wherein the cable is a flexible cable comprising braided strands of electrically conductive wire.
21. The method of claim 20, wherein the through-hole has a diameter that is larger than a diameter of the cable.
- 25 22. The method of claim 21, wherein the grounding shunt has a length that is substantially similar to an uncompressed thickness of the rubber block.
23. The method of claim 22, wherein the cable is configured to flex, bend, and/or
- 30 deflect within the through-hole when the rubber block is compressed by relative movement between the inner and outer wheel portions, so that effectively no stiffness is added to the rubber block by the grounding shunt.

24. The method of claim 19, wherein the rubber block is compressed and inserted within a channel formed between the inner and outer wheel portions of the railcar wheel assembly.
- 5 25. The method of claim 19, wherein:
the first and/or second flanges comprise one or more keyed portions, and
the at least one flange insertion slot has a cross-sectional shape that is compatible with the one or more keyed portions, such that the cable can only be installed in the through-hole when the first and/or second flanges are oriented such
10 that the one or more keyed portions can pass through the at least one flange insertion slot.
26. The method of claim 19, wherein the first and second flanges each comprise a collar, each collar being rigidly connected to the cable and the first and second ends
15 thereof.
27. The method of claim 19, comprising:
forming flange recesses in the rubber block at opposing ends of the through-hole, on respective radially inner and outer surfaces of the rubber block; and
20 arranging the first and second flanges within one of the flange recesses when the grounding shunt is installed within the rubber block.
28. The method of claim 27, wherein the flange recesses have a depth in a direction of the thickness of the rubber block, such that, when the grounding shunt is
25 installed within the rubber block, a surface of the first flange by which the first flange contacts the inner wheel portion is substantially coplanar to the radially inner surface of the rubber block and a surface of the second flange by which the second flange contacts the outer wheel portion is substantially coplanar to the radially outer surface of the rubber block.
- 30 29. A method of electrically grounding a railcar wheel assembly, the method comprising:
arranging an outer wheel portion concentrically around an inner wheel portion

to define a channel between the inner and outer wheel portions of the railcar wheel assembly;

inserting a plurality of rubber blocks within the channel radially about the railcar wheel assembly, wherein one or more of the plurality of rubber blocks are
5 electrical grounding devices according to claim 1 and wherein a radial distance between surfaces by which the rubber blocks contact the inner and outer wheel portions is smaller than a thickness of the rubber blocks, so that the plurality of rubber blocks are compressed within the channel; and

conducting an electrical current between the inner wheel portion and the outer
10 wheel portion via the grounding shunts to dissipate an electrical charge generated by a railcar to which the railcar wheel assembly is rotatably attached.

30. The method of claim 29, wherein each cable is a flexible cable comprising braided strands of electrically conductive wire.

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31. The method of claim 30, wherein each through-hole has a diameter that is larger than a diameter of the cable arranged therein.

32. The method of claim 31, wherein each grounding shunt has a length that is
20 substantially similar to an uncompressed thickness of the rubber block through which the grounding shunt is installed.

33. The method of claim 32, wherein each cable is configured to flex, bend, and/or deflect within the through-hole when the rubber block is compressed by relative
25 movement between the inner and outer wheel portions, so that effectively no stiffness is added to the rubber block by the grounding shunt.

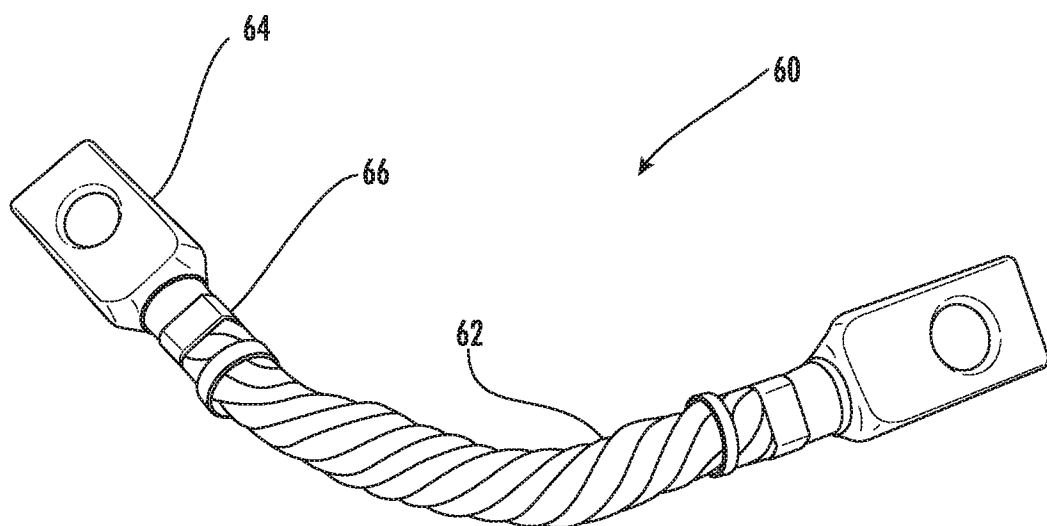
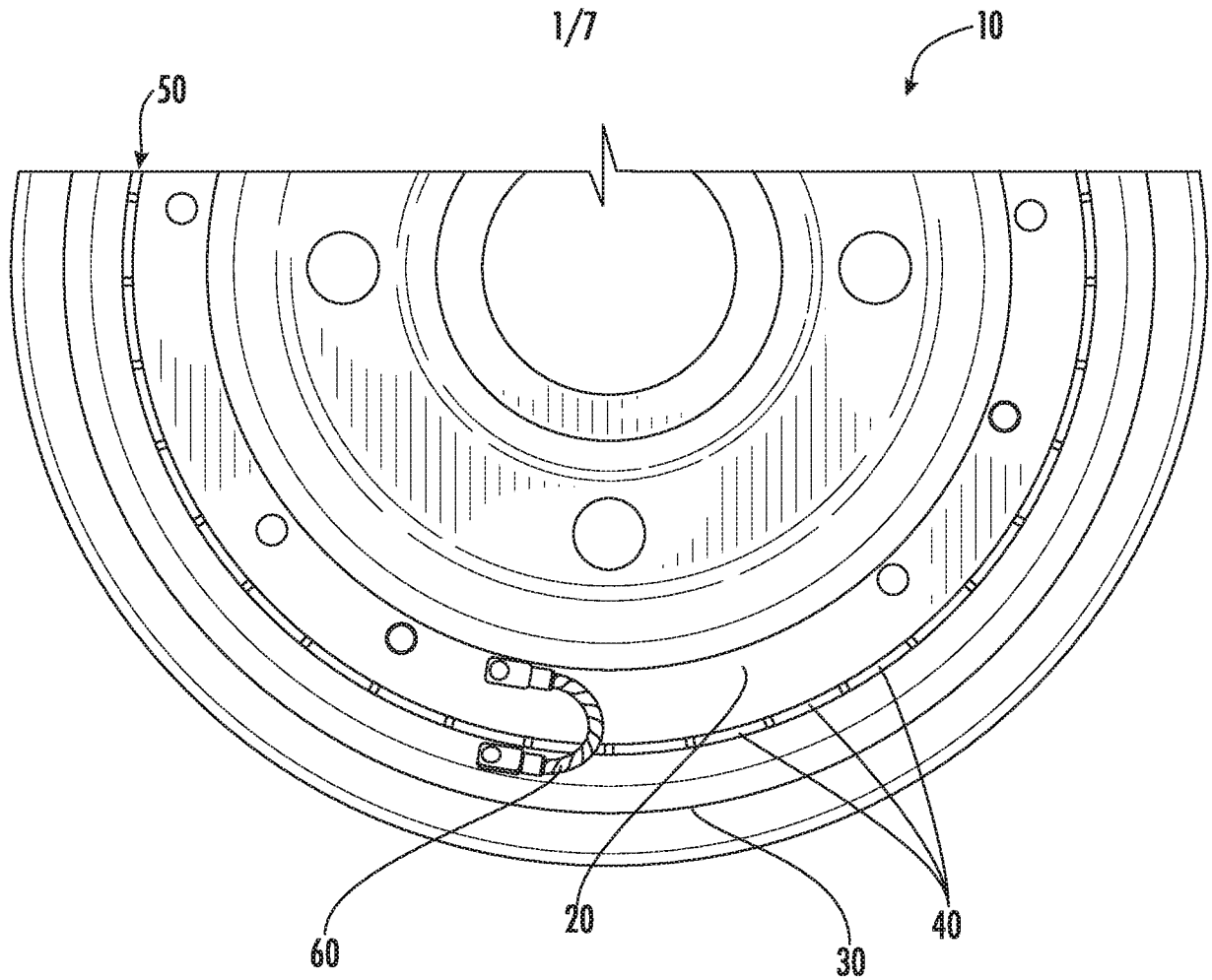
34. The method of claim 29, comprising:
forming one or more keyed portions on the first and/or second flanges;
30 forming at least one flange insertion slot in each rubber block, the at least one flange insertion slot being radially connected to the through-hole, and
inserting the first flange and/or the second flange through one of the rubber blocks, so that the cable is installed in the through-hole, wherein the cable can only

be installed in the through-hole when the first and/or second flanges are oriented such that the one or more keyed portions can pass through the at least one flange insertion slot.

5 35. The method of claim 29, wherein the first and second flanges each comprise a collar, each collar being rigidly connected to the cable at one of the first and second ends thereof.

10 36. The method of claim 29, wherein each rubber block comprises, on both a radially inner surface and on a radially outer surface of the rubber block, a flange recess in which one of the first and second flanges rest when the grounding shunt is installed within a respective one of the plurality of rubber blocks.

15 37. The method of claim 36, wherein the flange recesses have a depth in a direction of the thickness of the rubber block such that, when the grounding shunt is installed within the rubber block, a surface of each first flange by which each such first flange contacts the inner wheel portion is substantially coplanar to the radially inner surface of the rubber block and a surface of each second flange by which each such second flange contacts the outer wheel portion is substantially coplanar to the
20 radially outer surface of a respective one of the rubber blocks.



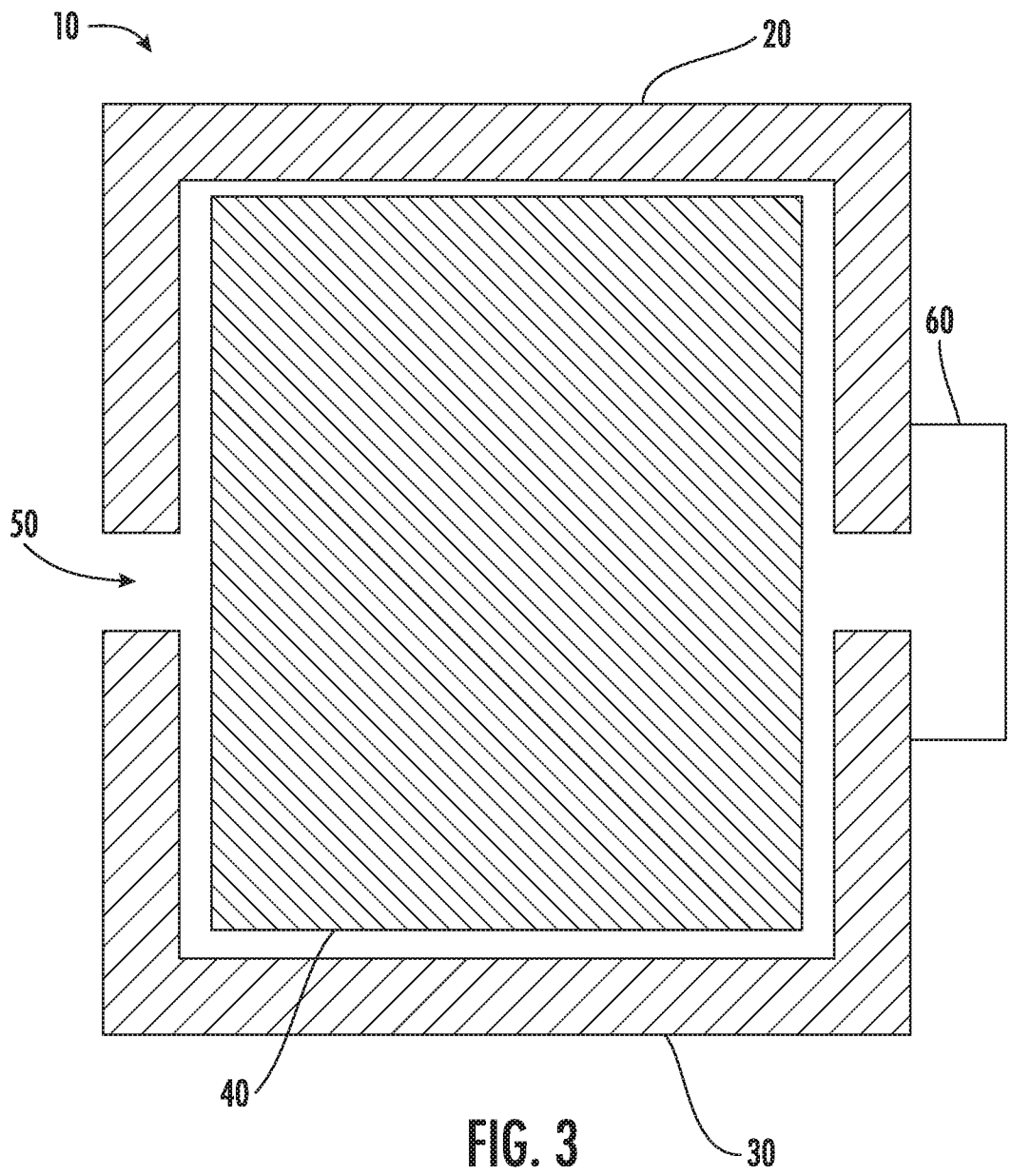


FIG. 3
PRIOR ART

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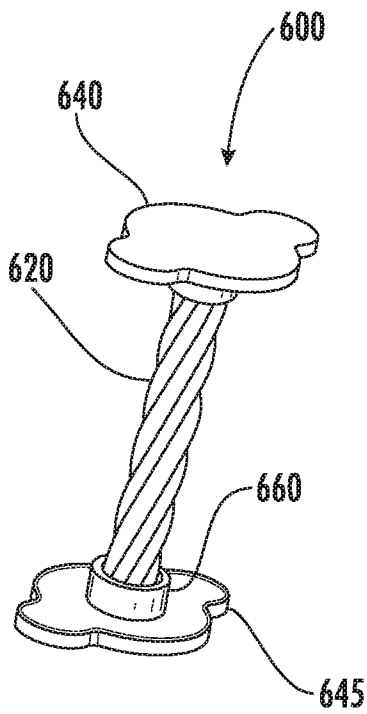


FIG. 4

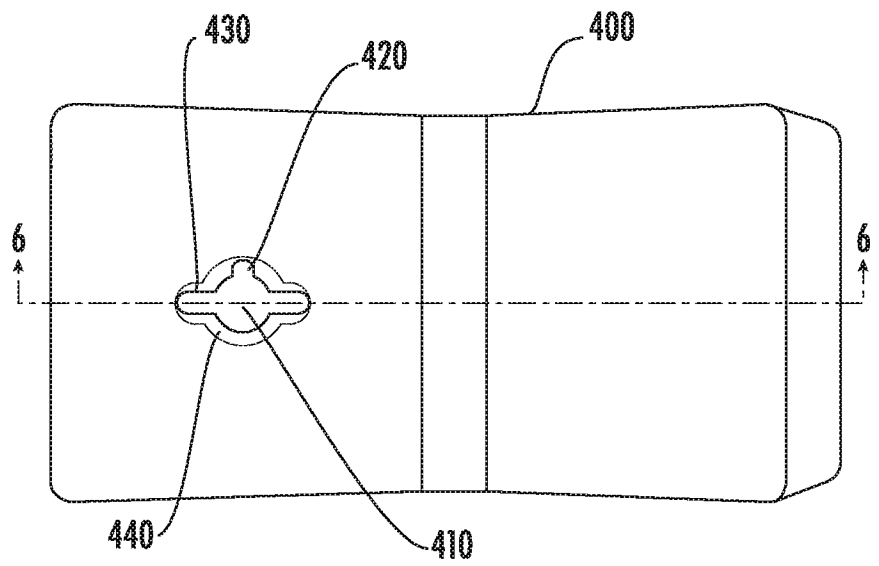


FIG. 5

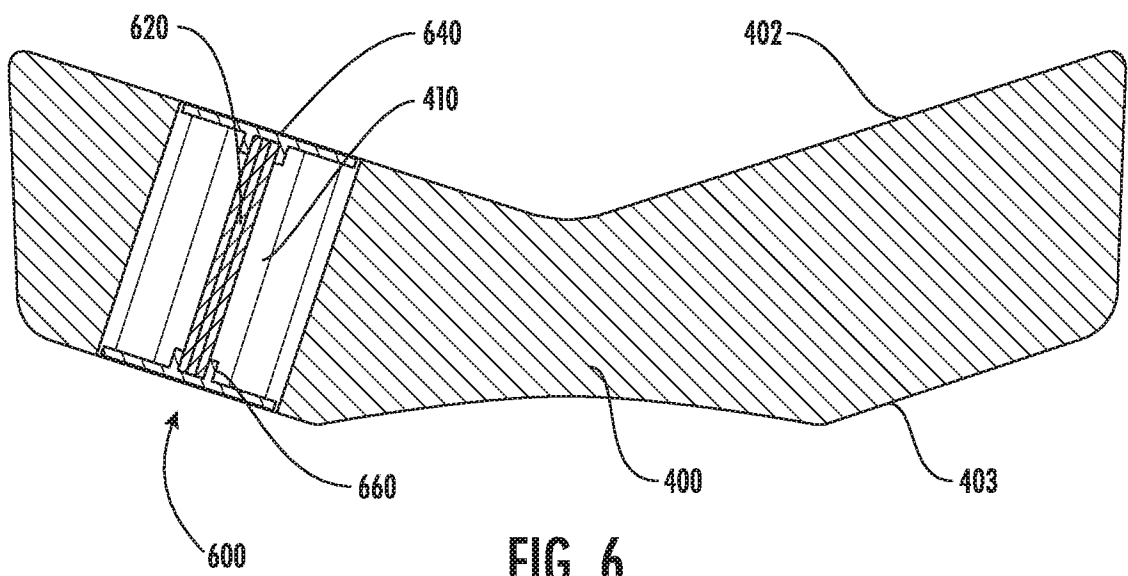


FIG. 6

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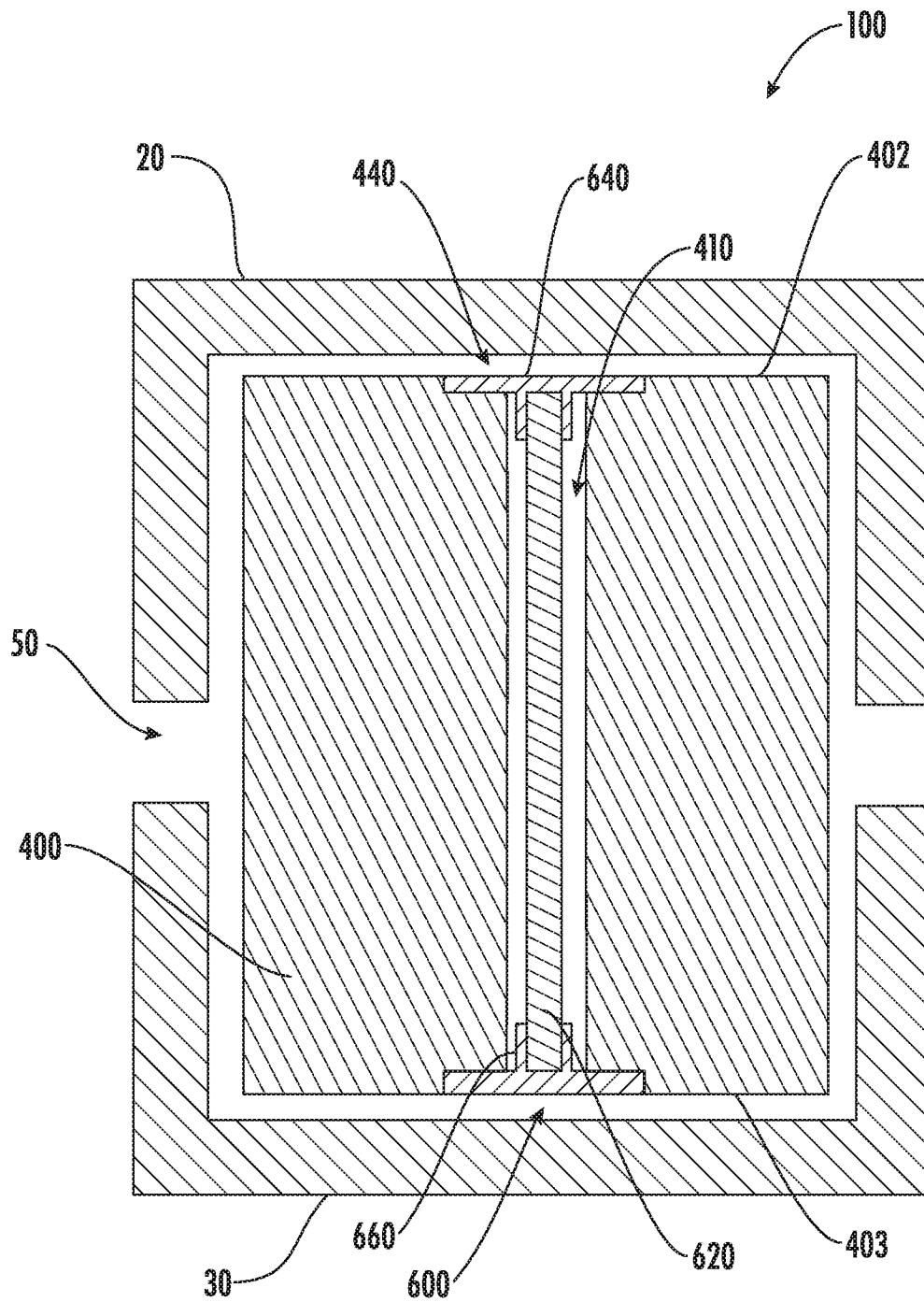


FIG. 7

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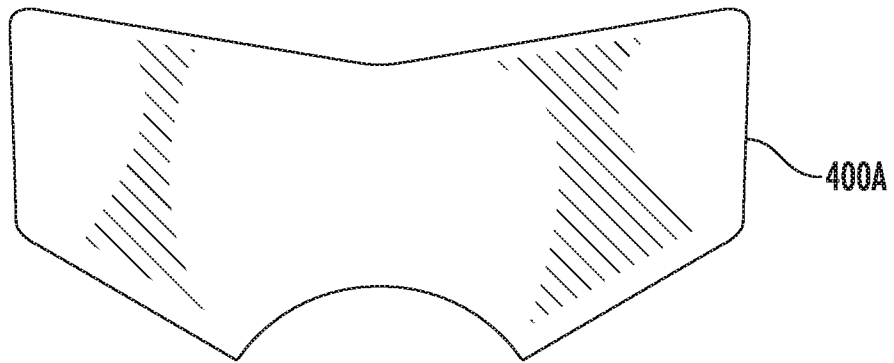


FIG. 8A

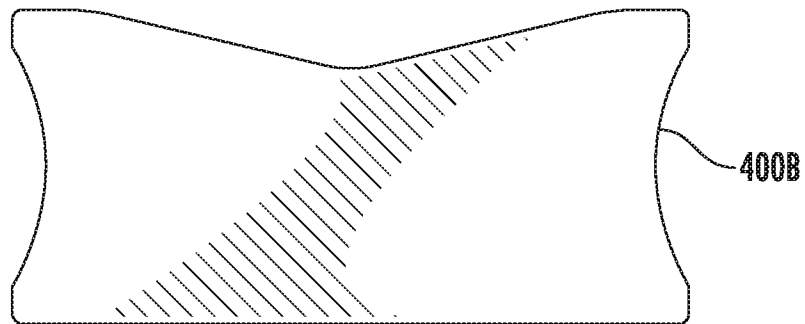


FIG. 8B

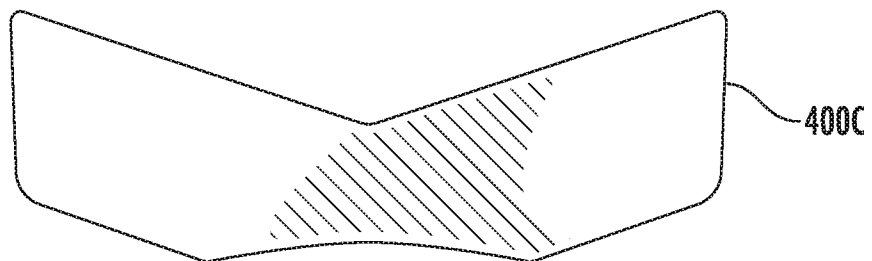


FIG. 8C

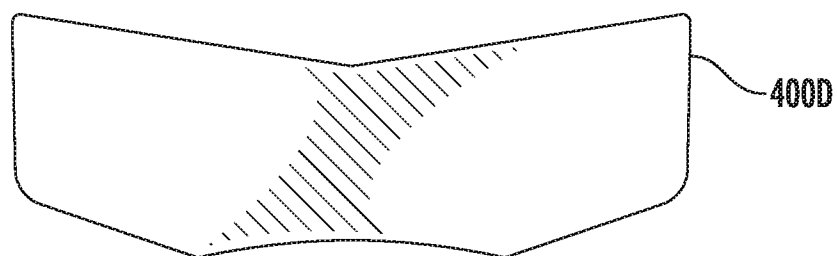


FIG. 8D

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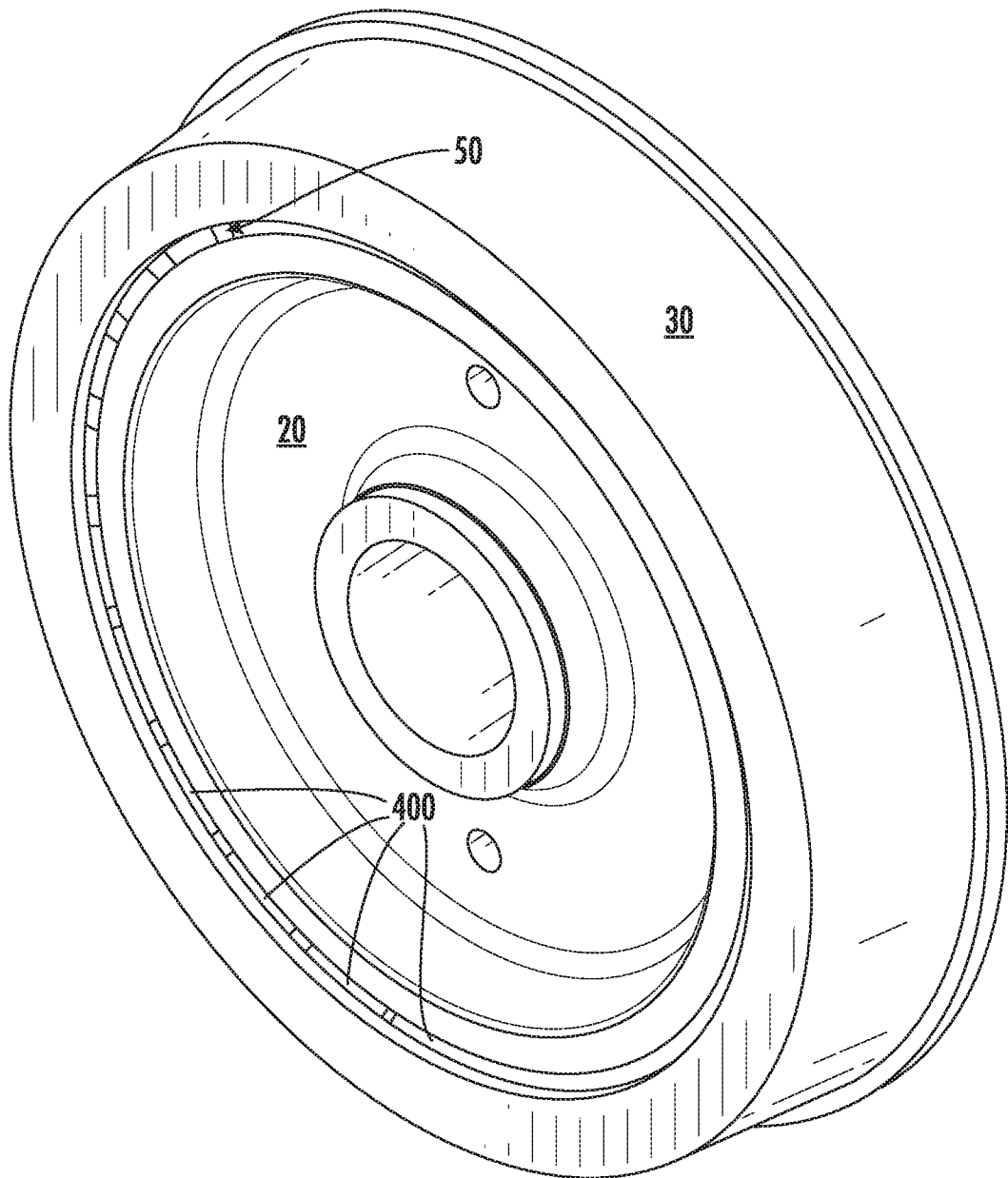


FIG. 9

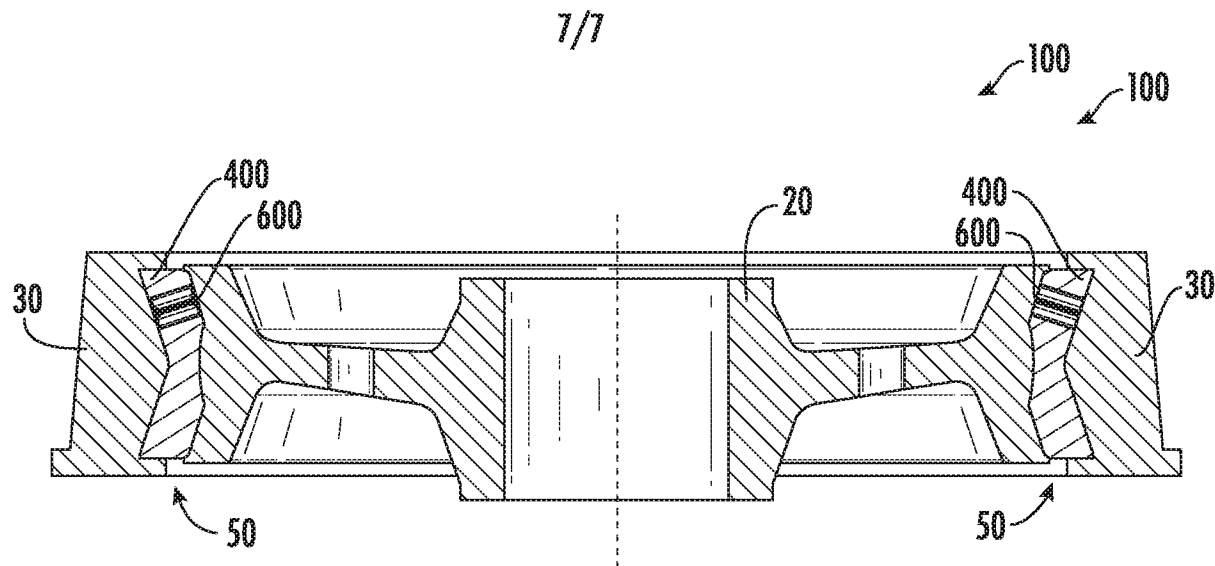


FIG. 10A

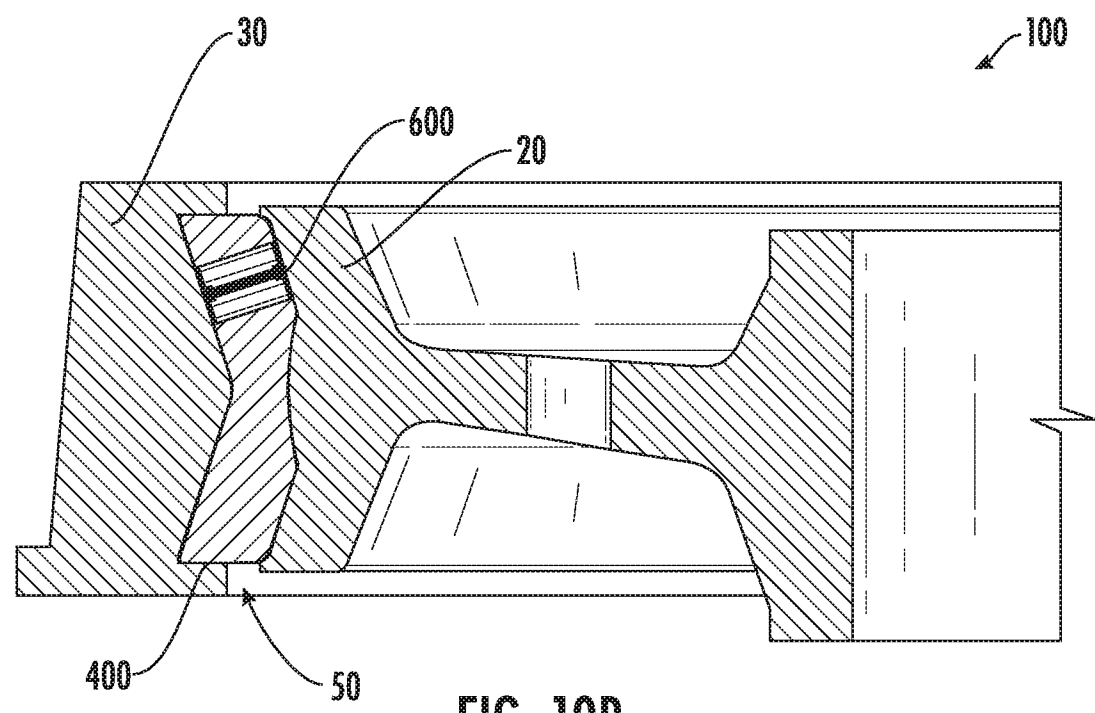


FIG. 10B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2020/020908

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60B17/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60B

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 934 921 A (NELKEN EWALD) 27 January 1976 (1976-01-27) column 1, line 58 - column 4, line 16; figures 1-4	1-37
X	----- EP 0 658 448 A1 (VER SCHMIEDEWERKE GMBH [DE]) 21 June 1995 (1995-06-21) column 2, line 49 - column 4, line 9; claim 6; figures 1-5	1-37
X	----- DE 195 36 149 A1 (GUTEHOFFNUNGSHUETTE RADSATZ [DE]) 3 April 1997 (1997-04-03)	1-3, 5-12, 14-18
A	column 2, line 38 - column 3, line 8; figures 1-3 -----	4,13, 19-37



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

19 June 2020

Date of mailing of the international search report

02/07/2020

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Schreck, Mathias

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2020/020908

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DE 19536149	A1	03-04-1997	NONE