(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 October 2014 (16.10.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/169196 A1

(51) **International Patent Classification**:
F16D 65/12 (2006.01)

(21) **International Application Number**:
PCT/US2014/033775

(22) **International Filing Date**:
11 April 2014 (11.04.2014)

(25) **Filing Language**: English

(26) **Publication Language**: English

(30) **Priority Data**:
61/811,316 12 April 2013 (12.04.2013) 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, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, 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, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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, 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).

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(54) **Title**: BRAKE DISC ASSEMBLY FOR A WHEEL

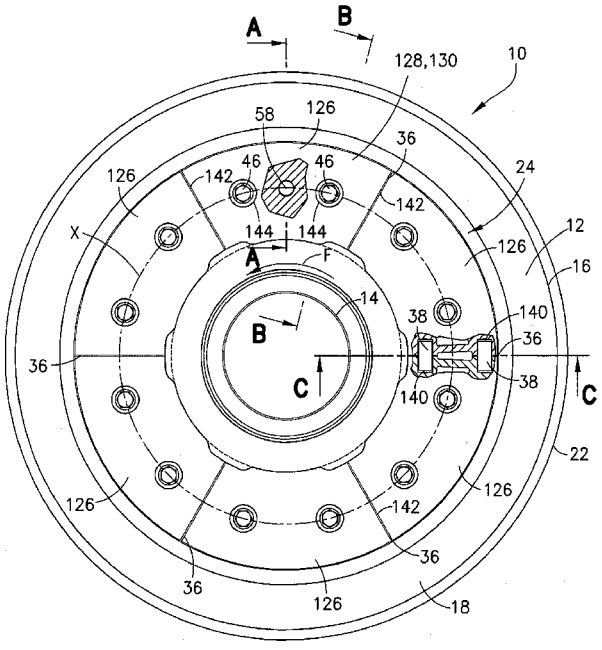


FIG. 1

(57) **Abstract**: A brake disc for providing a braking surface on a rotating body, such as a railway wheel is provided. The brake disc includes a plurality of arcuate segments (126) arranged to form a ring and a plurality of joining elements (38) for connecting the segments to adjacent segments. Each segment includes: an inner side configured to contact a surface of a wheel; an outer side having a braking surface for contacting a braking mechanism; at least one socket (140) on each radial end (142) of the segment (126) for receiving one of the plurality of joining elements (38); and a groove on the inner side of the segment configured to receive a coupling member to form a pivot joint (58) for positioning the segment (126) on the surface of the wheel.

WO 2014/169196 A1

Published:

— *with international search report (Art. 21(3))*

BRAKE DISC ASSEMBLY FOR A WHEEL

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Application No. 61/811,316 filed April 12, 2013, and is incorporated herein in its entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present disclosure relates to a brake disc for a rotating member, such as a wheel, and, more specifically, to an annular brake disc formed from a plurality of interconnected brake disc segments.

Description of Related Art

[0003] Brake discs are affixed to wheels for the purpose of providing a smooth, hard contact surface that can be contacted by a brake shoe or pad controlled by a brake mechanism, such as a brake jaw. When contact between the disc and shoe or pad is established, friction between the elements is sufficient to reduce or entirely inhibit rotation of the wheel. Disc brakes are commonly used in a variety of applications including, for example, industrial machines, such as cranes and lifts, as well as in conveying installations, such as escalators, elevators, ski-lifts, and the like. Disc brake assemblies are also employed in transport vehicles, such as rail cars, public transportation vehicles, trucks, and automobiles.

[0004] It is well known that significant heat is created as a result of the frictional contact between the brake shoe and brake disc. The heat may cause thermal expansion of portions of the brake assembly and may cause the brake assembly to deform or degrade following prolonged use. More particularly, known braking apparatus often do not permit uniform distribution of the generated heat leading to wide temperature gradients across the braking assembly. Such temperature gradients may cause fissures and cracks to form in the brake disc. Additionally, cooling air flow is often neither uniform nor adequate to counteract the destructive effects of the heat being generated. Instead, cooling air may actually increase temperature gradients on the brake disc, worsening thermal transitional phenomena. Additionally, a considerable amount of the heat created on the contact surface of the brake element is transferred to the shaft on which the brake disc is mounted. This transferred heat may cause oxidation to occur on the shaft and/or wheel making replacing brake elements more difficult. Prolonged heat exposure also alters the centering or calibration of the brake elements and/or drive members, further affecting performance of the brake system and wheel.

[0005] To make the brake linings and/or brake discs more accessible and to simplify maintenance, brake discs have been developed that are formed from two or more interlocking segments or friction rings, which can be individually removed and replaced. For example, U.S. Patent No. 4,132,294 to Poli, incorporated herein by reference, discloses a disc brake including two or more linings disposed about a central hub. The outer sides of the linings are configured to be contacted by a brake shoe and function in the conventional manner. The inner side of the lining includes a plurality of radial cooling ribs for dissipating heat. The disc brake is connected to a disc brake positioned on the opposite side of the wheel or to the wheel itself by a fastener or screw inserted through a hole in the lining. The disc brake is configured to affix to the wheel such that the inner surface of the lining is in contact with a surface of the wheel.

[0006] Other segmented disc brakes are known in which individual segments are spaced apart by a gap to permit the segments to expand when exposed to heat. For example, U.S. Patent No. 5,788,026 to Poli, incorporated herein by reference, discloses a disc brake having a number of brake disc segments affixed to a rotating body to form an annular ring. Corresponding segments of disc brakes are attached to one another by fasteners extending through holes in the segments and rotating body. The segments are also slidably connected to adjacent segments in the annular disc brake by joining elements or pins extending from a socket of a segment to a corresponding socket of the adjacent segment. In this way, the segments may move and expand in response to heat, friction, and pressure caused by contact between the disc brake and brake mechanism.

[0007] However, in such braking systems the segments are free to move as pressure is applied. For example, increased pressure may push the segments in the circumferential or radial direction relative to the wheel hub causing the segment to become poorly aligned with the brake shoe. Thus, when the brake shoe contacts the misaligned segment, the segment may be bent or damaged. The segment may also wear in an unanticipated pattern, which further increases failure rates. The misaligned segment may also rub against the wheel surface causing a screeching sound or other undesirable noise.

SUMMARY OF THE INVENTION

[0008] In view of the foregoing, the rotating body and brake assembly of the present disclosure is a segmented brake disc that is less susceptible to damage caused by thermal expansion. Furthermore, while the brake disc is permitted to expand, movement of individual segments in the circumferential and radial directions is restricted to prevent a brake shoe from contacting misaligned segments. As a result of such modifications, the provided brake disc

assembly is less susceptible to wear-based damage and operates more quietly than known alternative systems.

[0009] Generally, this disclosure is directed to a brake assembly and rotating body that addresses or overcomes some or all of the deficiencies and drawbacks associated with existing braking systems. Therefore, according to one aspect of the invention, a brake disc is provided. The brake disc includes a plurality of arcuate segments arranged to form a ring and a plurality of joining elements for connecting the segments to adjacent segments. Each segment includes: an inner side configured to contact a surface of a wheel; an outer side having a braking surface for contacting a braking mechanism; at least one socket on each radial end of the segment for receiving one of the plurality of joining elements; and a groove on the inner side of the segment configured to receive a coupling member to form a pivot joint for positioning the segment on the surface of the wheel.

[0010] In certain embodiments, the coupling member includes a head configured for insertion in the segment groove. In that case, the pivot joint may be a condyloid joint. Alternatively, the pivot joint is a ball and socket joint.

[0011] In certain further embodiments, the disc includes a plurality of transverse through holes extending between the inner side and the outer side of the segment configured to receive fasteners to connect the segment to the wheel. Additionally, each segment may include two sockets on each radial end of the segment. In that case, each of the plurality of joining elements may be slidably received within a respective socket. Furthermore, a depth of each socket may be greater than a length of the joining elements, thereby allowing the joining element to slide entirely into the socket.

[0012] In certain embodiments, the disc includes six segments and adjacent segments are separated by a radial gap. The segments may be movable, with respect to the joining elements, to expand or reduce a width of the gap. The segment may include at least one protrusion extending from the inner side of the segment for directing cooling air to the inner side of the segment. The protrusions may include radial fins extending between an inner circumferential side and an outer circumferential side of the segment.

[0013] According to another aspect of the invention, a brake assembly is provided. The assembly includes a wheel having a central hub, an outer rim, and a body extending between the hub and the rim. The body has a front side surface and a rear side surface. The brake assembly also includes a front brake disc connected to the front side surface of the body and a rear brake disc connected to the rear side surface of the body. Each brake disc includes a plurality of arcuate segments arranged to form a ring and a plurality of joining elements for

connecting the segments to adjacent segments. Each segment includes: an inner side configured to contact the front side surface or rear side surface of the body of the wheel; an outer side comprising a braking surface for contacting a braking mechanism; at least one socket located on each radial end of the segment for receiving the joining element; and a groove on the inner side of the segment configured to receive a coupling member to form a pivot joint for positioning the segment on the front side surface or the rear side surface of the wheel.

[0014] In certain embodiments, the coupling member comprises a head on each longitudinal end thereof and a shaft extending therebetween. A groove of at least one segment may define an ellipsoid cavity configured to receive the head of the coupling member to form a condyloid joint. Alternatively, the groove may define a partially spherical cavity configured to receive the head of the coupling member to form a ball and socket joint. In certain embodiments, the coupling member extends through a hole in the body of the wheel, such that one end of the coupling member is inserted in a groove of a segment of the front brake disc and the other end of the coupling member is inserted in a groove of a segment of the rear brake disc.

[0015] In certain embodiments, each segment further includes at least one transverse through hole extending between the inner side and the outer side of the segment. In that case, the assembly may also include a fastener inserted through each through hole for connecting the front brake disc to the rear brake disc through a corresponding through hole in the body of the wheel. In certain embodiments, each segment may include two transverse through holes located on a center axis of the segment.

[0016] The foregoing and other features and characteristics, as well as the methods of operation and functions of the related elements of structures and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following description and the appended claims with reference to the accompanying drawings, all of which form a part of this specification, wherein like reference numerals designate corresponding parts in the various figures. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention. As used in the specification and the claims, the singular form of "a", "an", and "the" include plural referents unless the context clearly dictates otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Some of the advantages and features of the preferred embodiments of the invention have been summarized hereinabove. These embodiments, along with other potential embodiments of the device, will become apparent to those skilled in the art when referencing

the following drawings in conjunction with the detailed descriptions as they relate to the figures.

[0018] **FIG. 1** is a front and partially perspective view of an embodiment of a brake disc connected to a wheel;

[0019] **FIG. 2** is a front perspective view of a segment of the brake disc of **FIG. 1**;

[0020] **FIG. 3** is a rear perspective view of a segment of the brake disc of **FIG. 1**;

[0021] **FIG. 4A** is a cross-sectional view of the brake disc of **FIG. 1** along line **B-B** in **FIG. 1**;

[0022] **FIG. 4B** is detail view of the brake disc of **FIG. 4A** from the encircled detail area labeled **D** in **FIG. 4A**;

[0023] **FIG. 5** is a cross-sectional view of the brake disc of **FIG. 1** along line **C-C** in **FIG. 1**; and

[0024] **FIG. 6** is a cross-sectional view of the brake disc of **FIG. 1** along line **A-A** in **FIG. 1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] The following description is provided to enable those skilled in the art to make and use the described embodiments contemplated for carrying out the invention. Various modifications, equivalents, variations, and alternatives, however, will remain readily apparent to those skilled in the art. Any and all such modifications, variations, equivalents, and alternatives are intended to fall within the spirit and scope of the present invention. Further, for purposes of the description hereinafter, the terms "end", "upper", "lower", "right", "left", "vertical", "horizontal", "top", "bottom", "lateral", "longitudinal", and derivatives thereof shall relate to the invention as it is oriented in the drawing figures.

[0026] However, it is to be understood that the invention may assume various alternative variations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification, are simply exemplary embodiments of the invention. Hence, specific dimensions and other physical characteristics related to the embodiments disclosed herein are not to be considered as limiting. For the purpose of facilitating understanding of the invention, the accompanying drawings and description illustrate preferred embodiments thereof, from which the invention, various embodiments of its structures, construction and method of operation, and many advantages may be understood and appreciated.

[0027] The present disclosure is directed to a rotating body and brake disc. The rotating body may be any wheel structure, including a railway vehicle wheel, a wheel for a truck or automobile, or a wheel for various industrial machines. A brake disc refers to a structure adapted to connect to the surface of one or both sides of the rotating body. The brake disc is configured to be contacted by a braking mechanism, such as a brake jaw, brake pad, or brake shoe. Friction between the brake disc and shoe inhibits rotation of the rotating body.

[0028] With reference to **FIG. 1**, a rotating body, such as railway wheel **10** is shown in accordance with one embodiment. The wheel **10** includes a body **12** extending between a hub **14** and outer rim **16**. The body **12** includes a front side surface **18** and a rear side surface **20** (shown in **FIGS. 4A**, **5**, and **6**). The outer rim **16** may include a tread **22**, configured to engage a rail (not shown). The body **12** may include regions having different thicknesses or rigidity. For example, the body **12** may include alternating concentric bands (not shown) having high and low rigidity. The rigidity of the various regions may result from varying either the thickness or material composition of the body **12**.

[0029] As shown, for example, for example, in **FIG. 4A**, a front brake disc **24** is connected to the front side surface **18** of the wheel **10** and a rear brake disc **24'** is connected to the rear side surface **20**. The front brake disc **24** and the rear brake disc **24'** may be arranged so that corresponding segments **126** of the brake discs **24**, **24'** are aligned through the wheel **10**. Generally, it is preferable to affix the brake discs **24**, **24'** to more rigid regions of the wheel body **12** to improve braking performance. The brake discs **24**, **24'** are formed of arcuate segments **126** connected around the hub **14** of the wheel **10** to form a closed annular ring, which may be referred to as a friction ring. The segments **126** may be identical in shape and size or may have different shapes and sizes, depending on performance and space requirements for the wheel and/or braking mechanism. The number of segments **126** may be even or odd. For example, the front brake disc **24** illustrated in **FIG. 1** has six identical segments configured to form a ring. Each segment **126** includes an outer side **128**, which functions as a standard braking surface **130**. The braking surface **130** is configured to be contacted by a brake shoe or pad controlled by a braking mechanism. An inner side **132** (shown in **FIG. 3**) is located opposite the outer side **128** of the segment **126**. The inner side **132** is configured to contact the front side surface **18** or rear side surface **20** of the wheel body **12** to impart the braking force along the wheel surface in the circumferential direction.

[0030] With reference to **FIGS. 2** and **3**, the inner side **132** may include protrusions **134**, such as fins, extending from the inner side **132** of the segment **126**. The protrusions **134** are effective for cooling the segment during use. Particularly, the protrusions **134** separate the

segment **126** from the front side surface **18** or rear side surface **20** (shown in **FIG. 4A**) of the wheel **10**, allowing air to pass through the open space. The air effectively cools the segment **126** and provides a more even temperature gradient during use. In certain embodiments, as shown in **FIG. 3**, the protrusions **134** extend radially outward from a inner circumferential side of the segment **126** to an outer circumferential side of the segment **126**. In that case, the protrusions **134** form channels for directing airflow radially away from the brake discs **24, 24'**.

[0031] Having generally described the structure of the brake disc **24** and arcuate segments **126**, various structures for connecting adjacent segments **126** to each other, to corresponding segments **126** on the rear brake disc **24'** on the other side of the wheel **10**, and to the body **12** of the wheel **10**, will now be described in detail. More specifically, the segment **126** includes a number of holes and grooves extending from the inner side **132** thereof. The holes and grooves are configured to receive various fasteners, pins, coupling members, and joining elements.

[0032] With reference to **FIGS. 1-3** and **5**, the segments **126** are separated from one another by a radial gap **36** (shown in **FIG. 1**) between the radial ends **142** of adjacent segments **126** so that the segments **126** can freely expand or contract depending on the temperature and force applied by the brake shoe or pad. The segments **126** are connected together by joining elements **38** extending across the gap **36**. The joining element **38** may be a pin, fastener, or slider as is known in the art. The joining elements **38** are configured to be inserted in sockets **140** extending inward from the radial ends **142** of each segment **126**, such that each joining element **38** extends between corresponding sockets **140** of adjacent segments **126**. In one embodiment, the depth of each socket **140** is greater than the length of the associated joining element **38**. Accordingly, the segments **126** are free to move, relative to the joining elements **38**, causing the joining element **38** to insert farther into one segment **126** and to pull away from the adjacent segment **126**. The sockets **140** have a generally circular cross-section and are equidistant from the central axis **X** (shown on **FIG. 1**) of the segment **126**. In one embodiment, each radial end **142** of each segment **126** includes two sockets **140** in a side-by-side arrangement. Including two sockets **140** on each radial end **142** restricts rotation of the segments **126** relative to one another and assists in limiting movement of the segments **126** in the radial direction.

[0033] With reference to **FIGS. 1-4B**, the segments **126** further include transverse through holes **144** extending between the outer side **128** and inner side **132** of the segment **126**. The holes **144** are configured to receive a fastener **46**, such as a screw or bolt. The fasteners **46** may connect the segment **126** to the body **12** of the wheel **10**. Alternatively, as shown in **FIG. 4A**, the fasteners **46** may extend through the wheel body **12** to a corresponding segment **126**

on the opposite side of the wheel **10**. In one embodiment, as shown in **FIG. 1**, each segment **126** includes two such through holes **144** having a circular cross-section. The holes **144** are positioned along the central longitudinal axis X of the segment **126** and are equidistant from the segment center.

[0034] With continuing reference to **FIGS. 1-4B**, the fastener **46** is inserted through the hole **144**, and rigidly and fixedly connects the segment **126** positioned on the front brake disc **24** to a corresponding segment **126** of the rear brake disc **24'**. A top portion of the fastener **46** may be recessed within the transverse through hole **144** so that it does not extend above the hole opening. Recessing the fastener **46** ensures that it does not contact or obstruct the brake shoe or brake pad of the brake mechanism. The fastener **46** may be connected to the segment **126** with a washer **52** and a nut **54** or with other fastening and connecting structures, as are known in the art. In an alternative embodiment, the holes **144** may not be included on the body of the segments **126**. Instead, the segment **126** may include additional structural elements, such as appendices or brackets (not shown) connected to and extending from the segments **126**. The fasteners **46** may be inserted through holes in the appendices or brackets.

[0035] With reference to **FIGS. 1, 3**, and **6**, the segment **126** further includes a groove **156** adapted to receive a coupling member **62** to form a pivot joint **58**. As will be described hereinafter, the pivot joint **58** prevents the segment **126** from sliding radially outward along the surface of the wheel **10** as a result of centripetal force and thermal expansion. The coupling member **62** may include a head **64** located on each end of the coupling member **62** shaped to be inserted in the groove **156**, and a cylindrical shaft **66** extending therebetween. The head **64** and shaft **66** may be separate members connected together by a known fastener or adhesive or may be integrally formed. The groove **156** includes an opening **160** extending inward from the inner side **132** of the segment **126**. The head **64** of the coupling member **62** is shaped for insertion through the opening **160** into the groove **156**. Once the coupling member **62** is inserted in the groove **156**, the segment **126** is permitted to freely rotate in at least one direction about the head **64**. The shaft **66** of the coupling member **62** may be inserted into a through hole **68** extending from the front side surface **18** to the rear side surface **20** of the wheel body **12**. In this configuration, one end of the coupling member **62** is inserted in a groove **156** of a segment **126** of the front brake disc **24** and the other end of the coupling member **62** is inserted in a groove **156** for the corresponding segment **126** of the rear brake disc **24'**.

[0036] In a non-limiting embodiment, the pivot joint **58** is an ellipsoid or condyloid joint. In that case, the head **64** of the coupling member **62** is an ellipsoid configured for insertion in the groove **156** through an elliptical opening **160**. A condyloid joint is freely rotatable along

the latitudinal and longitudinal axis of the groove **156**. However, the condyloid joint prevents the segment **126** from twisting or rotating. In an alternative embodiment, the pivot joint **58** may be a ball and socket joint (e.g., spherical joint) having a circular opening **160** that would also permit twisting rotation about the head **64**. Each segment **126** includes its own groove **156** and is configured to receive a corresponding coupling member **62**. Accordingly, each segment **126** is permitted to rotate in the directions permitted by the pivot joint **58**, but is prevented from sliding radially inward or outward along the wheel side surfaces **18, 20**.

[0037] More specifically, the pivot joint **58** effectively creates a fixed point around which the segment **126** can expand or contract. Including a pivot joint **58** prevents radial displacement of the segment **126** during thermal expansion, ensuring that the segment **126** is properly aligned with the brake pad or shoe and preventing wear to the edges of the segments caused by improper alignment. Similarly, the pivot joint **58** is effective for maintaining the segment **126** in the desired position by resisting centripetal force caused by rotation of the wheel **10** about the hub **14**, which tends to force the segment **126** toward the outer rim **16**. The pivot joint **58** also effectively transmits the braking force applied by the brake mechanism to the wheel to restrict wheel rotation. Finally, since the head **64** of the coupling member **62** is not fixedly connected to the segment **126**, but merely rests within the corresponding groove **156**, lateral deformation of the wheel body **12** is not transmitted to the segment **126**. Since such deformation of the wheel body **12** is not transmitted to the segment **126**, structural integrity of the segment **126** is preserved. Specifically, the segment **126** is protected from bending, improper wear, misalignment with the brake shoe, or other deforming forces that would weaken the segment **126** following prolonged use.

[0038] With reference to **FIG. 1**, in use, a braking force **F** is applied to corresponding segments **126** of the front brake disc **24** on the front **18** and the rear brake disc **24'** (shown in **FIG. 4A**) on the rear **20** side surfaces of the wheel **10** by the brake shoes or pads of a brake mechanism. The braking force F is transmitted to the wheel **10** by both the inner side **132** of the segment **126** and coupling member **62**. More particularly, the force F is applied in the circumferential direction causing the segments **126** contacted by the brake shoe or pads to pivot thereby transmitting force to adjacent segments **126** as well. Since the segments **126** are slidably connected by the joining elements **38**, the segments **126** are permitted to pivot or rotate in response to the applied force. However, since forces applied to adjacent segments **126** on opposite sides of the contacted segment **126** are equal in force, but opposite in direction, rotation of the segments **126** is restricted. Therefore, the segments **126** are effectively locked

together, meaning that the brake discs **24, 24'** function as continuous or unitary structures, even though the segments **126** are separated by the radial gap **36**.

[0039] As force **F** is applied to the segments **126**, heat is created causing the contacted segment **126** to expand. The segments **126** are also exposed to centripetal forces that tend to push the segments **126** radially outward toward the outer rim **16** of the wheel **10**. However, even as the segment **126** expands, it is prevented from sliding as a result of the contact between the groove **156** and head **64** of the coupling member **62**. In this way, the pivot joint **58** is a fixed point around which the segment **126** can expand. Beneficially, radial displacement of the segment **126** is effectively prevented. Instead, the segment **126** is only permitted to pivot or rotate in directions restricted by the shape of the pivot joint **58**.

[0040] While specific embodiments of the brake disc and rotating body have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of invention which is to be given the full breadth of the claims appended and any and all equivalents thereof. Further, although the invention has been described in detail for the purpose of illustration based on what is currently considered to be the most practical and preferred embodiments, it is to be understood that such detail is solely for that purpose and that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover modifications and equivalent arrangements that are within the spirit and scope of the appended claims. For example, it is to be understood that the present invention contemplates that, to the extent possible, one or more features of any embodiment can be combined with one or more features of any other embodiment.

What is claimed is:

1. A brake disc comprising:

a plurality of arcuate segments arranged to form a ring and a plurality of joining elements for connecting the segments to adjacent segments, wherein each segment comprises:

an inner side configured to contact a surface of a wheel;

an outer side comprising a braking surface for contacting a braking mechanism;

at least one socket on each radial end of the segment for receiving one of the plurality of joining elements; and

a groove on the inner side of the segment configured to receive a coupling member to form a pivot joint for positioning the segment on the surface of the wheel.

2. The brake disc of claim 1, wherein the coupling member comprises a head configured for insertion in the groove.

3. The brake disc of claim 2, wherein the pivot joint is a condyloid joint.

4. The brake disc of claim 2, wherein the pivot joint is a ball and socket joint.

5. The brake disc of claim 1, further comprising a plurality of transverse through holes extending between the inner side and the outer side of the segment configured to receive fasteners to connect the segment to the wheel.

6. The brake disc of claim 1, wherein each segment comprises two sockets on each radial end of the segment.

7. The brake disc of claim 1, wherein each of the plurality of joining elements is slidably received within a respective socket.

8. The brake disc of claim 7, wherein a depth of each socket is greater than a length of the joining elements, thereby allowing the joining element to slide entirely into the socket.

9. The brake disc of claim 1, wherein the brake disc comprises six segments.

10. The brake disc of claim 1, wherein adjacent segments are separated by a radial gap, and wherein the segments are movable, with respect to the joining elements, to change a width of the radial gap.

11. The brake disc of claim 1, further comprising at least one protrusion extending from the inner side of the segment for directing cooling air to the inner side of the segment.

12. The brake disc of claim 11, wherein the at least one protrusion comprises a radial fin extending between an inner circumferential side and an outer circumferential side of the segment.

13. A brake assembly comprising:

a wheel having a central hub, an outer rim, and a body extending between the hub and the rim, the body having a front side surface and a rear side surface;

a front brake disc connected to the front side surface of the body; and

a rear brake disc connected to the rear side surface of the body,

wherein each brake disc comprises a plurality of arcuate segments arranged to form a ring and a plurality of joining elements for connecting the segments to adjacent segments and wherein each segment comprises:

an inner side configured to contact the front side surface or rear side surface of the body of the wheel;

an outer side comprising a braking surface for contacting a braking mechanism;

at least one socket located on each radial ends of the segment for receiving the joining element; and

a groove on the inner side of the segment configured to receive a coupling member to form a pivot joint for positioning the segment on the front side surface or the rear side surface of the wheel.

14. The brake assembly of claim 13, wherein the coupling member comprises a head on each longitudinal end thereof and a shaft extending therebetween.

15. The brake assembly of claim 14, wherein the groove of each segment defines an ellipsoid cavity configured to receive the head of the coupling member to form a condyloid joint.

16 The brake assembly of claim 14, wherein the groove of each segment defines a partially spherical cavity configured to receive the head of the coupling member to form a ball and socket joint.

17. The brake assembly of claim 13, wherein the coupling member extends through a hole in the body of the wheel, and wherein one end of the coupling member is inserted in a groove of a segment of the front brake disc and the other end of the coupling member is inserted in a groove of a corresponding segment of the rear brake disc.

18. The brake assembly of claim 13, wherein each segment further comprises at least one transverse through hole extending between the inner side and the outer side of the segment, and wherein the assembly further comprises a fastener inserted through each through hole for connecting the front brake disc to the rear brake disc through a corresponding through hole in the body of the wheel.

19. The brake assembly of claim 18, wherein each segment comprises two transverse through holes located on a center axis of the segment.

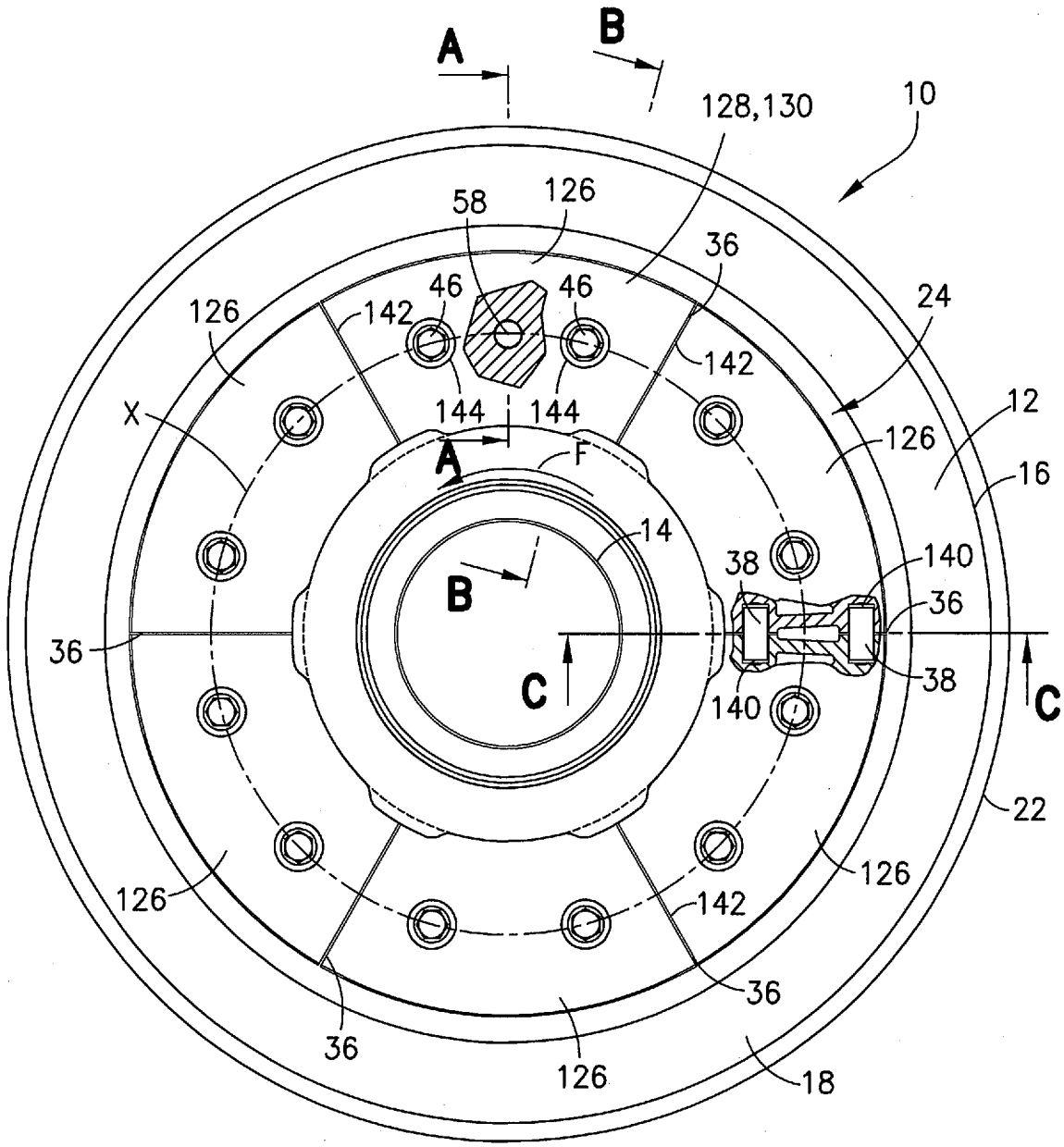

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FIG. 1

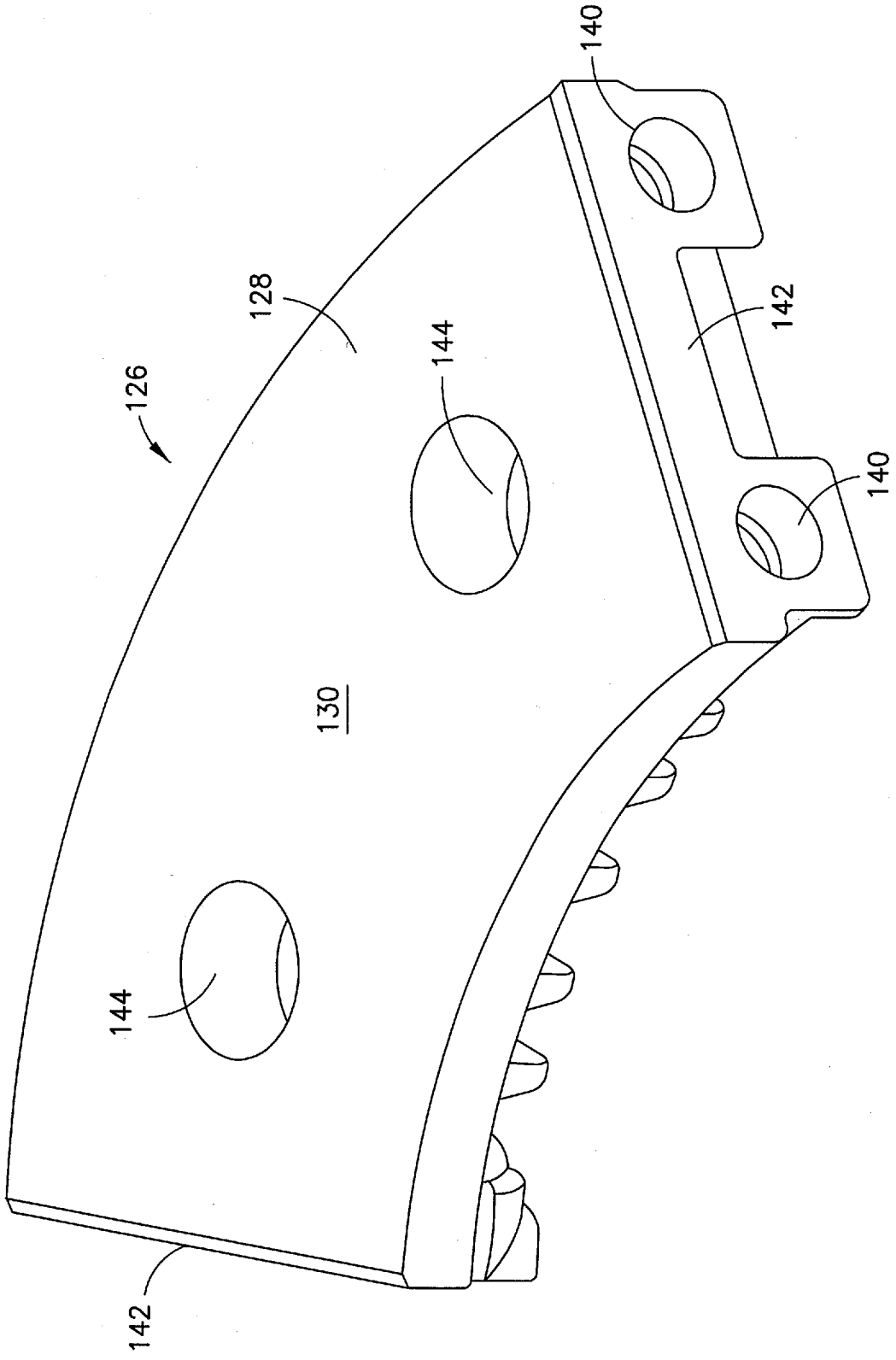


FIG.2

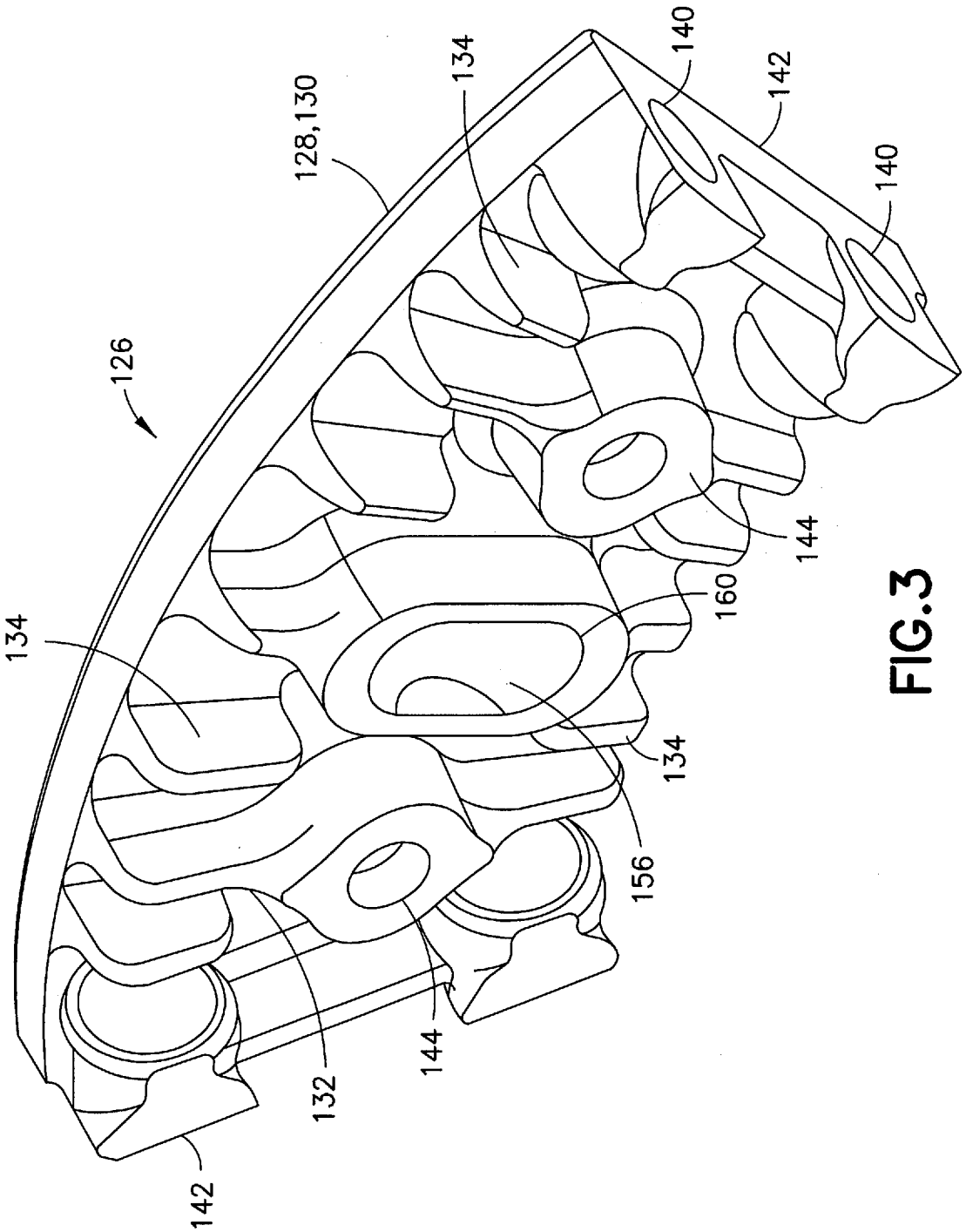


FIG.3

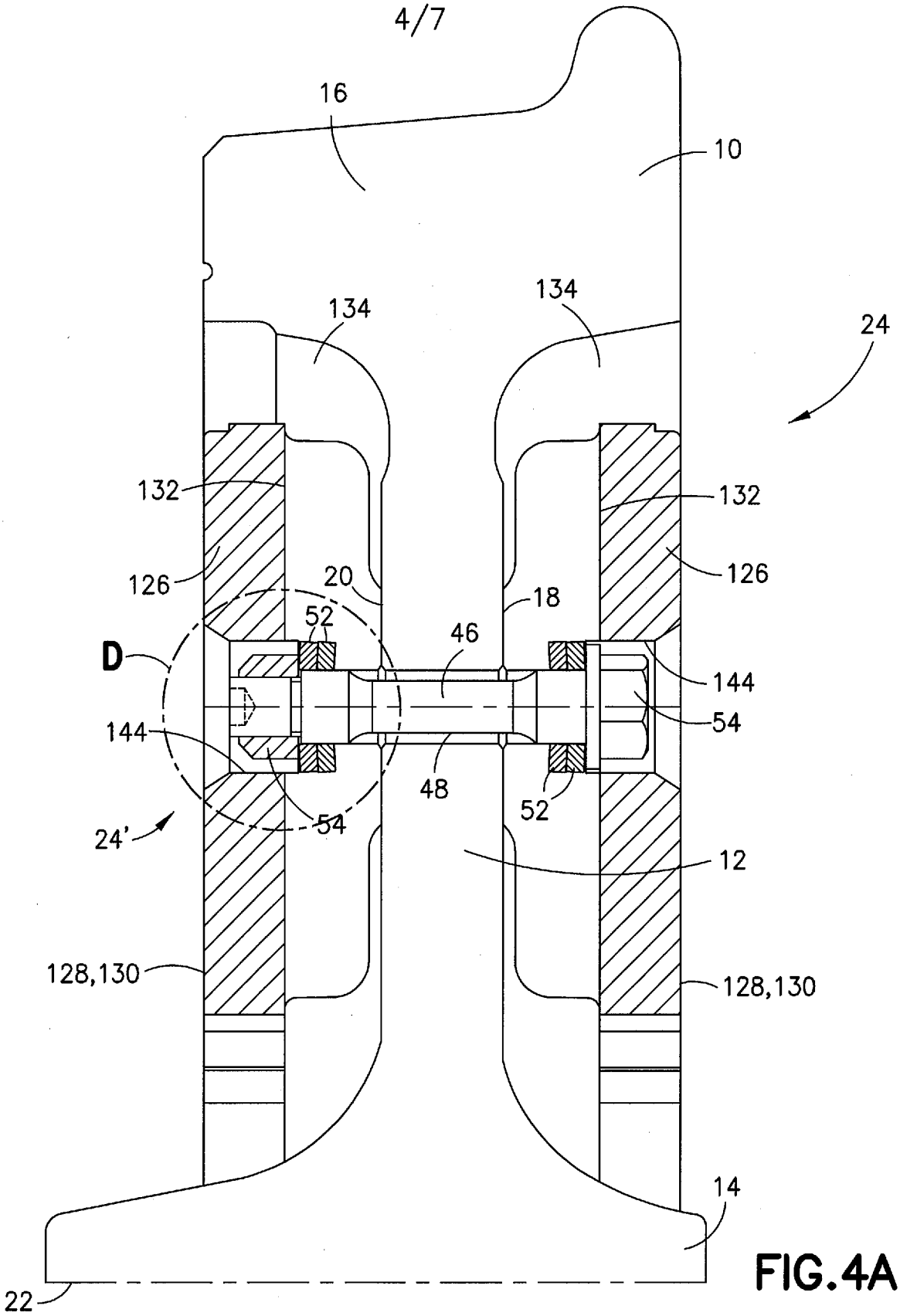

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FIG.4A

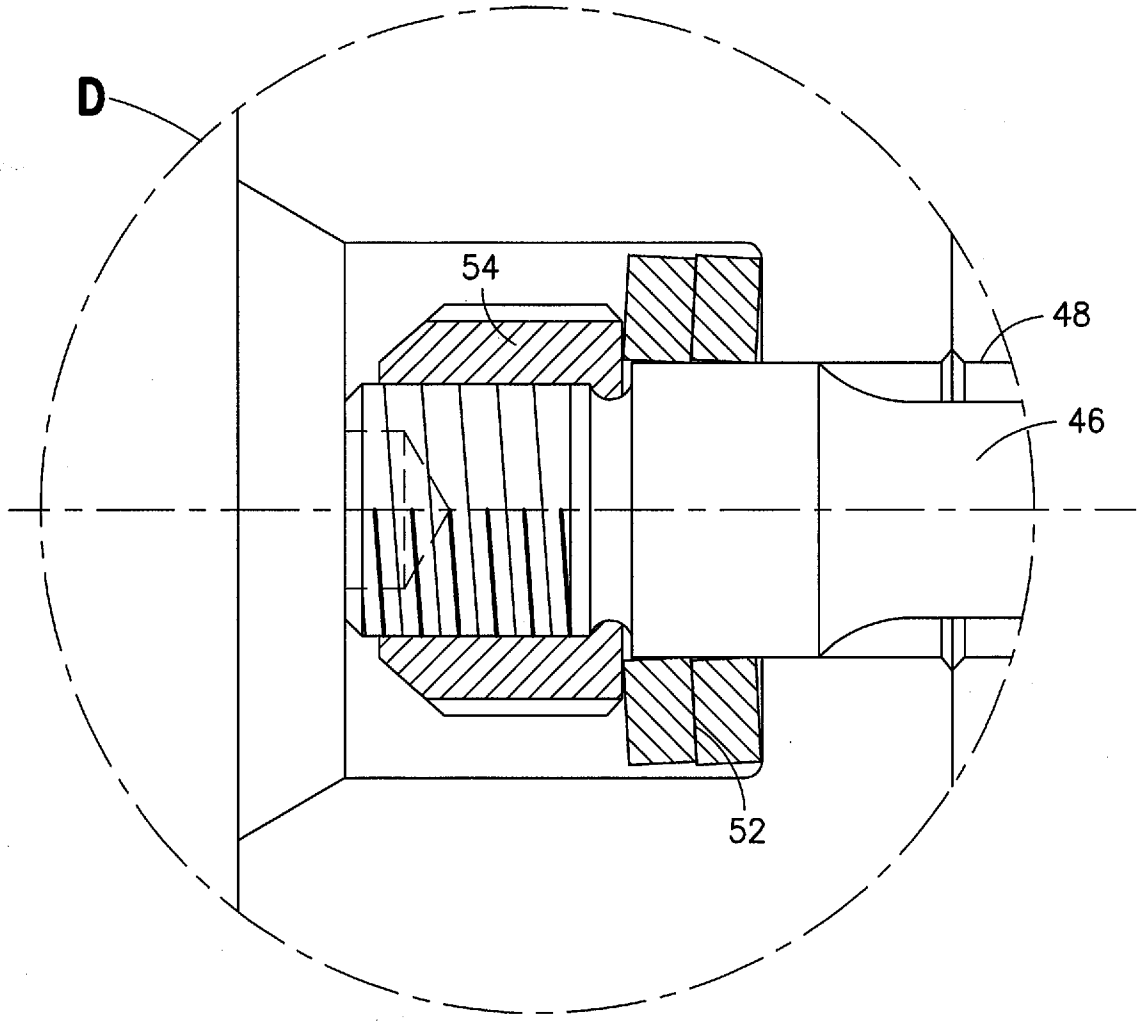


FIG.4B

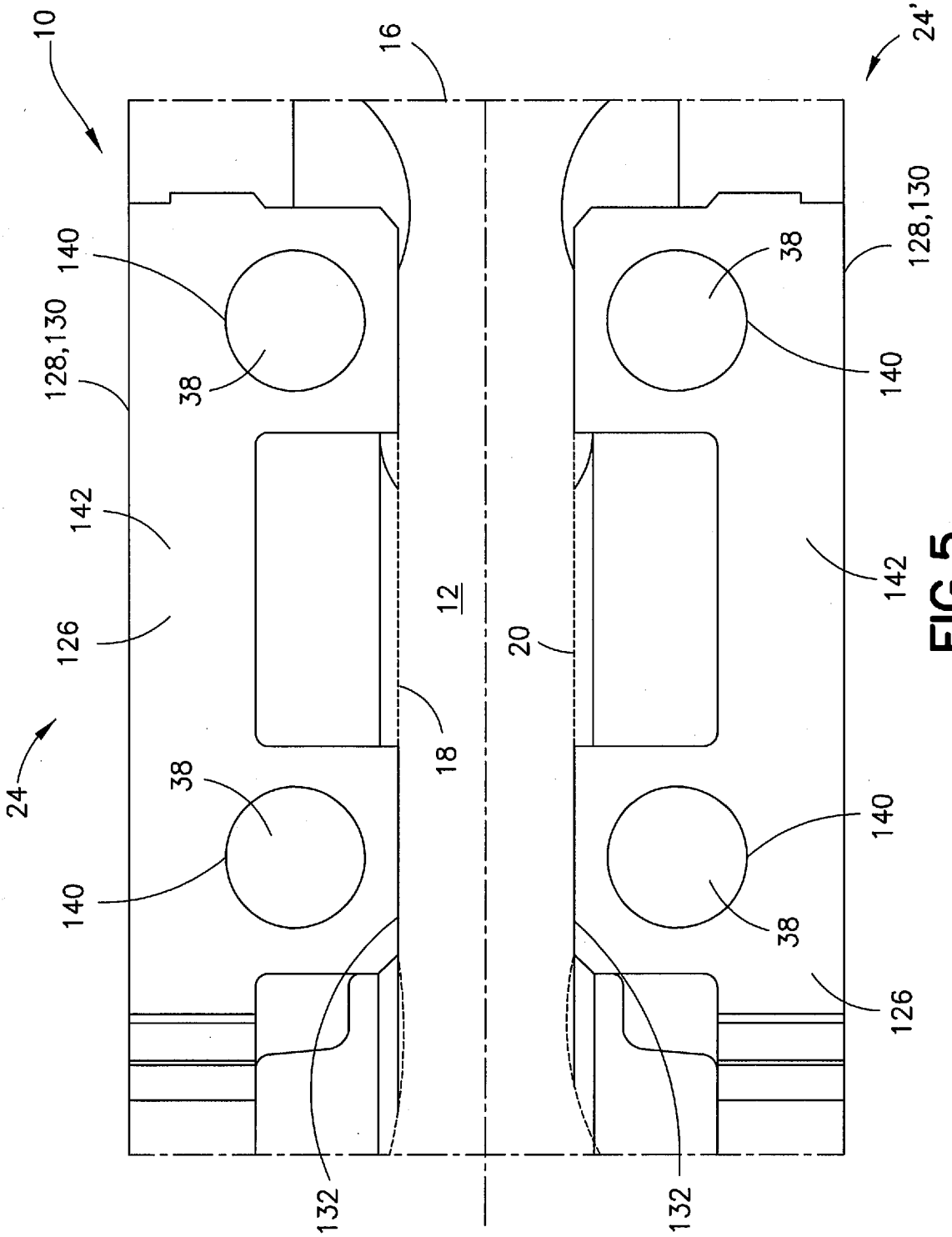

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FIG.5

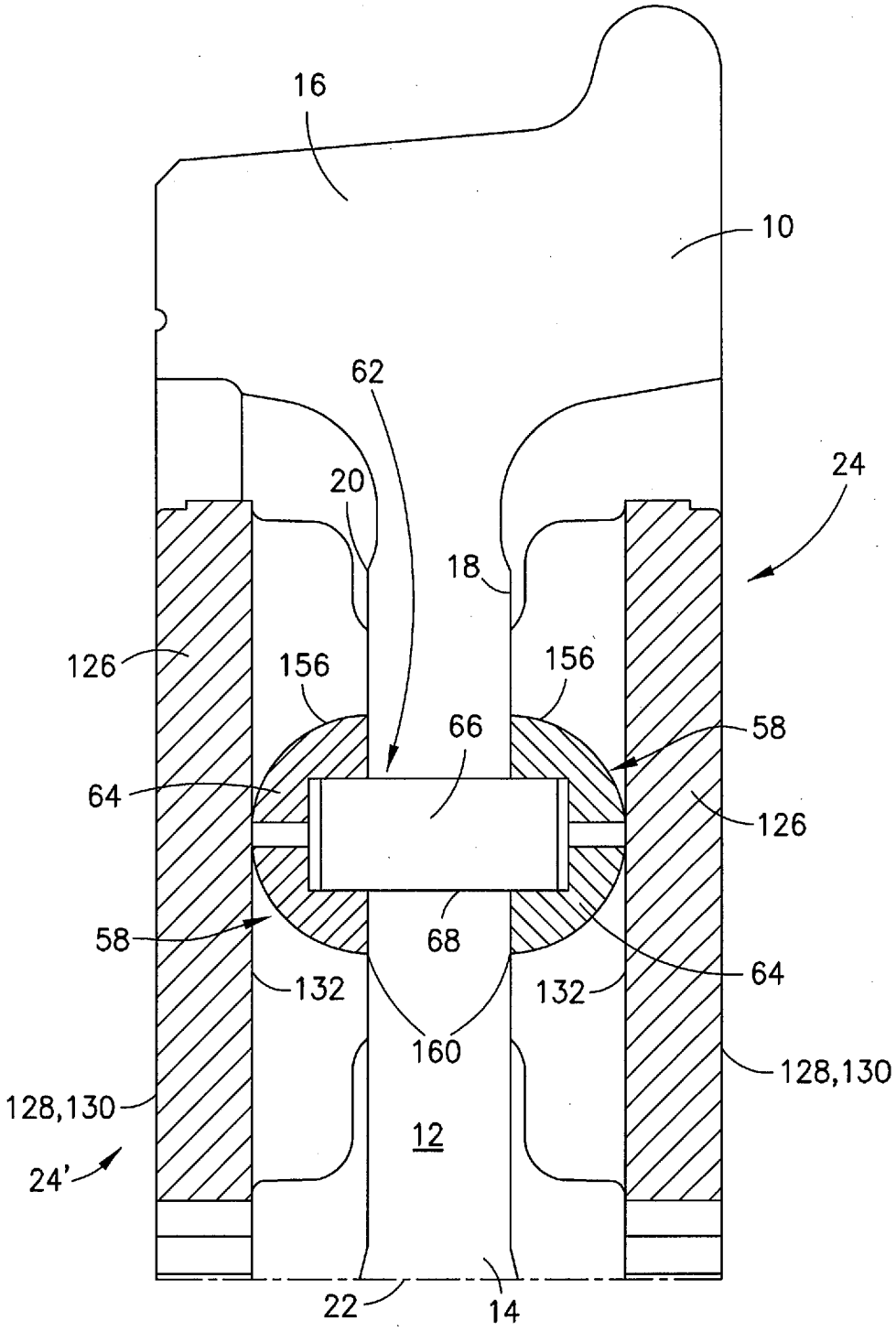

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FIG.6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/033775

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16D65/12
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)
F16D

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	DE 23 15 134 A1 (KLOECKNER WERKE AG; KNORR BREMSE GMBH) 10 October 1974 (1974-10-10)	1-4,6,7, 9,10,13, 19
Y	page 5, last paragraph - page 6, last paragraph; figures 8-11	5,8,11, 12
Y	US 4 132 294 A (POLI ANTONIO [IT]) 2 January 1979 (1979-01-02) cited in the application column 5, line 30 - column 6, line 2; figures 6,7	5,8,11, 12
A	WO 2010/108671 A1 (FAIVELEY TRANSP WITTEN GMBH [DE]; AAB HEINZ [DE]; BRAECKER TOBIAS [DE]) 30 September 2010 (2010-09-30) page 9, paragraph 3	1,13

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

☒ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 July 2014	24/07/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	van Koten, Gert

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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