



(51) International Patent Classification:
B60B 7/06 (2006.01)

(21) International Application Number:
PCT/US2012/037196

(22) International Filing Date:
10 May 2012 (10.05.2012)

(25) Filing Language: English

(26) Publication Language: English

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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, 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, IS, JP, KE, KG, KM, 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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, 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, ML, MR, NE, SN, TD, TG).

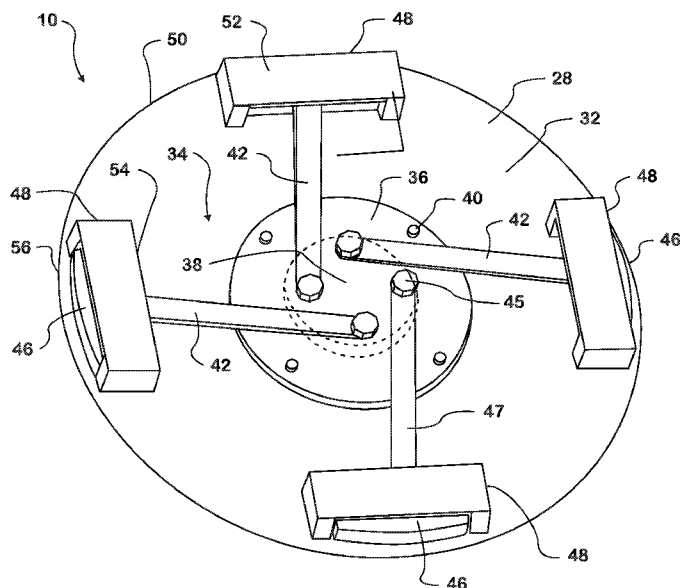
Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

- with international search report (Art. 21(3))

(54) Title: WHEEL COVER ASSEMBLY



(57) Abstract: A wheel cover assembly for a wheel having a rim with an interior surface and a bolt circle includes a cover plate configured to at least partially enclose the interior surface of the rim. The cover plate has an interior surface that faces towards the bolt circle. A ratchet assembly is at the interior surface of the cover plate and includes a rotating element that is rotational with respect to the cover plate, and at least one leg extending from the rotating element. The at least one leg has a distal end. A pressure pad is at the distal end and is configured to be frictionally engaged against the interior surface of the rim. The at least one leg is extendable and retractable in a generally radial direction upon rotation of the rotating element to engage the pressure pad against the interior surface of the rim.

WHEEL COVER ASSEMBLY

BACKGROUND

[0001] Embodiments described herein relate generally to wheel covers for vehicles, and more particularly, to wheel covers for vehicles for reducing aerodynamic drag.

[0002] Wheel covers are attached to wheels of vehicles such as trucks, automobiles, recreational vehicles and buses. Within the rim of a wheel, a vacuum can be formed which results in aerodynamic drag on the vehicle. Wheel covers are frequently attached to the dual rear wheels of heavier vehicles, such as trucks. In the dual rear wheels of heavier vehicles, there is a comparatively larger distance from the exterior plane of the rim to the bolt circle than in most automobiles. Due to this distance, the wheel covers of rear wheels are typically attached to the rim in a different way than the wheel covers of automobiles.

SUMMARY

[0003] A wheel cover assembly for a wheel having a generally cylindrical rim with an interior surface and a bolt circle that is generally perpendicular to the rim includes a generally circular cover plate. The cover plate is configured to at least partially enclose the interior surface of the rim. The cover plate has an interior surface that faces towards the bolt circle. A ratchet assembly is disposed at the interior surface of the cover plate and includes a rotating element that is rotational with respect to the cover plate, and at least one leg extending from the rotating element in a generally radial direction with respect to the cover plate. The at least one leg has a distal end. A pressure pad is disposed at the distal end and is configured to be frictionally engaged

against the interior surface of the rim. The at least one leg is extendable and retractable in a generally radial direction upon rotation of the rotating element to engage the pressure pad against the interior surface of the rim to attach the cover plate to the wheel.

[0004] Another wheel cover assembly for a wheel having a generally cylindrical rim with an interior surface and an exterior surface, and a bolt circle that is generally perpendicular to the rim, includes a generally circular cover plate. The cover plate is configured to at least partially enclose the interior surface of the rim. The cover plate has an interior surface that faces towards the bolt circle, an exterior surface opposite the interior surface, and at least one opening through the cover plate from the interior surface to the exterior surface. A hook assembly is attached to the cover plate and is configured to attach the cover plate to the wheel. The hook assembly includes at least two generally elastic straps attached to the cover plate and at least two hooks disposed on the at least two elastic straps. The hooks are configured to be engaged with the exterior surface of the rim and are configured to be maintained in engagement with the rim by the tension in the elastic straps.

[0005] A further wheel cover assembly for a wheel having a generally cylindrical rim with an interior surface and an exterior surface, and a bolt circle that is generally perpendicular to the rim, includes a generally circular cover plate. The cover plate is configured to at least partially enclose the interior surface of the rim, and has an interior surface that faces towards the bolt circle. A plate assembly is attached to the cover plate and is configured to attach the cover plate to the bolt circle of the wheel. The hook assembly includes a center plate that is configured to be generally parallel to the bolt circle and to have a plurality of bolt holes that are configured to be aligned with bolts holes of the bolt circle. The center plate is configured to be fastened with the bolt circle using the aligned bolt holes. At least one extension leg is configured to extend generally perpendicularly from the center plate to the cover plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a rear perspective view of a first embodiment of a wheel cover assembly.

[0007] FIG. 2 is an exploded front perspective view of the first embodiment of the wheel cover assembly and a wheel.

[0008] FIG. 3 is an exploded rear perspective view of the first embodiment of the wheel cover assembly and the wheel.

[0009] FIG. 4 is a partial detail view of the first embodiment of the wheel cover assembly and the wheel.

[0010] FIG. 5 is a rear perspective view of a second embodiment of a wheel cover assembly.

[0011] FIG. 6 is an exploded front perspective view of the second embodiment of the wheel cover assembly and the wheel.

[0012] FIG. 7 is a partial detail view of the second embodiment of the wheel cover assembly and the wheel.

[0013] FIG. 8 is a front perspective view of a third embodiment of a wheel cover assembly.

[0014] FIG. 9 is an exploded front perspective view of the third embodiment of the wheel cover assembly and the wheel.

DETAILED DESCRIPTION

[0015] Referring to FIGs. 1-9, three embodiments of wheel cover assemblies are indicated generally at 10, 110, 210 and are configured for attachment to a wheel 12. While the wheel cover assemblies 10, 110, 210 will be explained with reference to use with a wheel 12 of a vehicle, and in particular to rear wheels of heavy trucks, it should be appreciated that the wheel cover assembly can be used in any application for attachment to a wheel or rotating cylinder. The wheel 12 includes a bolt circle 14 and a generally cylindrical rim 16 that extends generally perpendicularly from the bolt circle. At an edge 18 of the rim 16 that is opposite from the bolt circle 14, the edge defines a rim plane 20 that is open to an interior surface 22 of the rim unless covered by a wheel cover assembly 10, 110, 210.

[0016] The wheel 10 has a center axis A about which the rim 16 is generally concentric, and the bolt circle 14 may have a center thru-hole 15 which is generally centered about the center axis A. The rim 16 may include an opening 24 that is stamped or otherwise formed to allow access from an exterior surface 26 of the rim to the interior surface 22 of the rim. Along the length of the rim 16 in the direction parallel with the center axis A, the rim may have varying diameters.

[0017] Referring to FIGs. 1-4, the wheel cover assembly 10 has a generally circular cover plate 28 that is configured to engage the rim 16 at or near the edge 18 of the rim 16 and to be seated or otherwise located generally in the rim plane 20. The cover plate 28 is configured to generally enclose the interior surface 22 of the rim 16. The cover plate 28 has an exterior surface 30 that forms the exterior surface of the wheel cover assembly 10 and generally encloses the wheel 10. The exterior surface 30 may be generally smooth. Alternately, the cover plate 28 may be configured to cover a portion of the interior surface 22 of the rim 16. A peripheral edge 50 of the cover plate 28 may engage the edge 18 or the interior surface 22 of the rim 16.

[0018] An interior surface 32 of the cover plate 28 is configured to face and to be generally parallel with the bolt circle 14. A ratchet assembly 34 is disposed on the interior surface 32, and may include a mounting plate 36 and a rotating element 38. The mounting plate 36 may be attached to the cover plate 28 with at least one bolt 40. The rotating element 38 may be of a ratcheting type that is rotatable with respect to the cover plate 28, and may be a generally circular plate mounted on the mounting plate 36, however other configurations are possible. Extending from the rotating element 38 in a generally radial direction with respect to the cover plate 28 is at least one leg 42 that is pivotably attached to the rotating element with a fastener 43. The fastener 43 may permit the leg 42 to pivot with respect to the rotating element 38. In the wheel cover assembly 10, there are four generally elongate and rigid legs 42 attached to the rotating element 38.

[0019] At a distal end 44 of each leg 42 is a pressure pad 46 that is configured to engage and deform against the interior surface 22 of the rim. The pressure pads 46 may be formed of any rubber or plastic material with a high friction coefficient. With rotation of the rotating element 38, the pressure exerted by the leg 42 onto the pressure pad 46 deforms the pressure pad against the interior surface 22 of the rim 16 such that the pressure pad is frictionally engagement and generally static against the rim.

[0020] At least one receiving channel 48 may be disposed on the interior surface 32 of the cover plate 28 at or near the peripheral edge 50 of the cover plate. The receiving channel 48 may be enclosed or open, and may be defined by at least one receiving wall or retaining structure 52. In the wheel cover assembly 10, there are four receiving channels 48 that receive the four pressure pads 46, and the four receiving channels are generally disposed at 90-degree increments around the generally circular cover plate 28, although other configurations are possible. The pressure pads 46 are received in the receiving channels 48 upon rotating the rotating element 38, which

extends and retracts the legs 42 and the pressure pads disposed at the distal end 44 of the legs. Upon rotation of the rotating element 38, the ratchet assembly 34 displaces the pressure pads 46 up into the receiving channel 48. The ratchet assembly 34 prevents the retraction of the legs 42 and pressure pads 46 until released by the user.

[0021] When the legs 42 are in an extended position, the pressure pads 46 protrude in the radial direction beyond the receiving channel 48. That is, the pressure pad 46 enters the receiving channel 48 at a radially interior entrance 54, and at least a portion of the pressure pad 46 protrudes beyond a radially exterior exit 56. The pressure pads 46 are configured to be extended to engage the interior surface 22 of the rim 16 (see FIG. 4). The ratchet assembly 34 maintains the extension of the pressure pads 46, while the receiving channel 48 maintains the location of the pressure pads with respect to the cover plate 28, and the pressure pads 46 exert sufficient pressure against the interior surface 22 of the rim 16 to fixedly attach the wheel cover assembly 10 to the wheel 12.

[0022] When assembling the wheel cover assembly 10 to the wheel 12, the cover plate 28 is positioned against the edge 18 of the rim 16 or adjacent the edge of the rim at an interior surface 22 of the rim. The ratchet assembly 34 is actuated by rotating the rotating element 38 to extend the legs against the interior surface 22 of the rim. Rotation of the rotating element 38 may be effected manually by a user extending a hand through the opening 24 or through the thru-hole 15 of the of the bolt circle 14.

[0023] Referring to FIGs. 5-7, a second embodiment of wheel cover assembly is indicated generally at 110 and has a generally circular cover plate 128 that is configured to engage the rim 16 at or near the edge 18 of the rim 16 and to be seated or otherwise located generally in the rim plane 20. The cover plate 128 generally encloses the interior surface 22 of the rim 16. The cover plate 128 has an exterior

surface 130 that forms the exterior surface of the wheel cover assembly 10 and generally encloses the wheel 10. The exterior surface 130 may be generally smooth. Alternately, the cover plate 128 may be configured to cover a portion of the interior surface of the rim 22. A peripheral edge 150 of the cover plate 128 may engage the edge 18 or the interior surface 22 of the rim 16.

[0024] Opposite from the exterior surface 130 is an interior surface 132 of the cover plate 128 that is configured to face the bolt circle 14 and to be generally parallel with the bolt circle. At least two openings 133 extend through the cover plate 128 from the interior surface 132 to the exterior surface 130. In the wheel cover assembly 110, there are four openings 133 that are disposed at about 90-degree increments around the cover plate 128 near a peripheral edge 150 of the cover plate.

[0025] A hook assembly 134 is attached to the cover plate 128 with a fastener 136. The hook assembly 134 includes at least two hooks 138 disposed through the opening 133 from the interior surface 132 to the exterior surface 130, and from the exterior surface around the peripheral edge 150 of the cover plate 128. In the wheel cover assembly 110, there are four hooks 138 that are received in four openings 133. The hooks 138 may be disposed on distal ends 142 of at least two straps 140 that are anchored generally at the center of the cover plate 128 with the fastener 136. The straps 140 may have elastic properties to allow the hooks 138 to be introduced through the openings 134, and to maintain the straps in tension.

[0026] In the wheel cover assembly 110, there may be four straps 140 that are separate or integrally formed, and that extend generally from the center of the cover plate 128 at 90-degree increments, however other configurations are contemplated. The at least two generally elastic straps 140 may be integrally formed and fastened to the cover plate 128 with the fastener 136 to define two straps on either side of the

fastener. Alternately, the hooks 138 may be on straps 140 that are individually attached to the cover plate 128.

[0027] When assembling the wheel cover assembly 110 to the wheel 12, the cover plate 128 is positioned against the edge 18 of the rim 16 or adjacent the edge of the rim at an interior surface 22 of the rim. The hook assembly 134 is engaged to the exterior surface 26 of the rim 16. Engagement of the hooks 138 onto the exterior surface 22 of the rim 16 may be effected manually by a user extending the hook against the elastic tension of the strap 140, and placing the hooks onto the exterior surface of the rim. The straps 140 provide tension to maintain the hook 138 against the rim 16, and to maintain the cover plate 128 against the wheel 12. It is possible that the hooks 138 may have a geometry that is configured to be received by the geometry of the rim 16. It is also possible that the hooks 138 may be additionally secured to the rim 16, such as with a fastener.

[0028] Referring to FIGs. 8-9, a third embodiment of wheel cover assembly is indicated generally at 210 and has a generally circular cover plate 228 that is configured to engage the rim 16 at or near the edge 18 of the rim 16 and to be seated or otherwise located generally in the rim plane 20. The cover plate 228 generally encloses the interior surface 22 of the rim 16. The cover plate 228 has an exterior surface 230 that forms the exterior surface of the wheel cover assembly 10 and generally encloses the wheel 10. The exterior surface 230 may be generally smooth. Alternately, the cover plate 228 may be configured to cover a portion of the interior surface of the rim 22. A peripheral edge 250 of the cover plate 228 may engage the edge 18 or the interior surface 22 of the rim 16.

[0029] Opposite from the exterior surface 230 is an interior surface 232 of the cover plate 228 that is configured to face the bolt circle 14 and to be generally parallel to the bolt circle 14. At least one hole 233 may be disposed through the cover plate

228 from the interior surface 232 to the exterior surface 230 for receiving at least one fastener 236.

[0030] A plate assembly 234 includes a center plate 238 that may be generally ring-shaped, and extension legs 240 that are configured to extend generally perpendicularly from the center plate 238. The center plate 238 is configured to be generally parallel to the bolt circle 14 and has a plurality of bolt holes 242 that are configured to be aligned with bolt holes 17 on the bolt circle 14 of the wheel 12. Fasteners 244 may attach the center plate 238 to the bolt circle 14. The pattern of the bolt holes 242 may be located on the center plate 238 according to known locations of bolt holes 17 on different wheels 12. Further, additional bolt holes 242 may be provided on the center plate 238. In this way, the center plate 238 and the wheel cover 210 has a universal design that can be attached to many different wheels 12 from different manufacturers.

[0031] The extension legs 240 may be attached to the center plate 238, such as with a threaded attachment or welded attachment. The extension legs 240 may have interior threads 246 for being attached to the cover plate 238 with fasteners 236, or to the center plate 238 with fasteners (not shown). To provide adjustability in length, the extension legs 240 may telescope. Alternately, different length extension legs 240 may be provided for the user to select a length according to the wheel 12. The extension legs 240 may be removably attached to the center plate 238, such as with a threaded attachment. The extension legs 240 are attached to the cover plate 228 with the fasteners 236, however other attachment methods can be used.

[0032] When assembled on wheels of vehicles, wheel covers 10, 110, 210 may reduce the vacuum that is formed within the wheel during motion, which may reduce aerodynamic drag and fuel consumption. Further, the wheel covers 10, 110, 210 have a universal design that permits attachment to a variety of different rims.

What is claimed is:

1. A wheel cover assembly for a wheel having a generally cylindrical rim with an interior surface and a bolt circle that is generally perpendicular to the rim, the wheel cover assembly comprising:

a generally circular cover plate that is configured to at least partially enclose the interior surface of the rim, the cover plate having an interior surface that faces towards the bolt circle;

a ratchet assembly disposed at the interior surface of the cover plate, the ratchet assembly comprising:

a rotating element that is rotational with respect to the cover plate;

at least one leg extending from the rotating element in a generally radial direction with respect to the cover plate, the at least one leg having a distal end; and

a pressure pad disposed at the distal end that is configured to be frictionally engaged against the interior surface of the rim;

wherein the at least one leg is extendable and retractable in a generally radial direction upon rotation of the rotating element to engage the pressure pad against the interior surface of the rim to attach the cover plate to the wheel.

2. The wheel cover assembly of claim 1 further comprising at least one receiving channel disposed on the interior surface of the cover plate, the receiving channel being defined by at least one retaining structure, the receiving channel being configured to receive the pressure pad.

3. The wheel cover assembly of claim 2 wherein the pressure pad enters the receiving channel at a radially interior entrance, and at least a portion of the pressure pad protrudes beyond a radially exterior exit of the receiving channel.

4. The wheel cover assembly of claim 1 wherein the at least one leg is pivotably attached to the rotating element to permit the leg to pivot with respect to the rotating element.

5. The wheel cover assembly of claim 1 wherein the ratchet assembly maintains the position of the at least one leg in an extended position to engage the pressure pad against the interior surface of the rim until released.

6. The wheel cover assembly of claim 2 wherein the at least one leg comprises four legs having four pressure pads, and wherein the at least one receiving channel comprises four receiving channels configured to receive the pressure pads.

7. A wheel cover assembly for a wheel having a generally cylindrical rim with an interior surface and an exterior surface, and a bolt circle that is generally perpendicular to the rim, the wheel cover assembly comprising:

a generally circular cover plate that is configured to at least partially enclose the interior surface of the rim, the cover plate having an interior surface that faces towards the bolt circle, an exterior surface opposite the interior surface, and at least one opening through the cover plate from the interior surface to the exterior surface;

a hook assembly attached to the cover plate and configured to attach the cover plate to the wheel, the hook assembly comprising:

at least two generally elastic straps attached to the cover plate; and

at least two hooks disposed on the at least two elastic straps;

wherein the hooks are configured to be engaged with the exterior surface of the rim and are configured to be maintained in engagement with the rim by the tension in the elastic straps.

8. The wheel cover assembly of claim 7 wherein the at least two hooks are disposed through the opening from the interior surface to the exterior surface, and from the exterior surface around a peripheral edge of the cover plate.

9. The wheel cover assembly of claim 7 wherein the at least two generally elastic straps may be integrally formed and fastened to the cover plate with a fastener to define two straps on either side of the fastener.

10. The wheel cover assembly of claim 7 wherein the at least two hooks have a geometry that is configured to be received by the geometry of the rim.

11. The wheel cover assembly of claim 7 wherein the at least two straps comprises four straps that extend from the center of the cover plate generally at 90-degree increments about the cover plate, and wherein the at least two hooks comprises four hooks, with one hook disposed at the end of each strap.

12. A wheel cover assembly for a wheel having a generally cylindrical rim with an interior surface and an exterior surface, and a bolt circle that is generally perpendicular to the rim, the wheel cover assembly comprising:

a generally circular cover plate that is configured to at least partially enclose the interior surface of the rim, the cover plate having an interior surface that faces towards the bolt circle;

a plate assembly attached to the cover plate and configured to attach the cover plate to the bolt circle of the wheel, the hook assembly comprising:

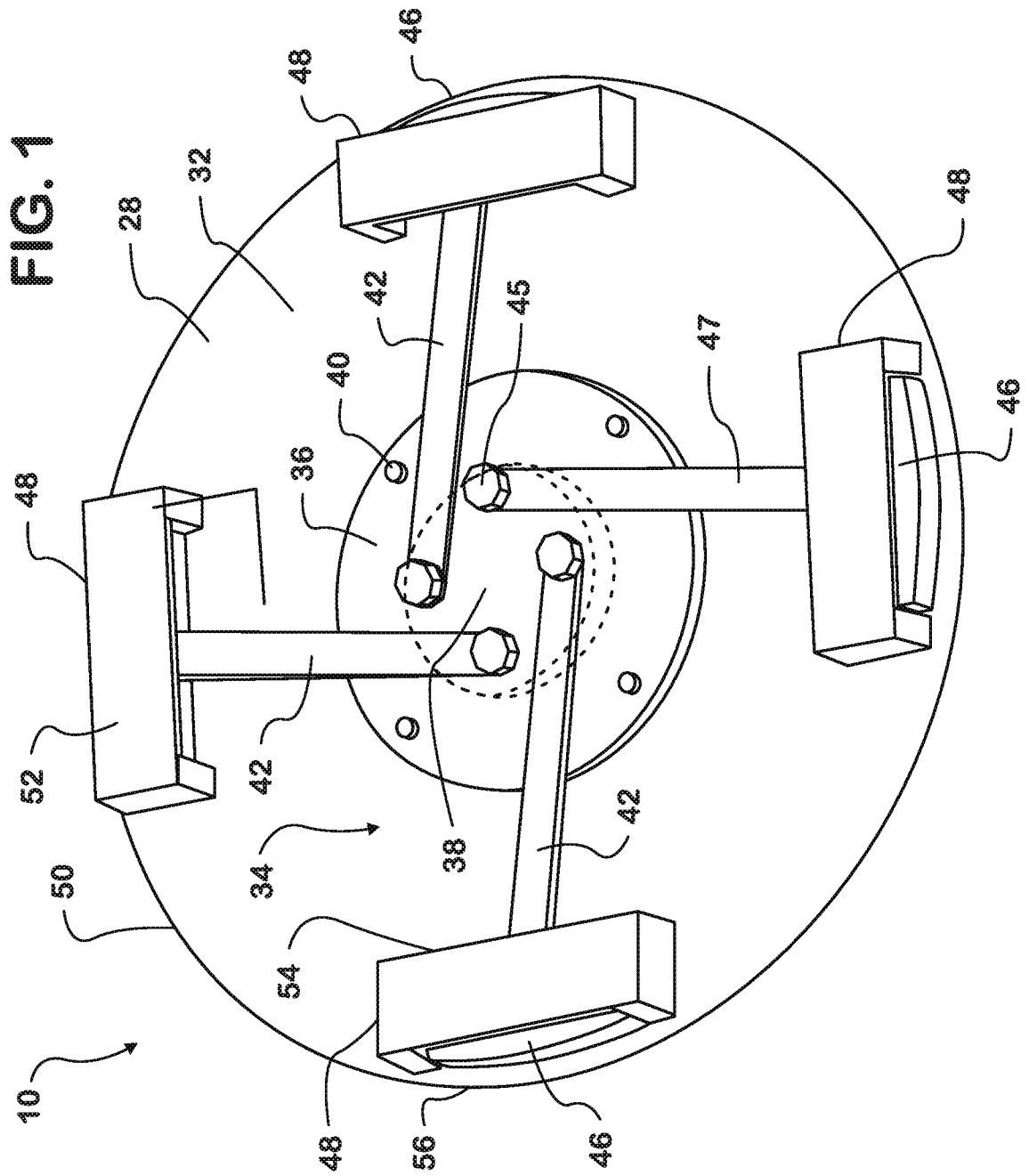
a center plate configured to be generally parallel to the bolt circle and to have a plurality of bolt holes that are configured to be aligned with bolts holes of the bolt circle, wherein the center plate is configured to be fastened with the bolt circle using the aligned bolt holes; and

at least one extension leg that is configured to extend generally perpendicularly from the center plate to the cover plate.

13. The wheel cover assembly of claim 12 wherein the center plate is generally ring-shaped.

14. The wheel cover assembly of claim 12 wherein the extension legs are telescoping.

15. The wheel cover assembly of claim 12 wherein the extension legs are selectively removable and replaceable with extension legs of different lengths.



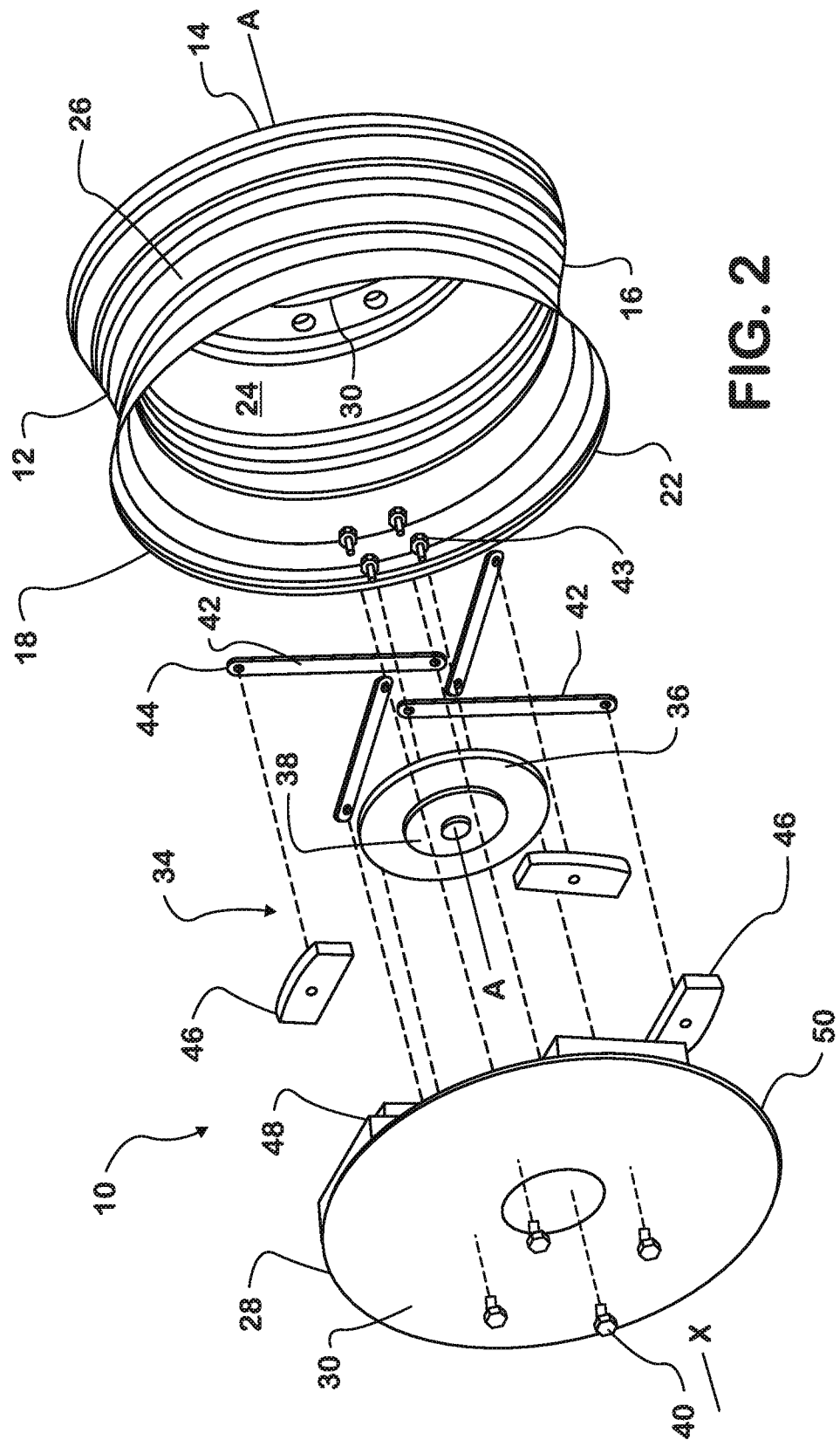
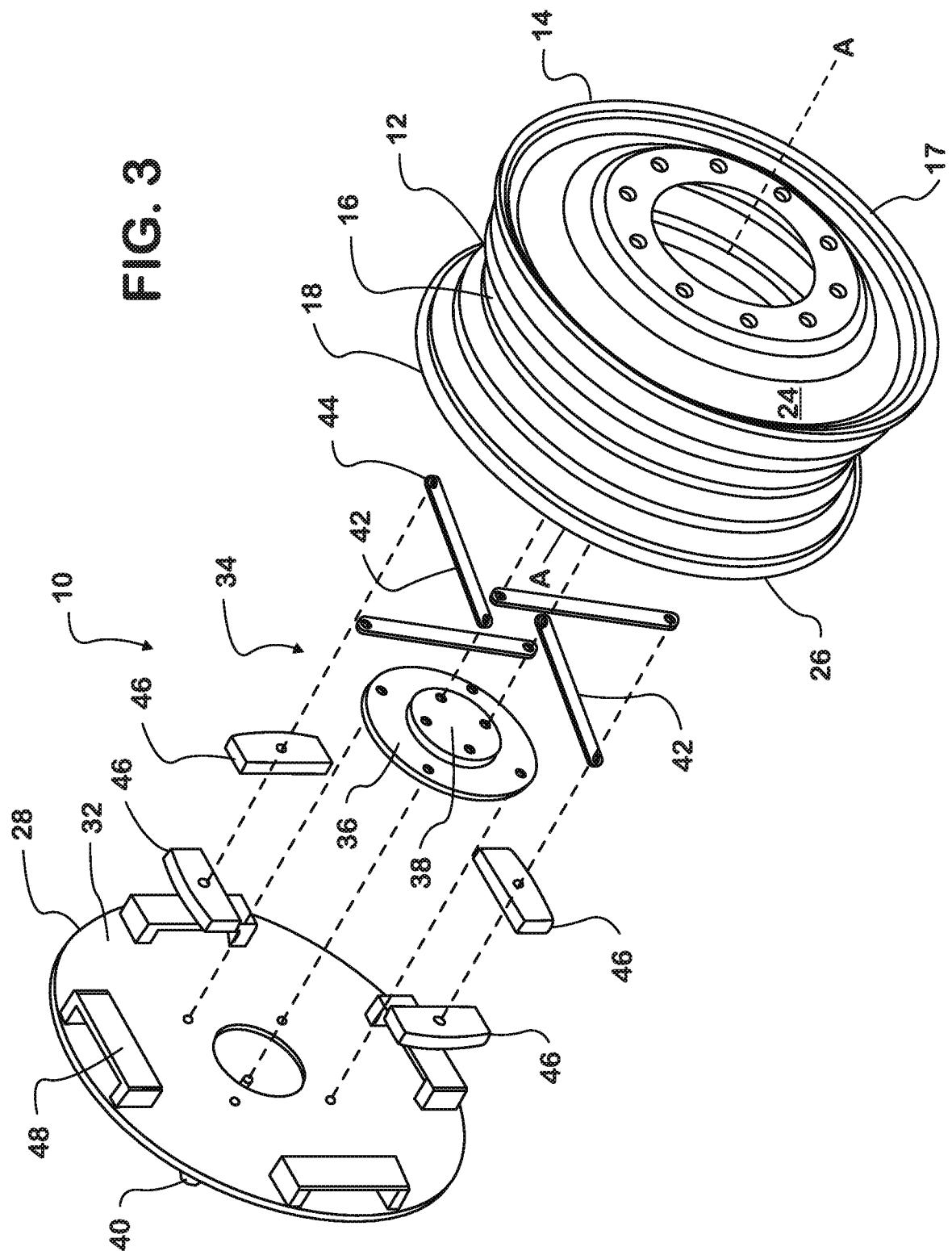


FIG. 3



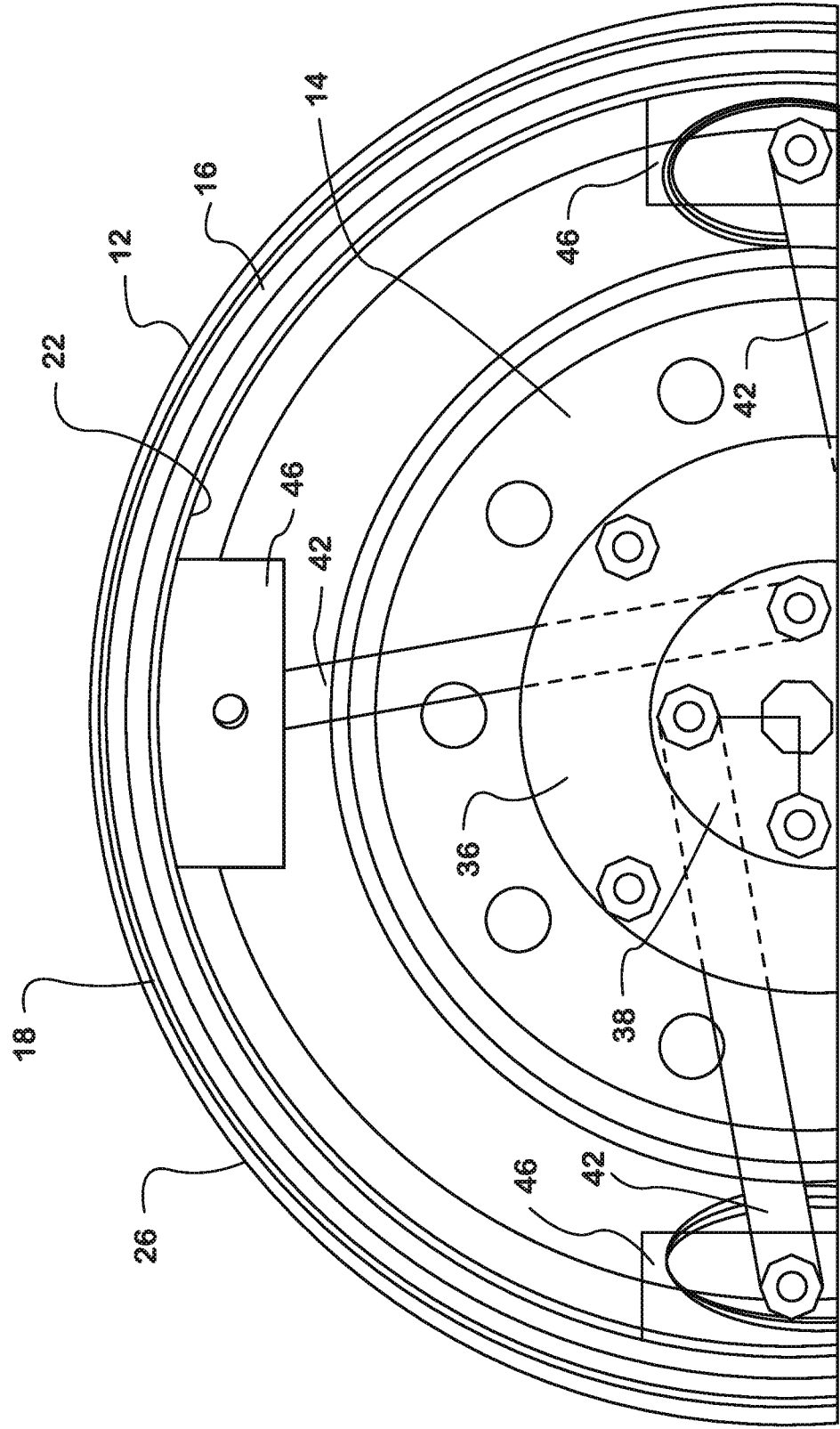
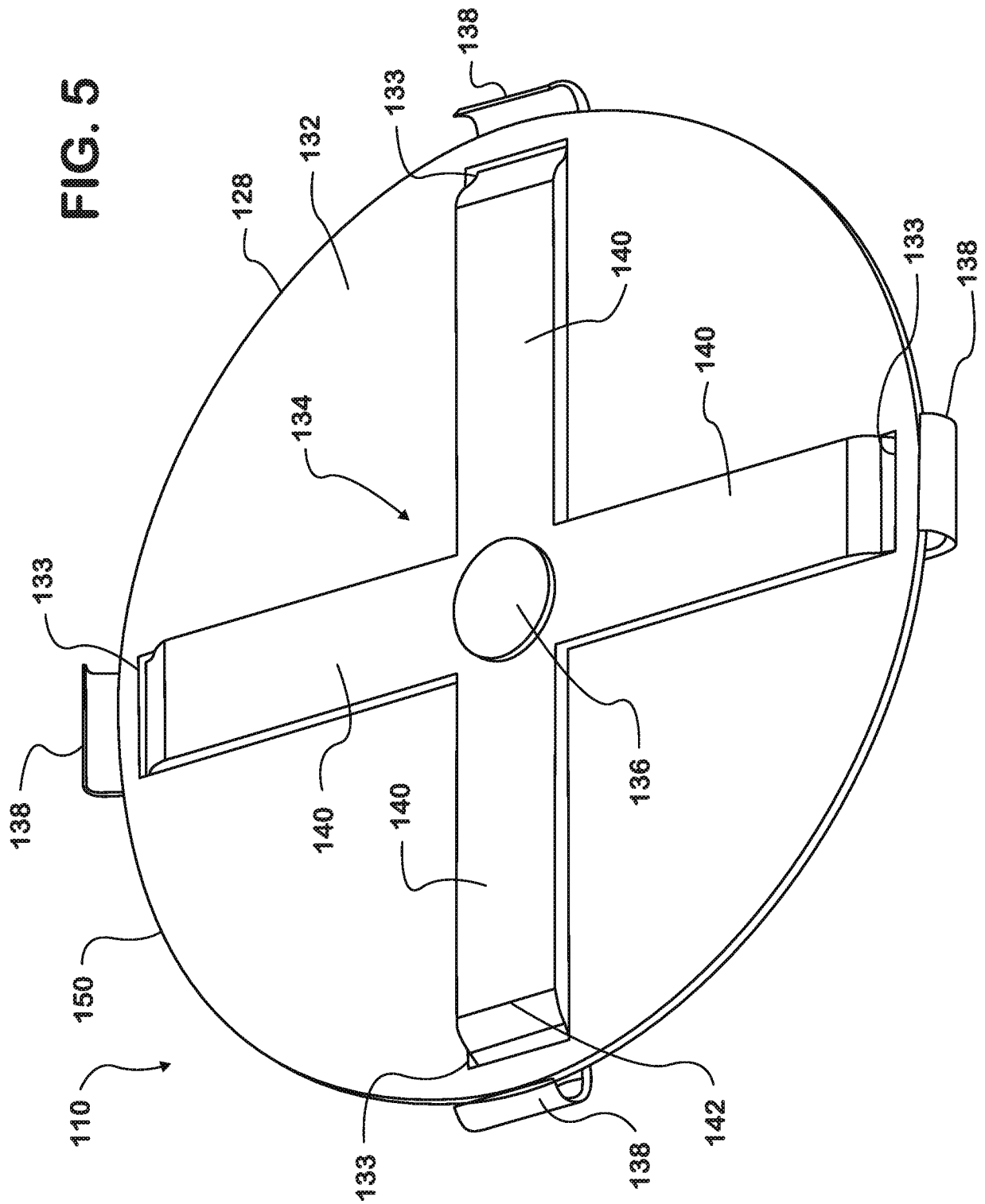


FIG. 4

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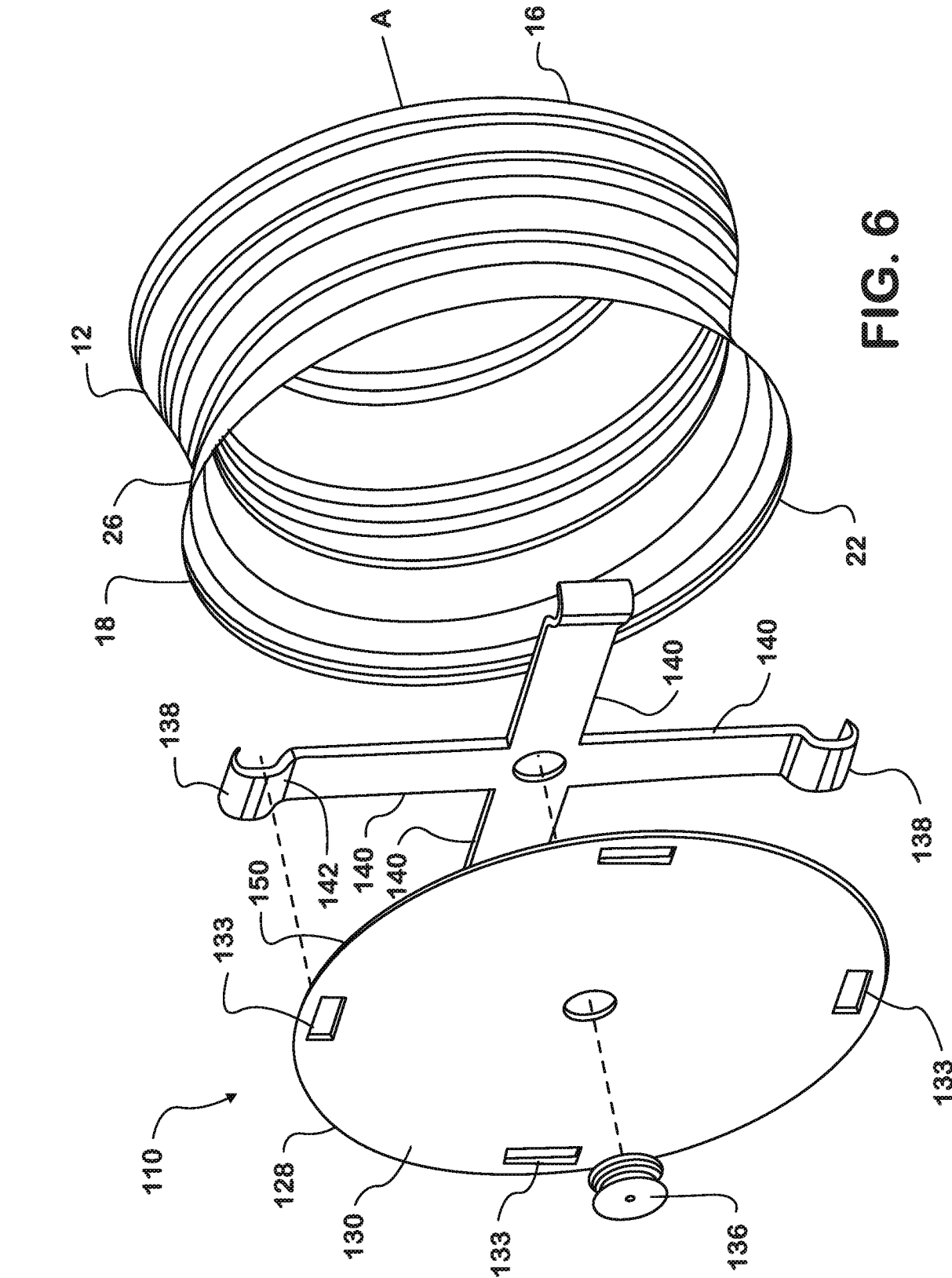
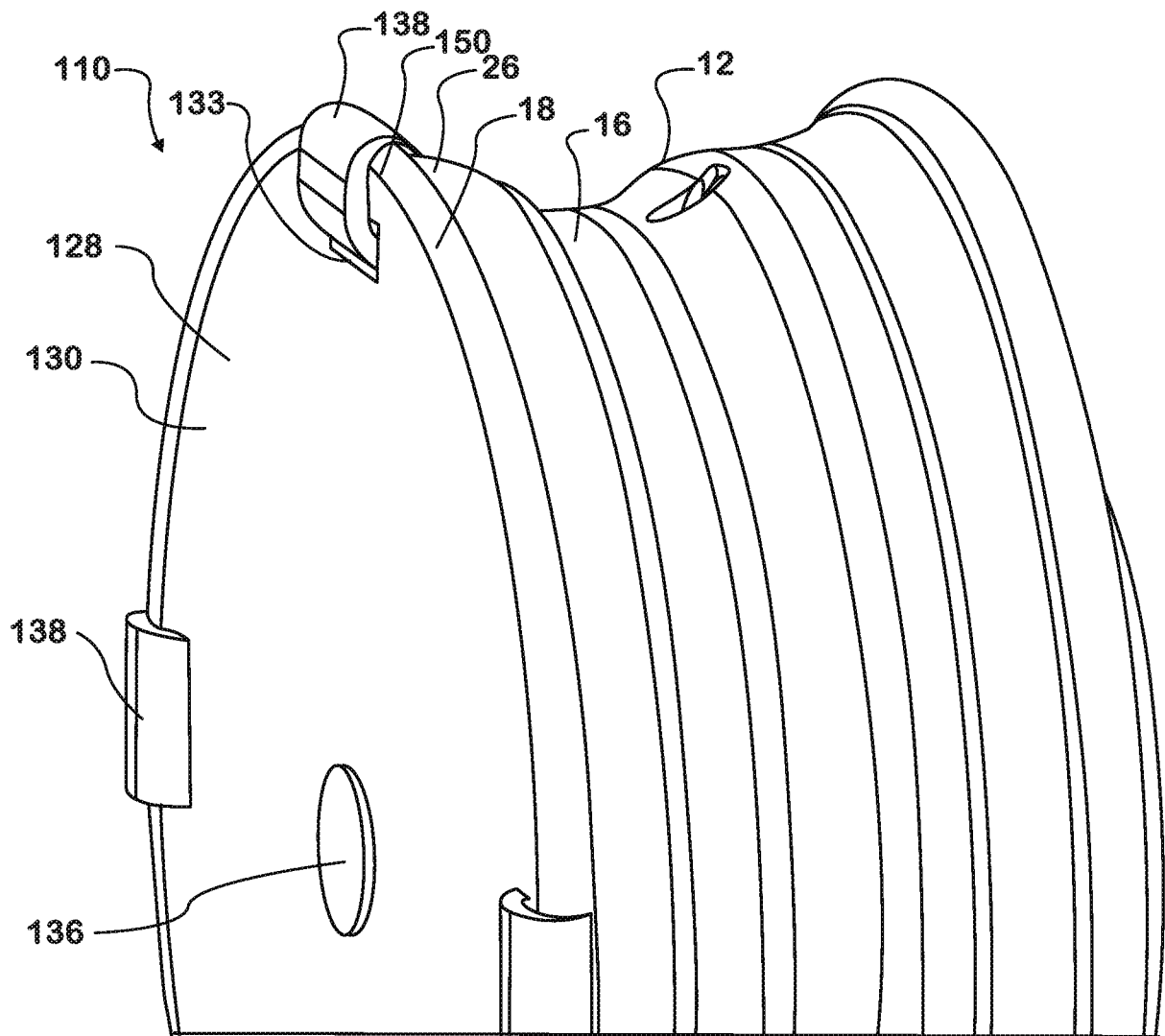
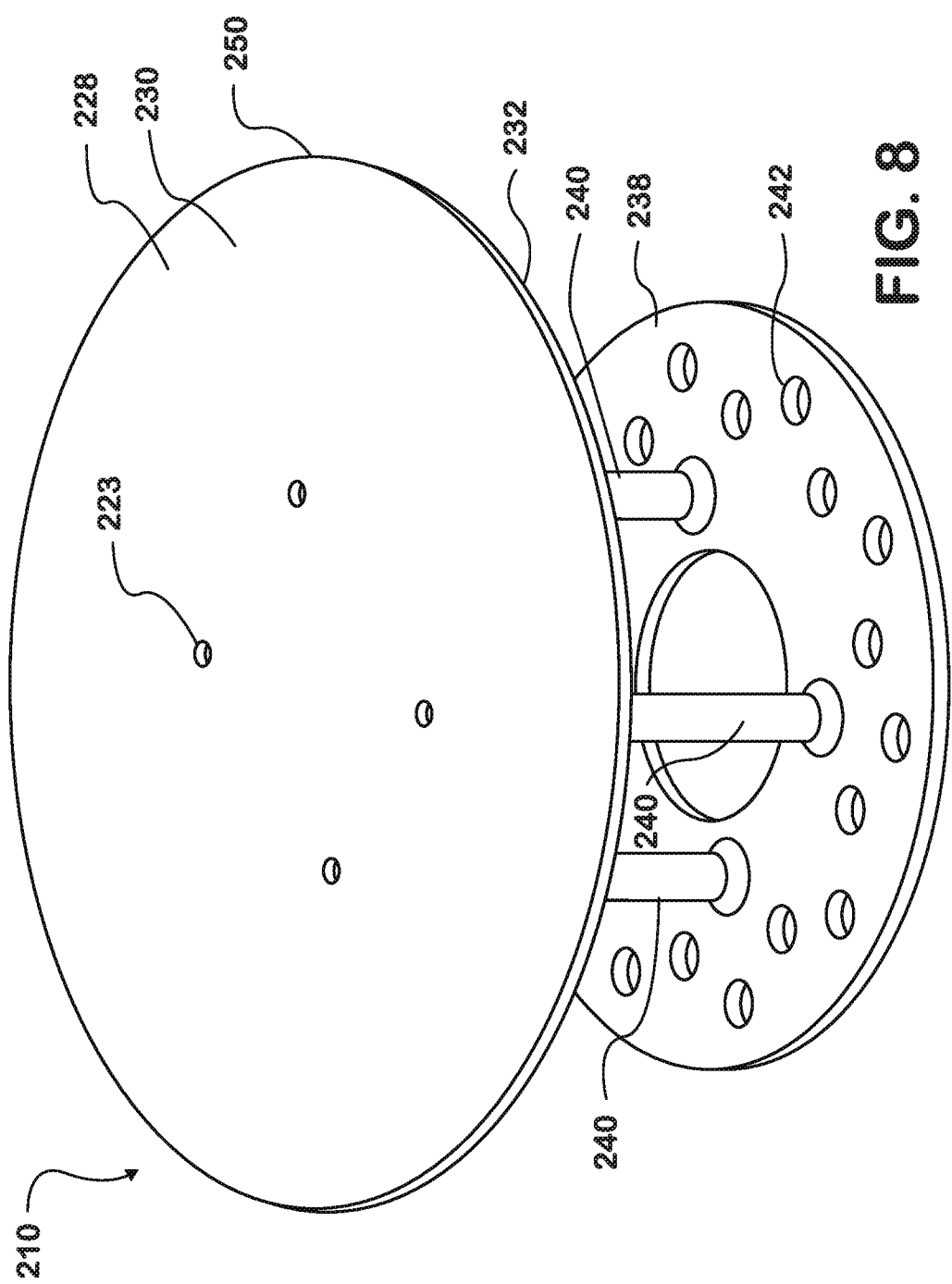
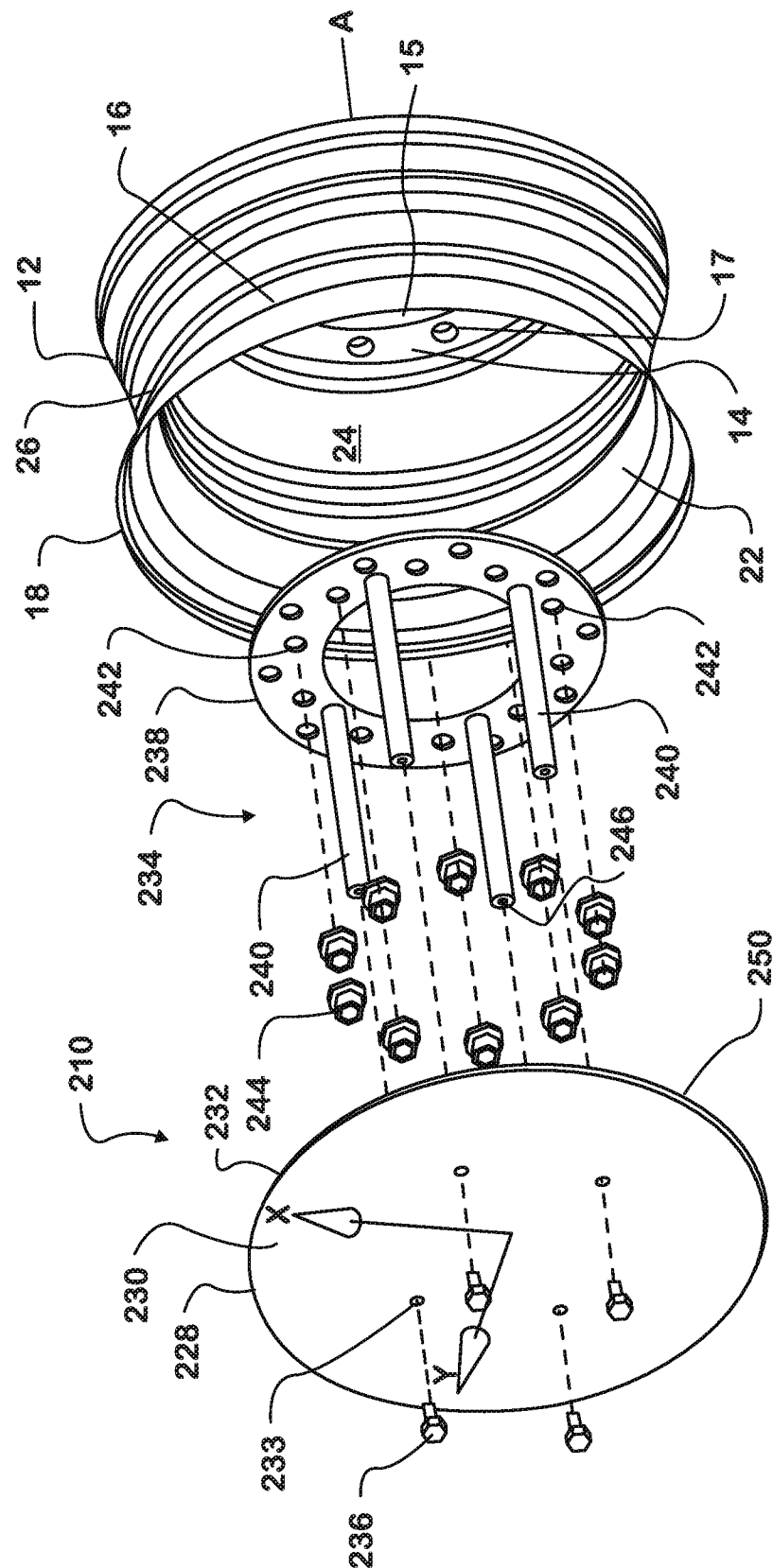


FIG. 7







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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/37196

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B60B 7/06 (2012.01)

USPC - 301/37.102

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B60B 7/06 (2012.01)

USPC: 301/37.102

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

IPC: B60B 7/06 (2012.01):

USPC: 301/105.1, 108.1, 37.101, 37.22, 37.44, 37.25, 37.102, 37.31, 37.34; 292/256.6, 256.65; 296/37.3, 198

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DialogWeb (348,349,652,654) Google (Patents, Scholar, Web)

Search Terms: wheel, tire, cover, assembly, system, mechanism, hubcap, trim, radial?, rotar?, rotat?, turn?, spin?, pivot?, actuat?, lock?, secur?, latch?, attach?, connect?, press?, push?, friction?, ratchet?, linear?, out?, slid?, translat?, exten?, arm, leg

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,135,289 A (FLECK et al.) 04 August 1992 (04.08.1992) Fig. 1-3; col 3, ln 56-68, col 4, ln 1-38; col 5, ln 51-54; Claim 3	1-6
Y	US 3,356,420 A (WHITEHEAD) 05 December 1967 (05.12.1967) Fig. 1, 4-5; col 2, ln 20-65	1-6
A	US 3,773,389 A (Foster et al.) 20 November 1973 (20.11.1973) entire reference	1-6

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

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

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

02 October 2012 (02.10.2012)

Date of mailing of the international search report

15 OCT 2012

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/37196

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

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

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

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

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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

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

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

Group I: claims 1-6 are directed to a rotating and ratcheting attachment mechanism.

Group II: claims 7-11 are directed to a hooked elastic strap attachment mechanism.

Group III: claims 12-15 are directed to a bolt hole attachment mechanism.

The inventions listed in Groups I-III do not related to a single general inventive concept under PCT Rule 13.1 because under PCT Rule 13.2 they lack the same or corresponding technical features for the following reasons:

--See Continuation Sheet--

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

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

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

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-6

Remark on Protest

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/37196

Continuation of Box III: Observations where unity of invention is lacking

Group I is drawn to a method of attaching a plate using a rotating and ratcheting mechanism to force pressure pads against the inside of a rim. Group I does not include the inventive concept as claimed in Groups II and III.

Group II is drawn to a method of attaching a plate using elastic straps having hooks on the ends to provide a tensioned attachment to the outside of a rim. Group II does not include the inventive concept as claimed in Groups I and III.

Group III is drawn to a method of attaching a plate using bolt holes in the plate that are attached to the existing bolts of a wheel. Group III does not include the inventive concept as claimed in Groups I and II.

The inventions of Groups I, II and III therefore lack unity of invention under PCT Rule 13.1 because they do not share a same or corresponding special technical feature providing a contribution over the prior art.