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(54) **ACTIVE AND PASSIVE OVERRUNNING WHEEL END DISCONNECT**

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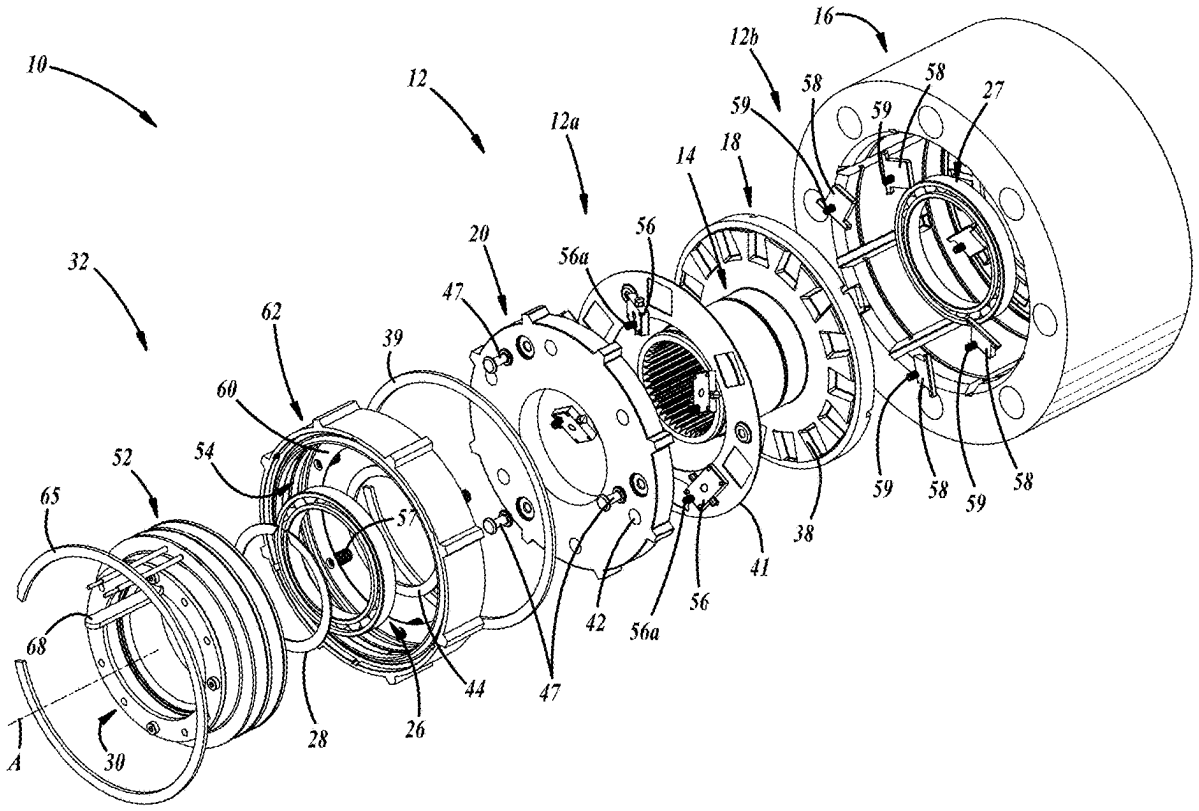
B60B 35/12	(2006.01)
F16D 41/12	(2006.01)

(52) **U.S. Cl.**

CPC ***B60K 17/02*** (2013.01); ***F16D 41/12*** (2013.01)

(57) **ABSTRACT**

An apparatus includes an axle, a wheel hub, and an active and passive overrunning wheel hub clutch disposed between the axle and the wheel hub. An active and passive overrunning wheel hub clutch includes a clutch hub, a wheel hub, an active clutch between the clutch hub and the wheel hub, and a passive clutch between the clutch hub and the wheel hub. A wheel end includes a wheel hub cover, and an active and passive overrunning wheel hub clutch coupled to the wheel hub cover.



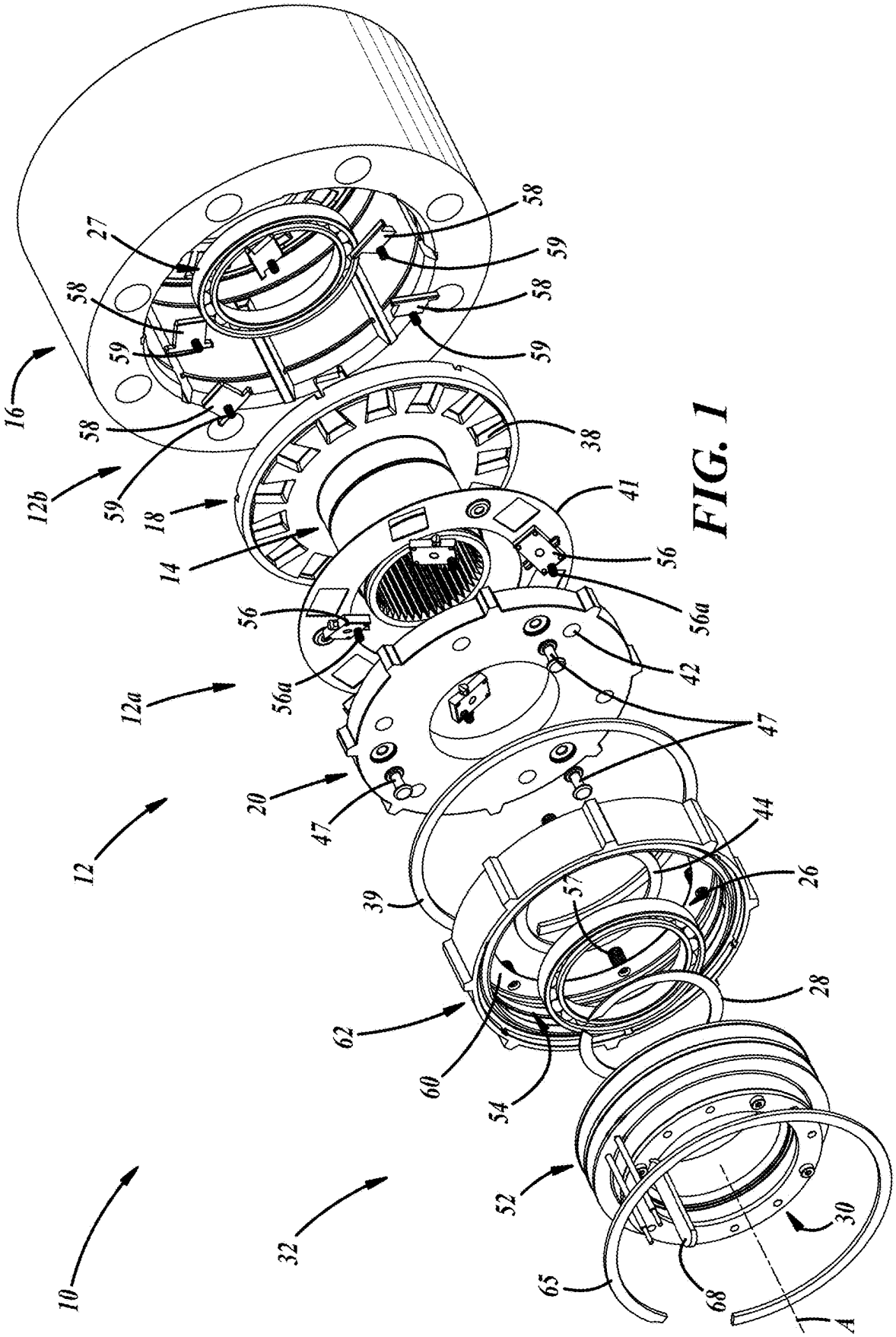

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FIG. 1

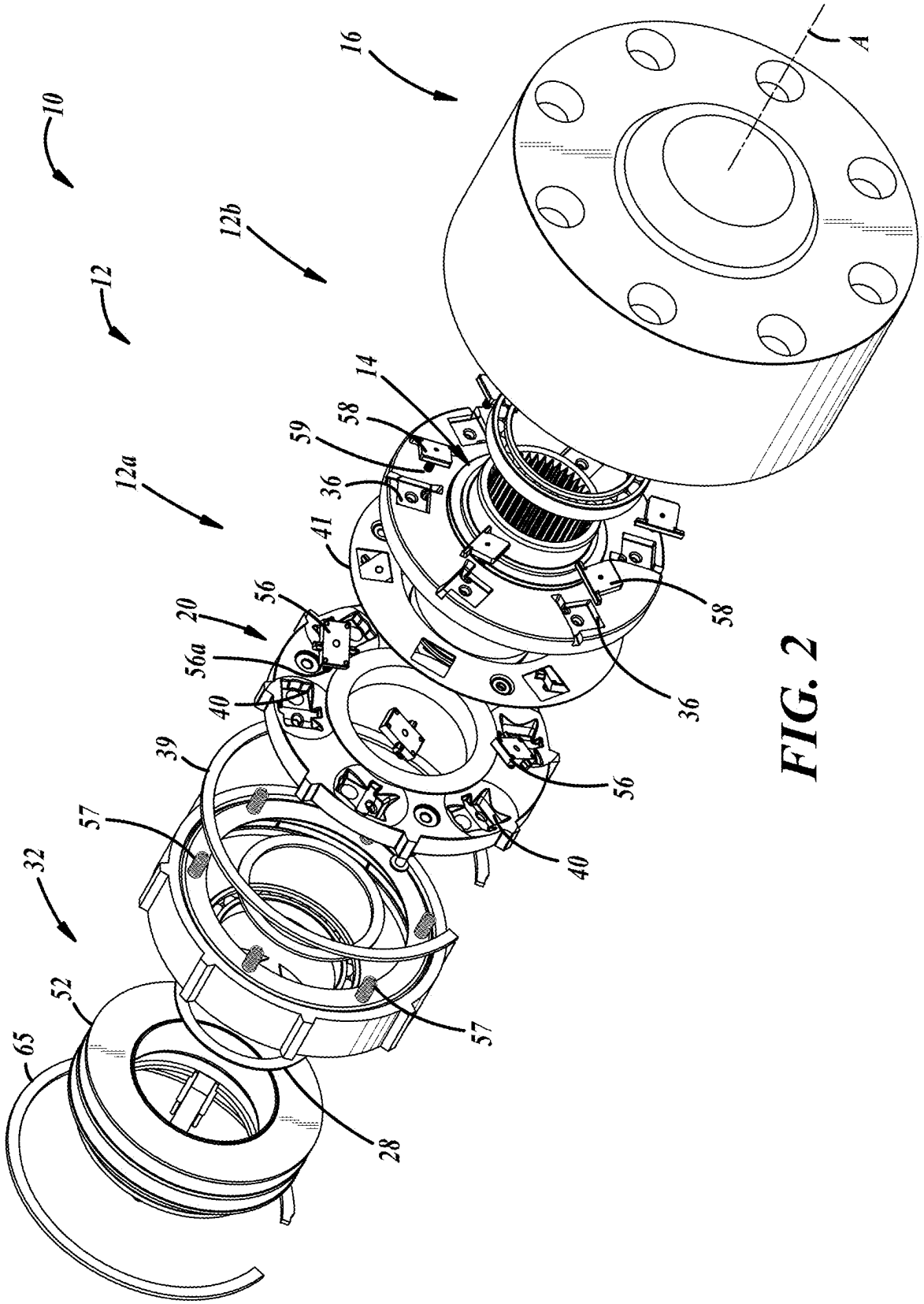

FIG. 2

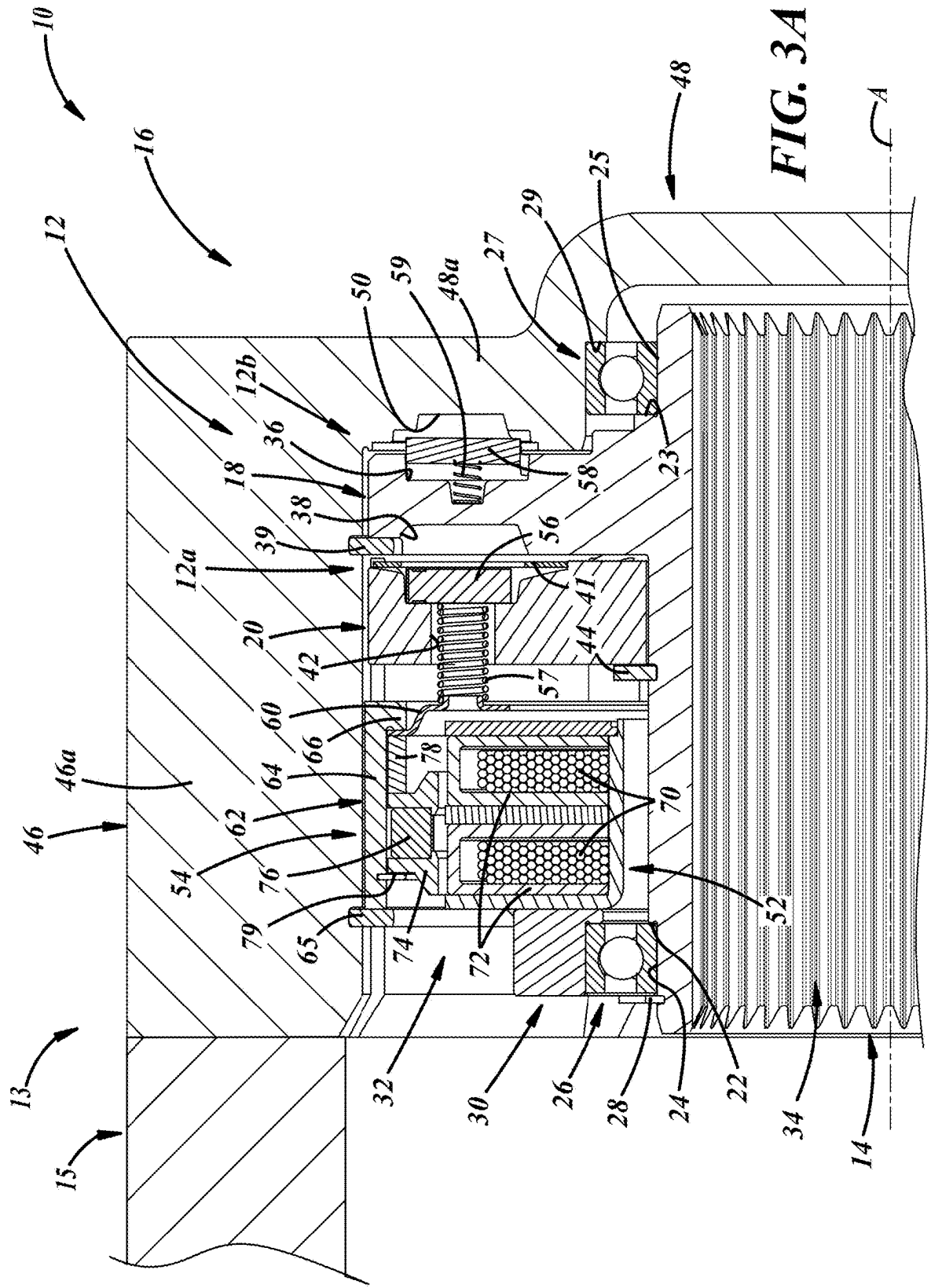
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FIG. 3A

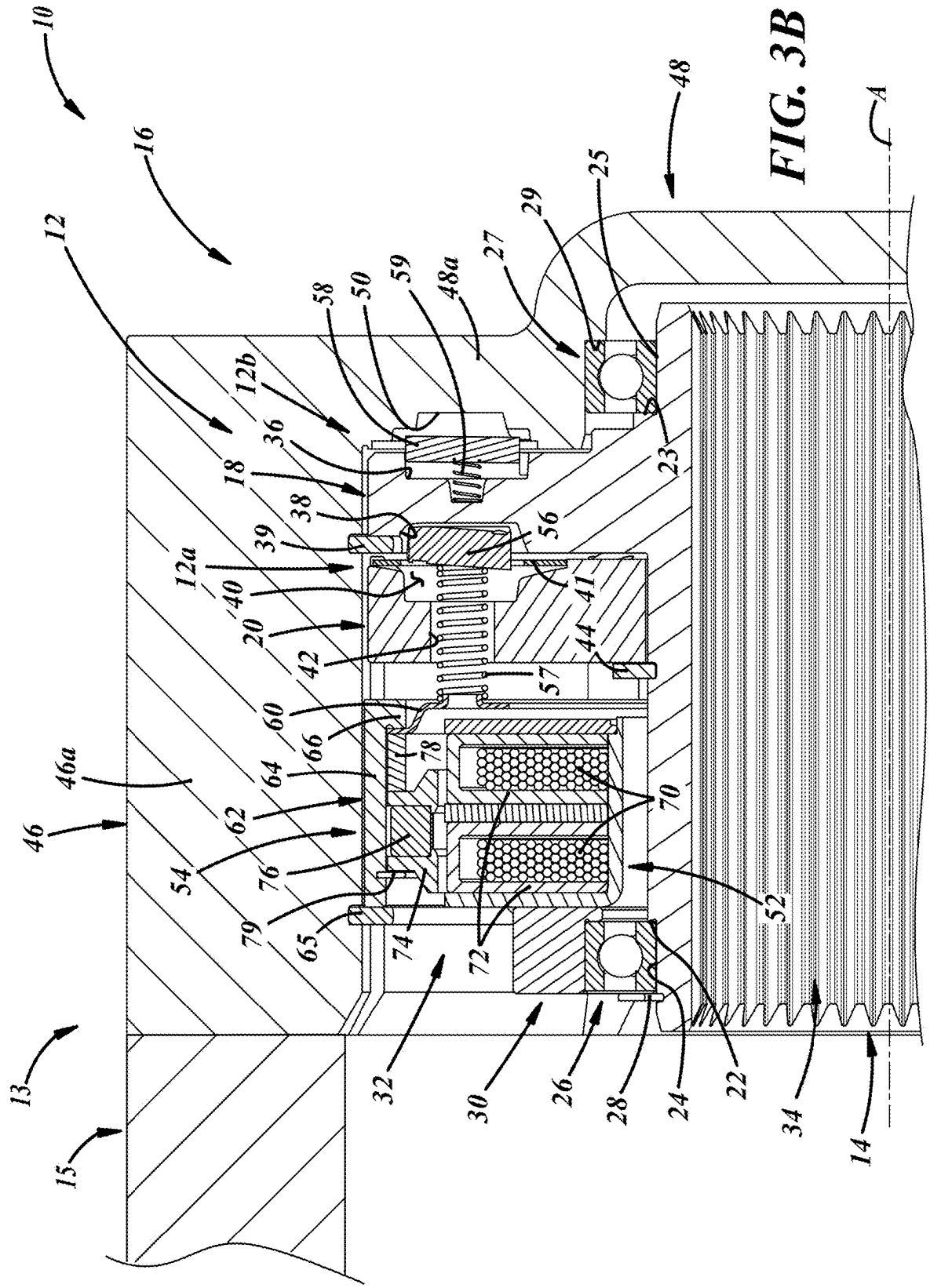
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FIG. 3B

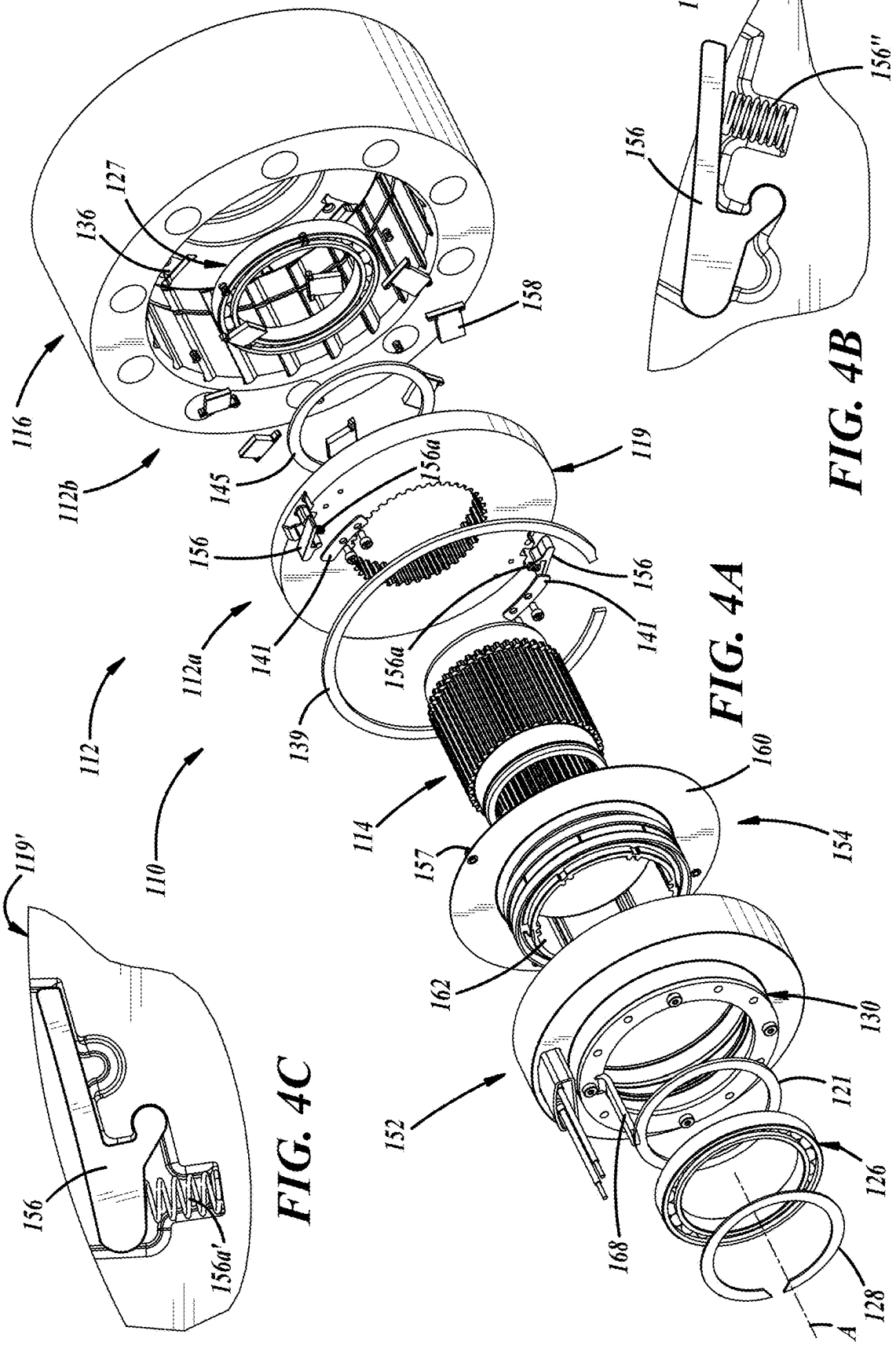

FIG. 4A

FIG. 4B

FIG. 4C

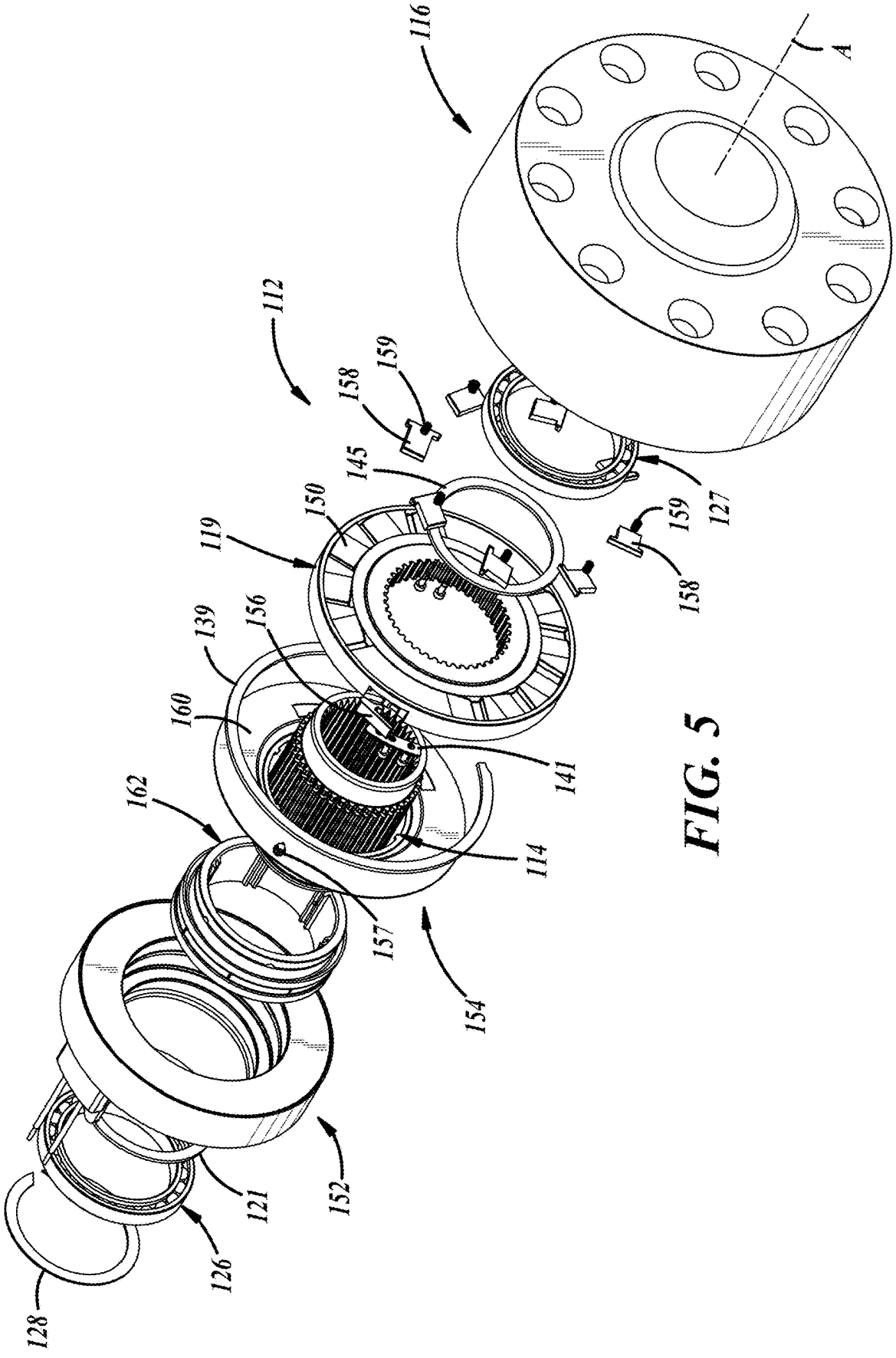
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FIG. 5

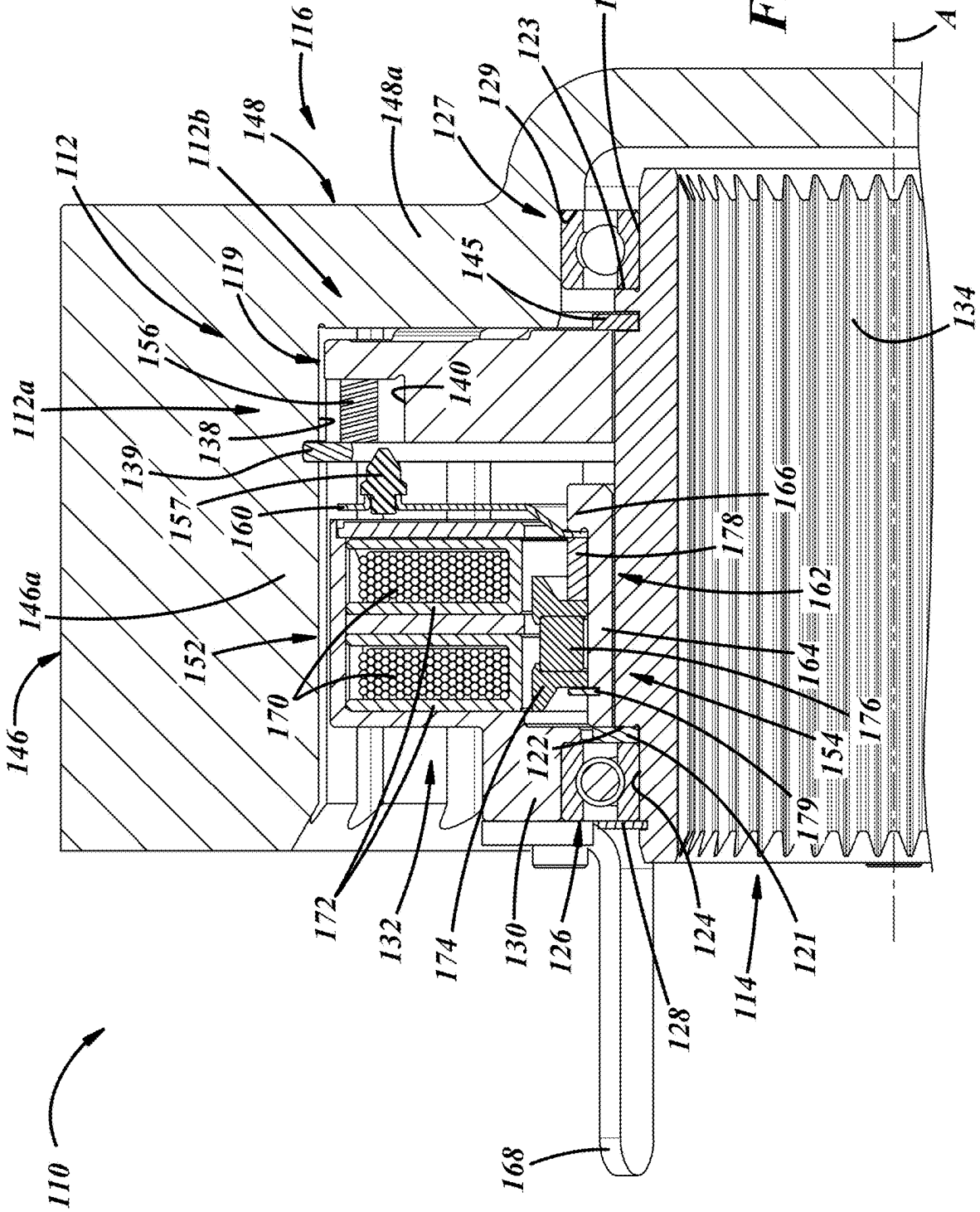
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FIG. 6A

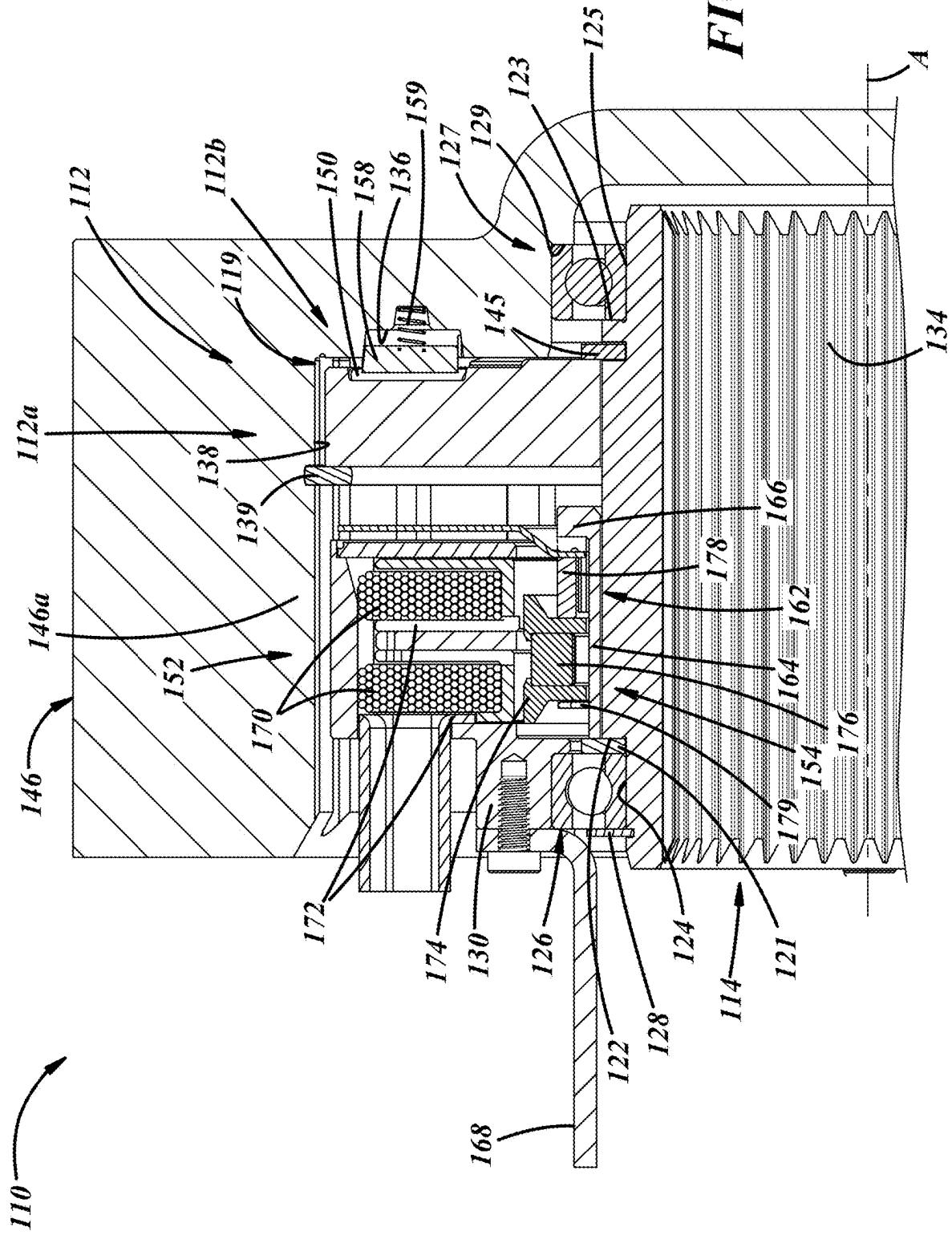
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FIG. 6B

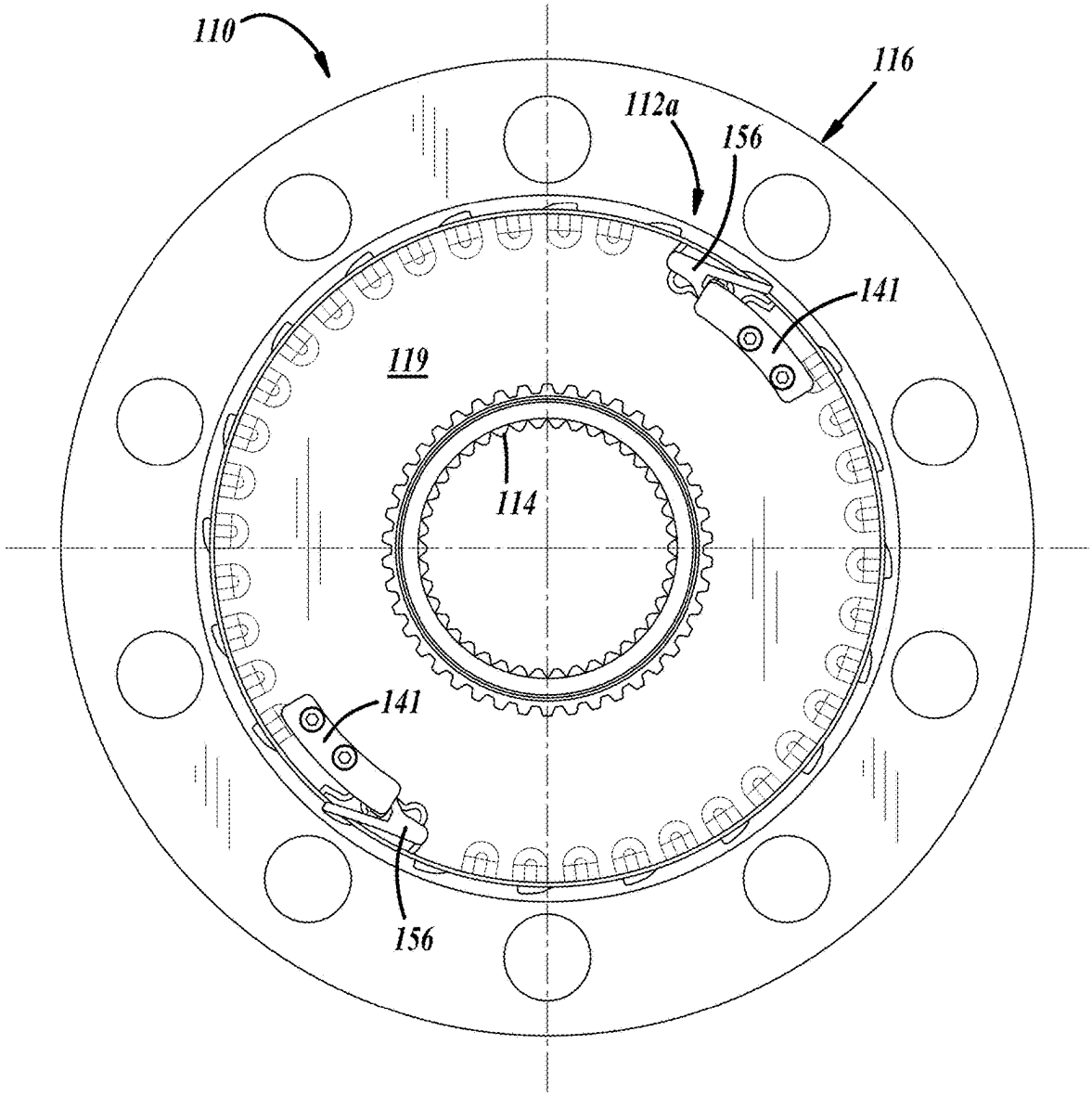

FIG. 6C

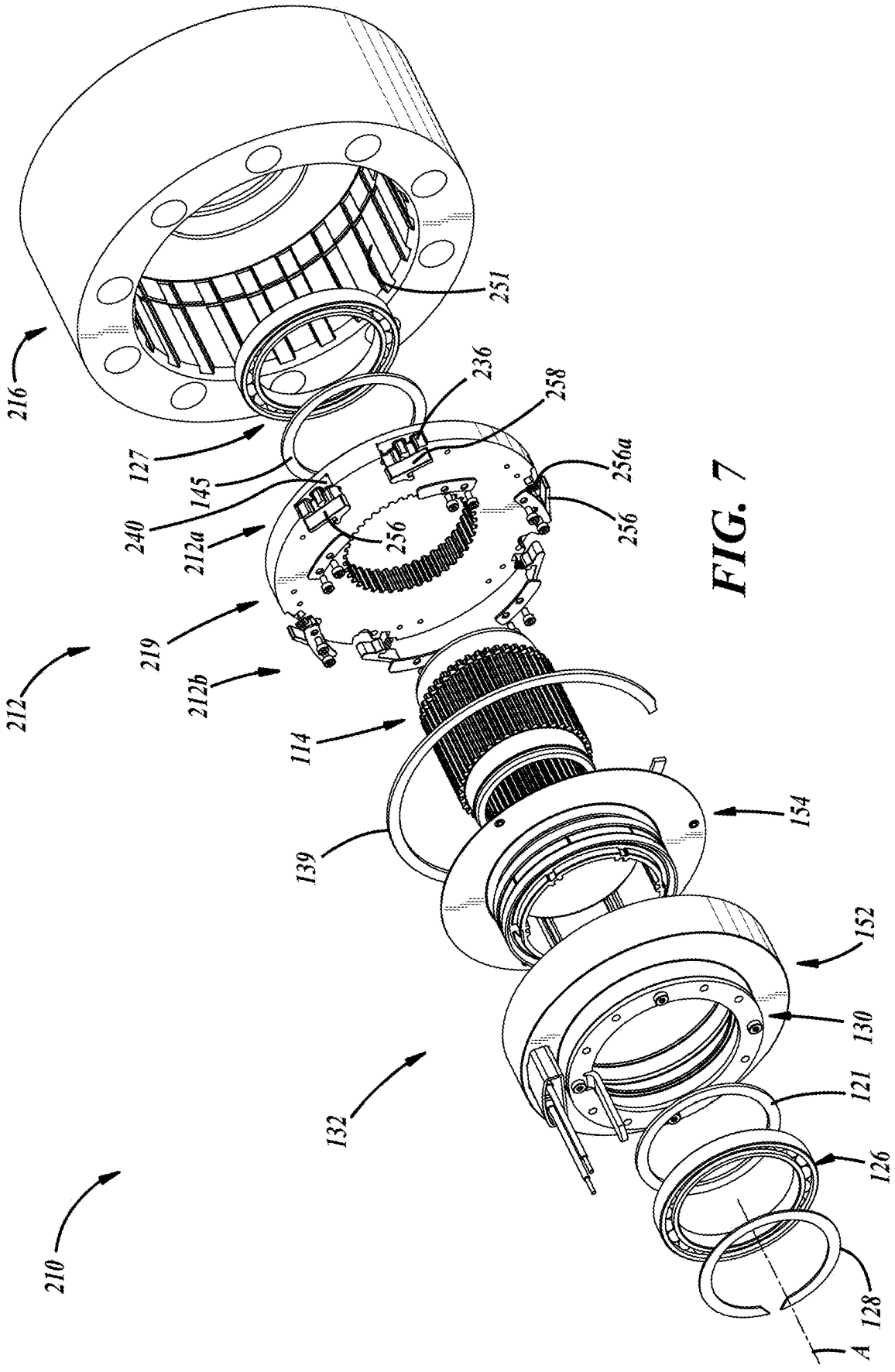
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FIG. 7

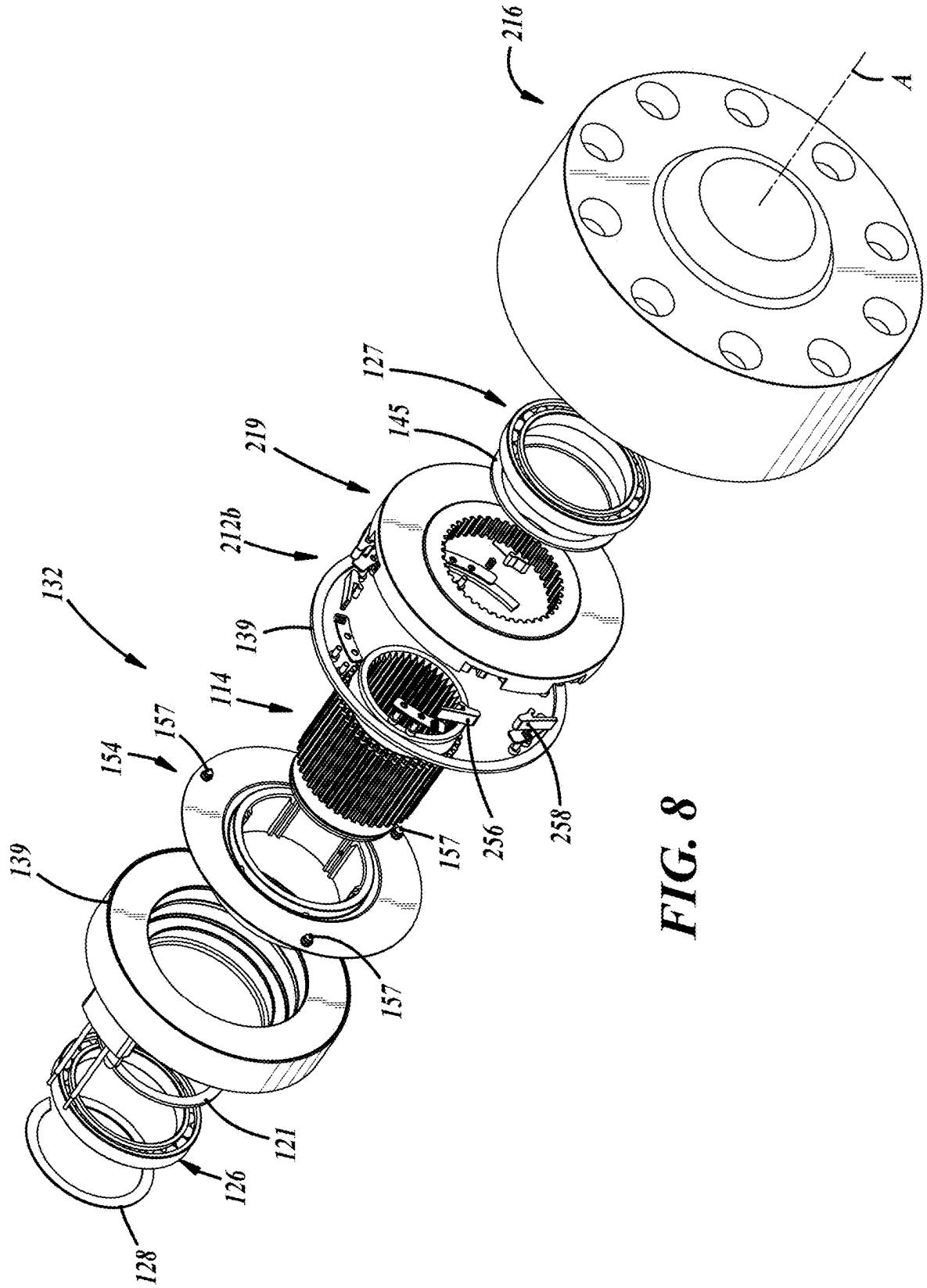
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FIG. 8

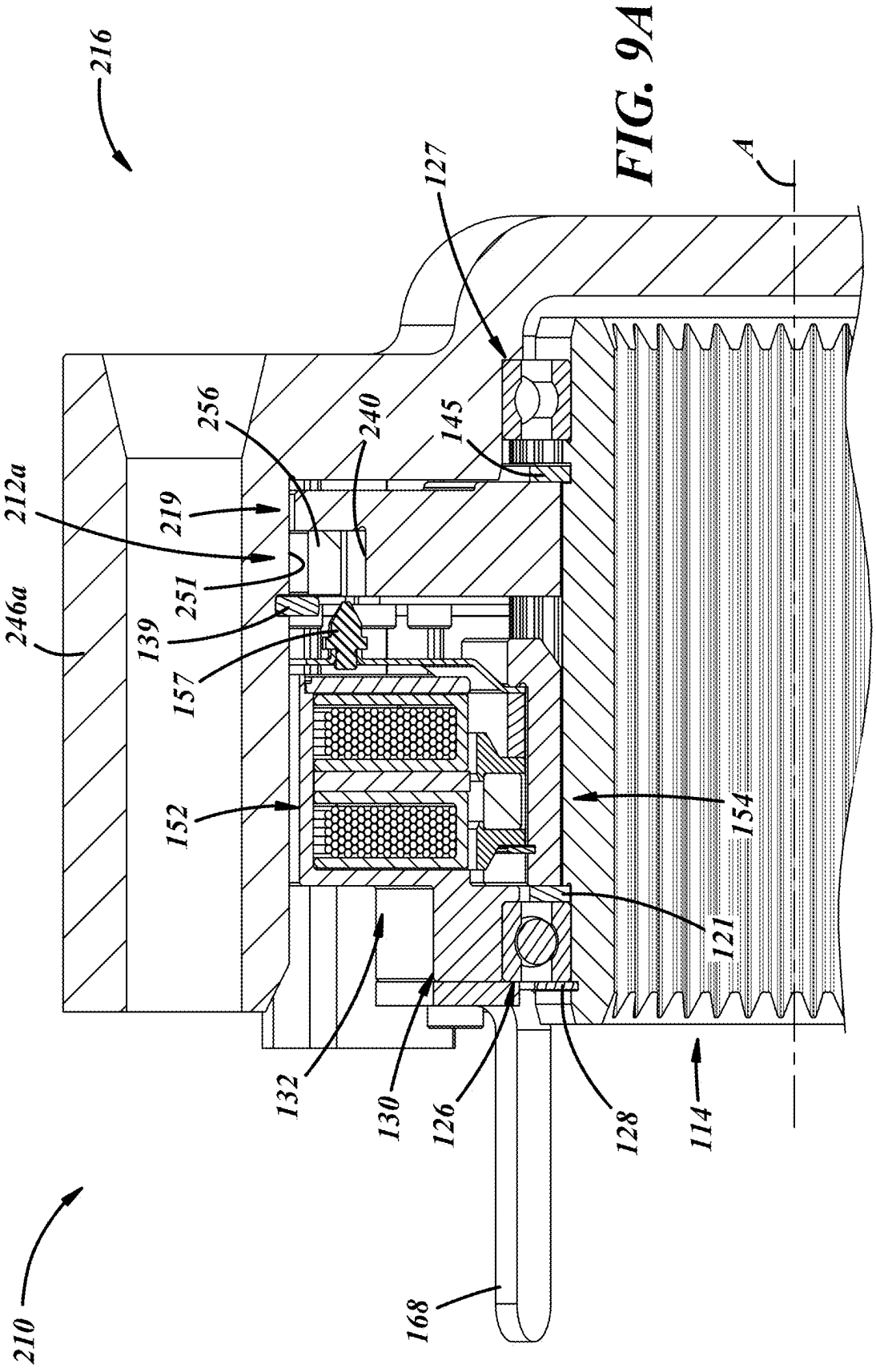
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FIG. 9A

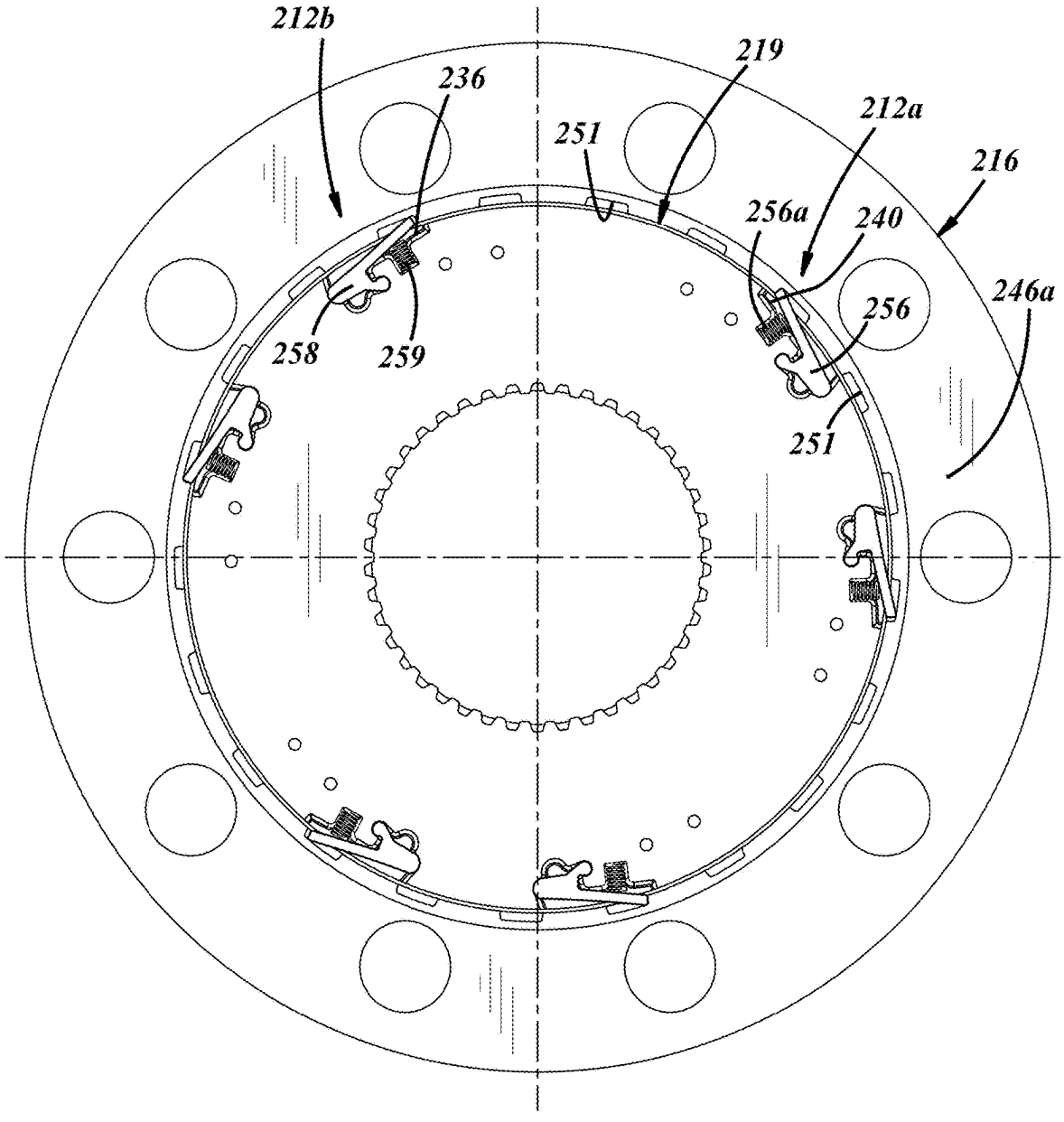

FIG. 9B

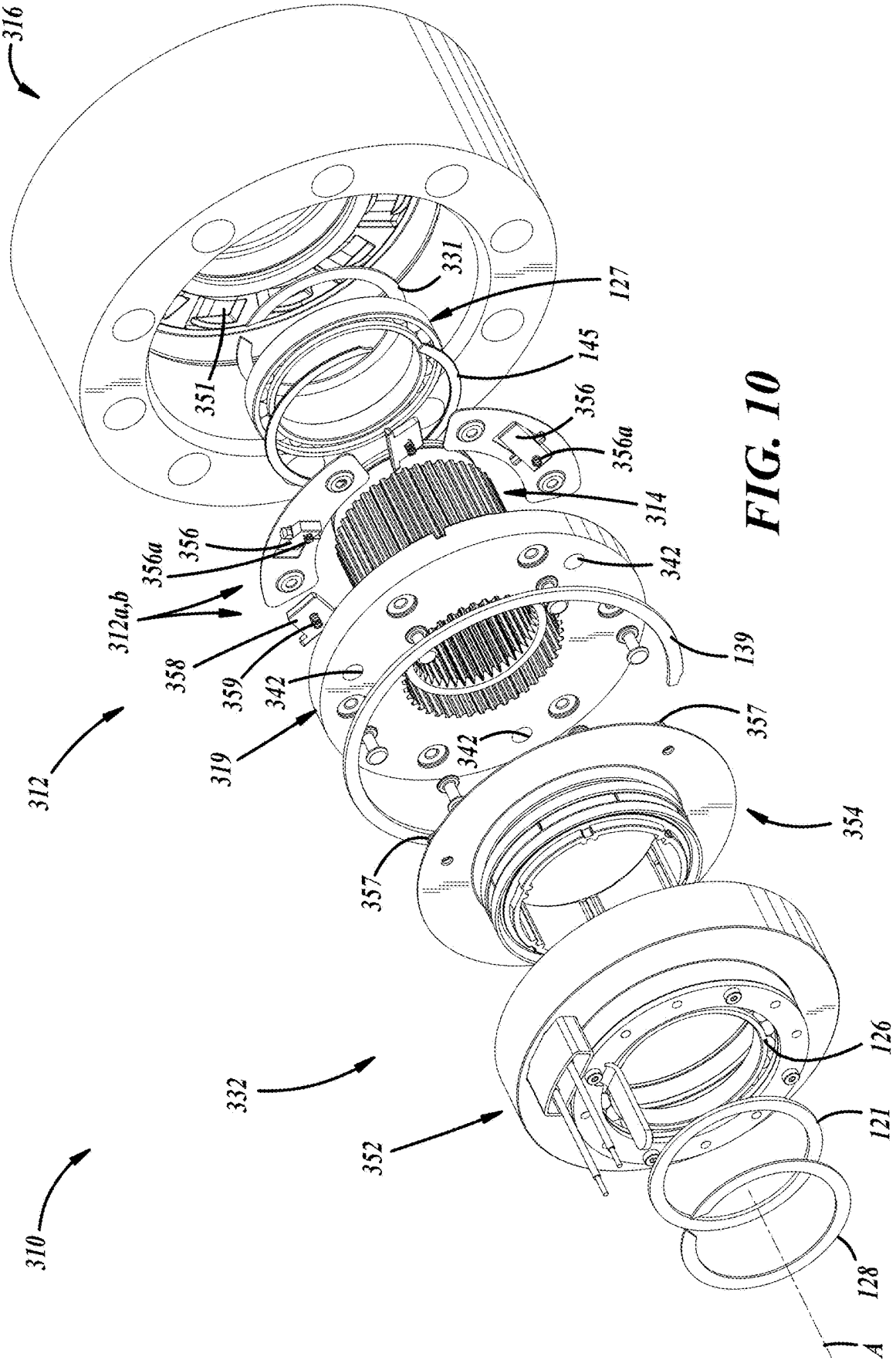
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FIG. 10

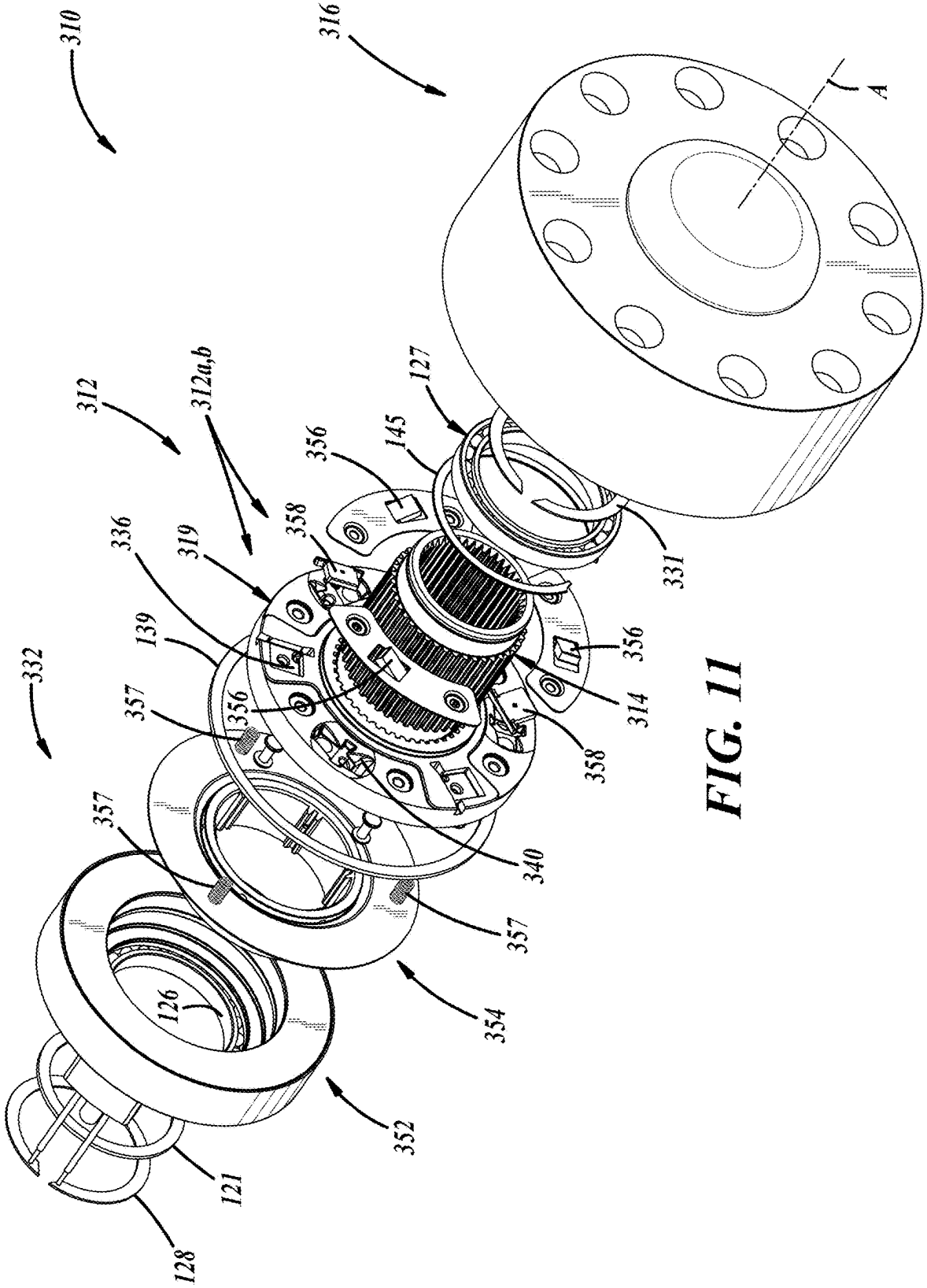
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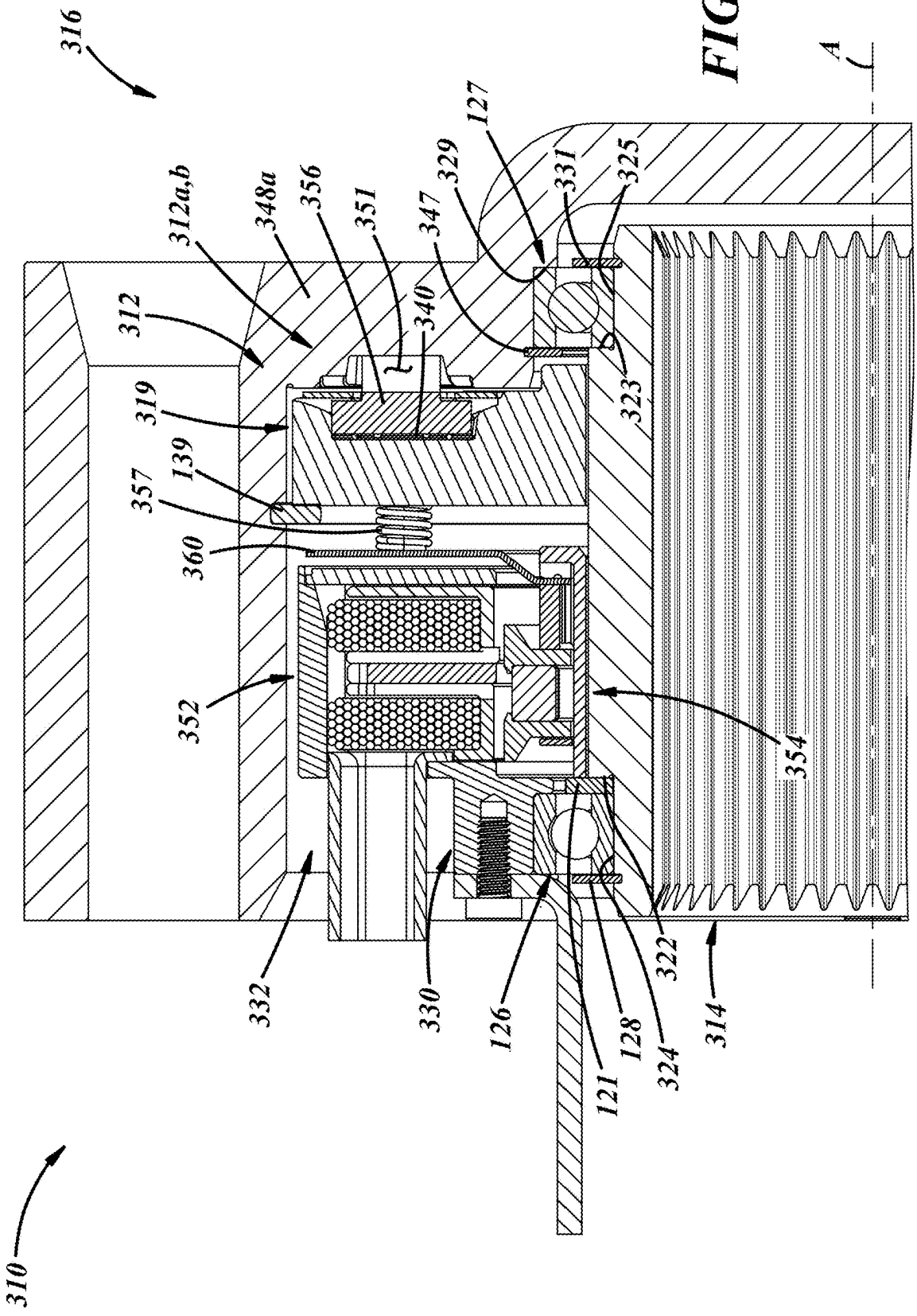
FIG. 11

FIG. 12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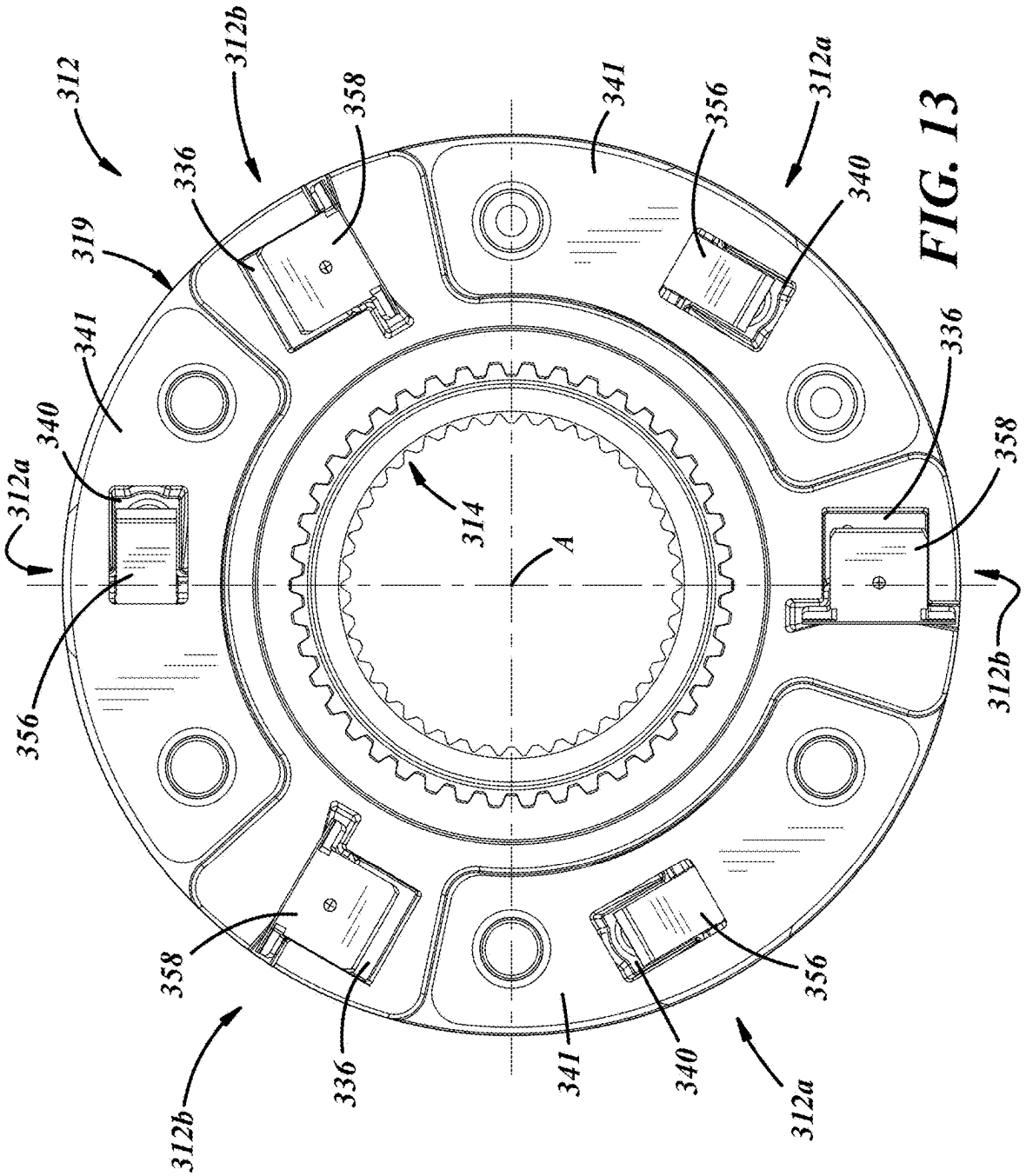
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FIG. 13

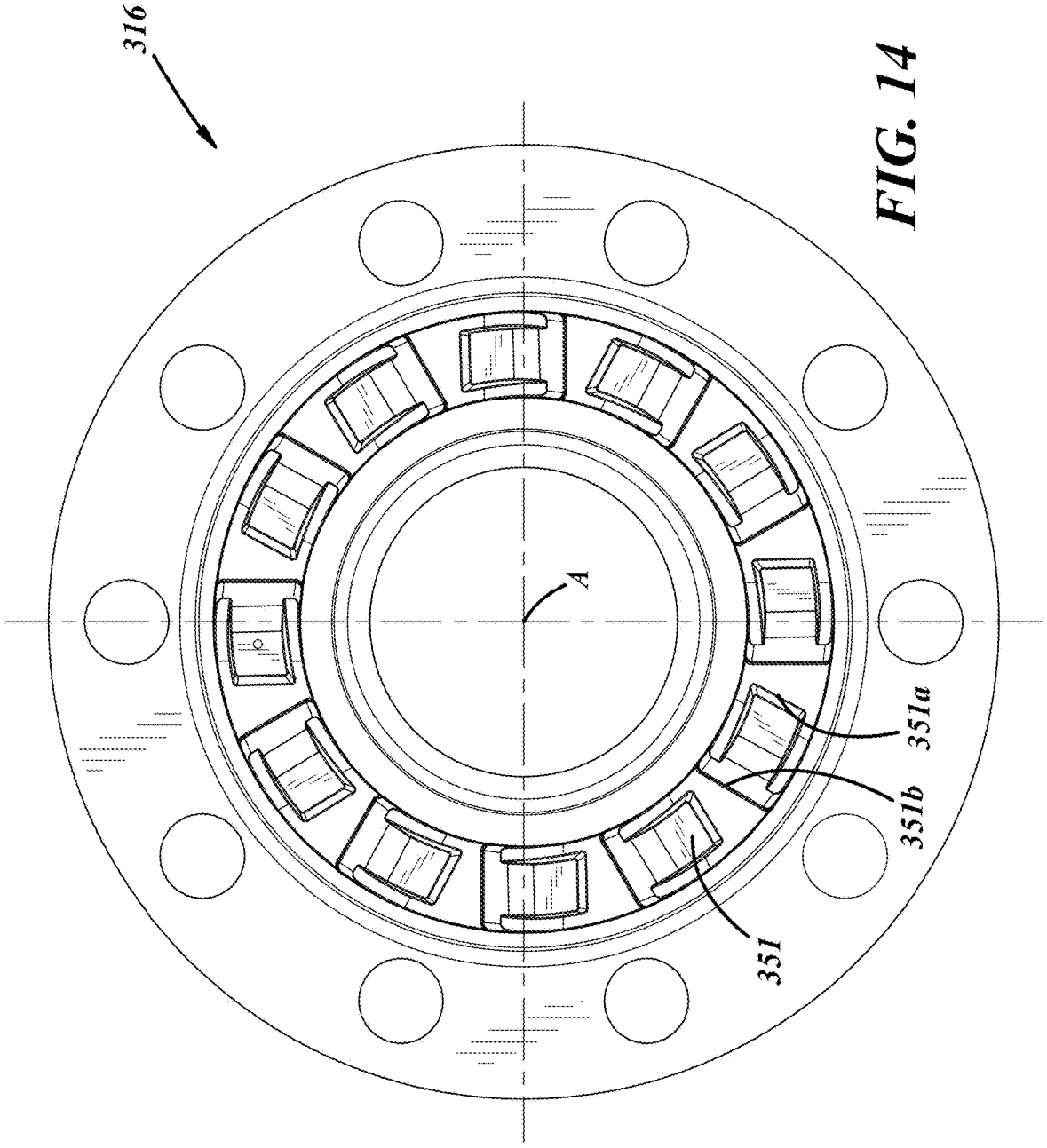

FIG. 14

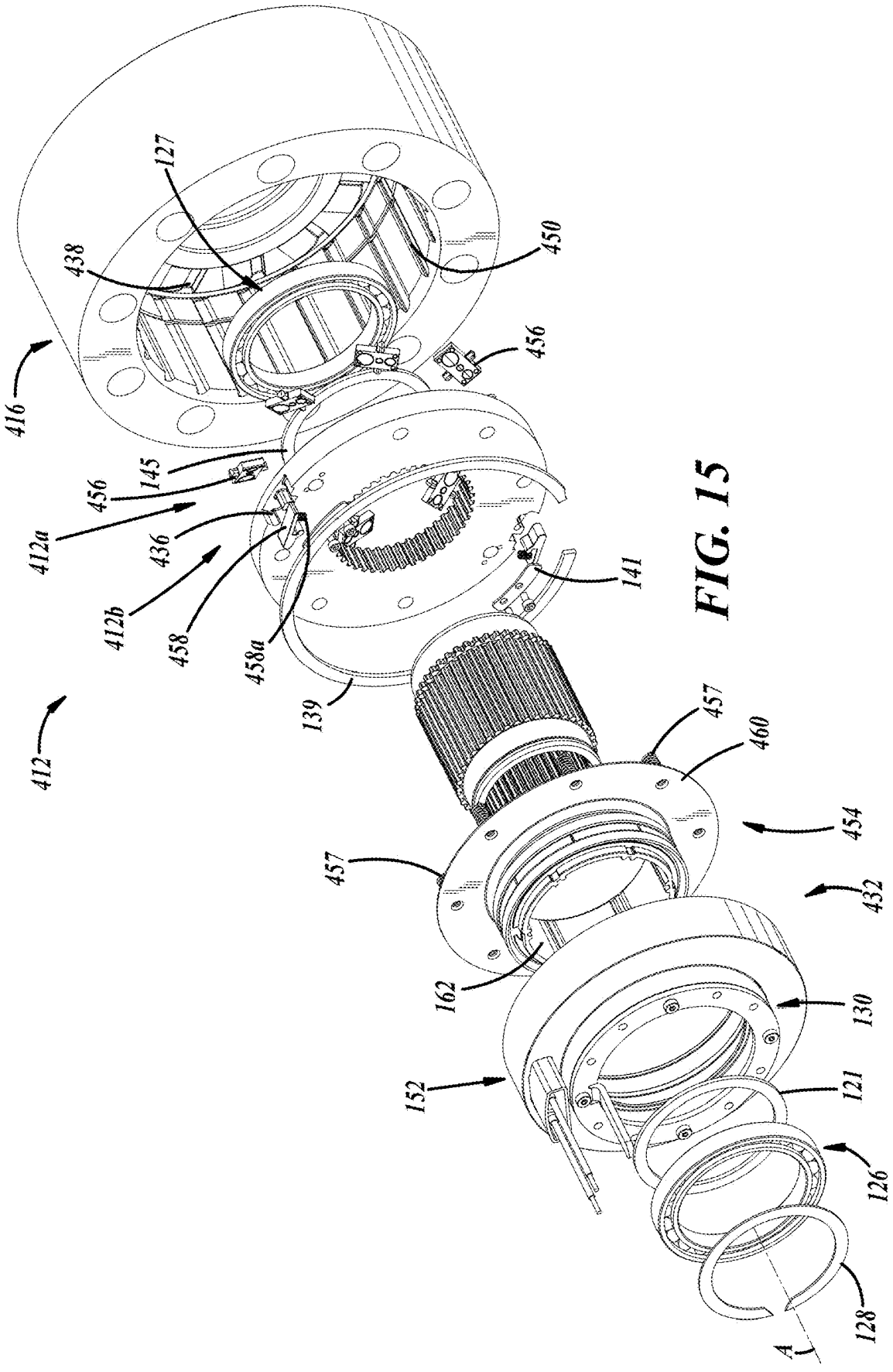
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FIG. 15

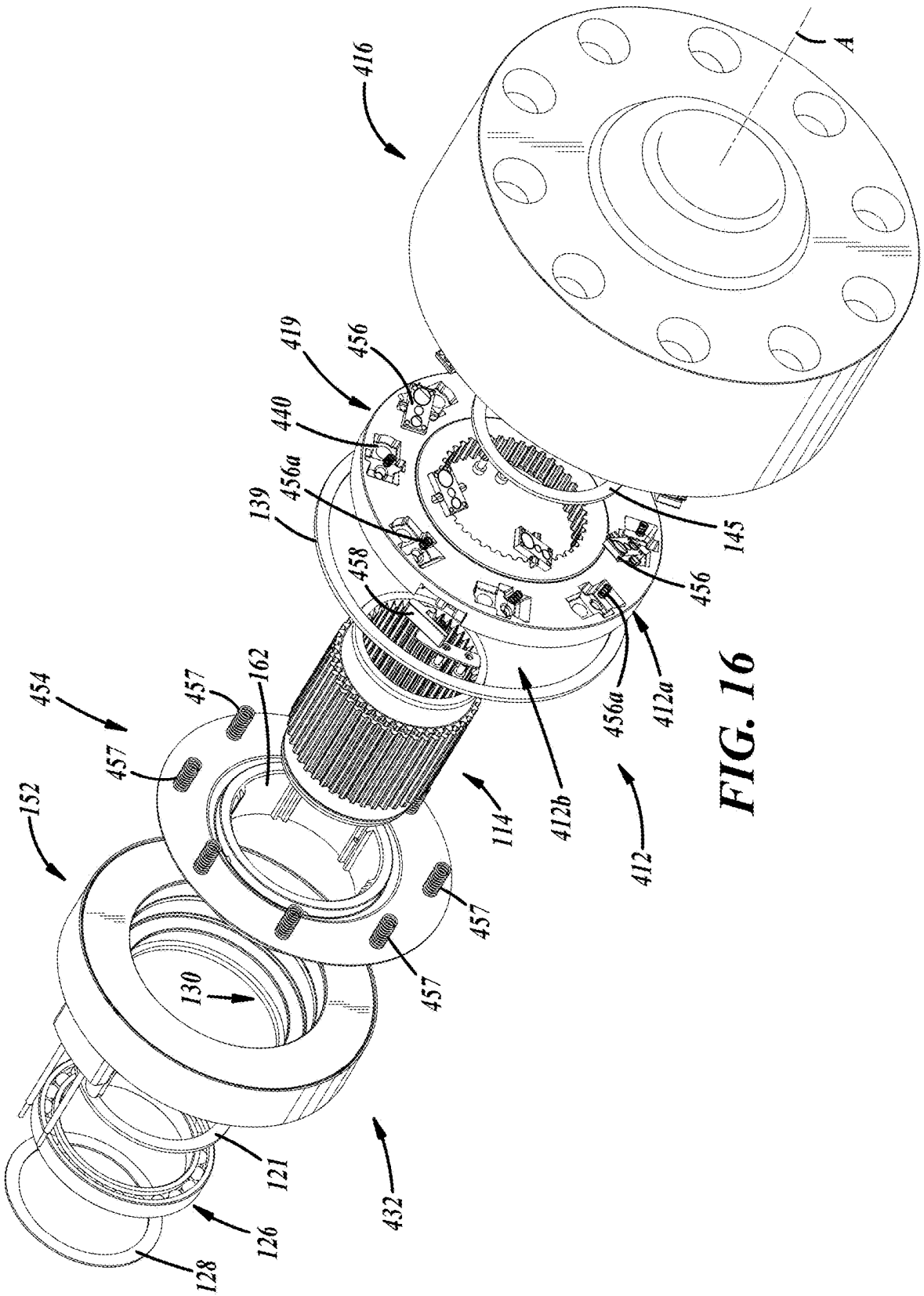
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FIG. 16

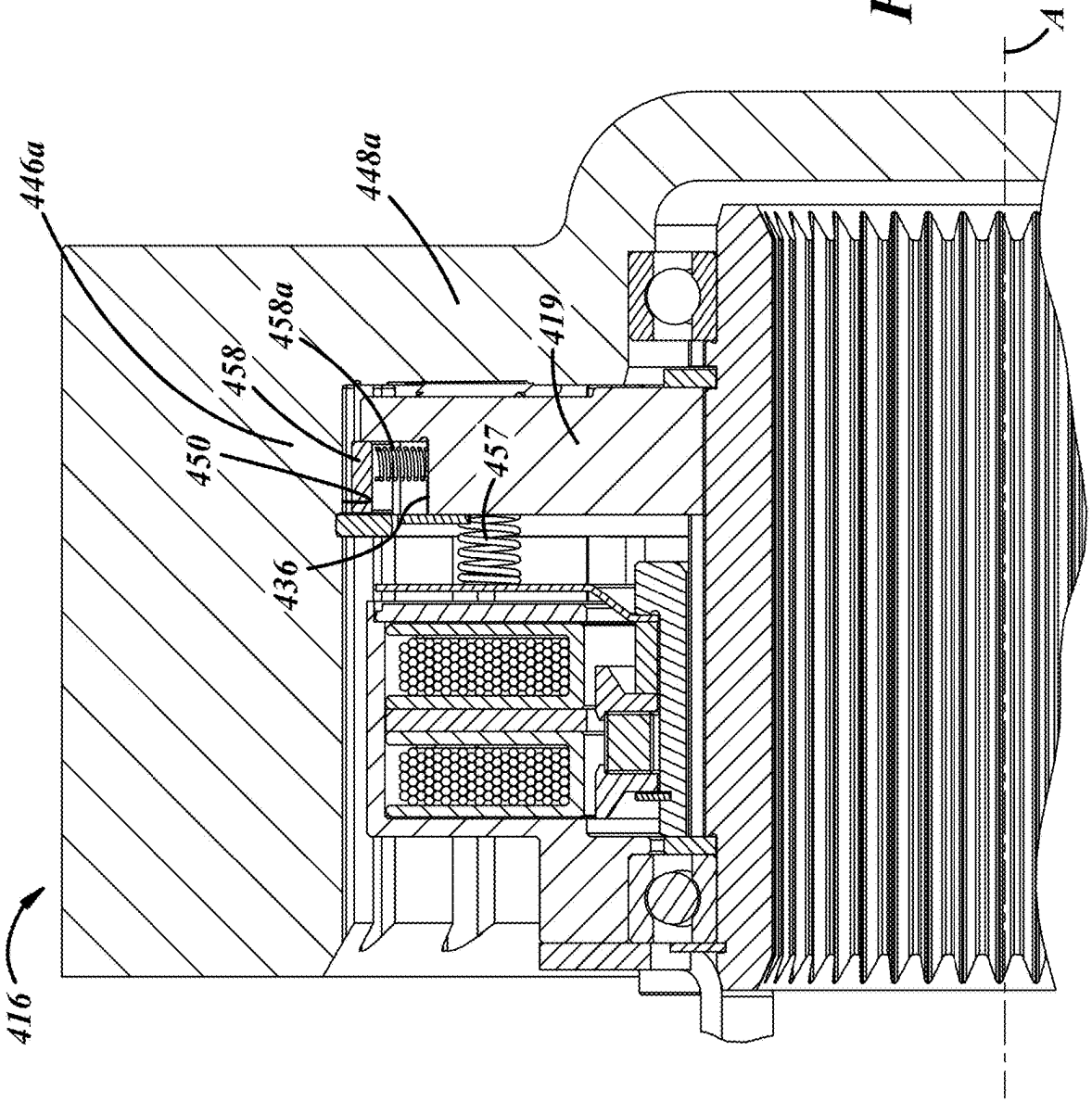

FIG. 17A

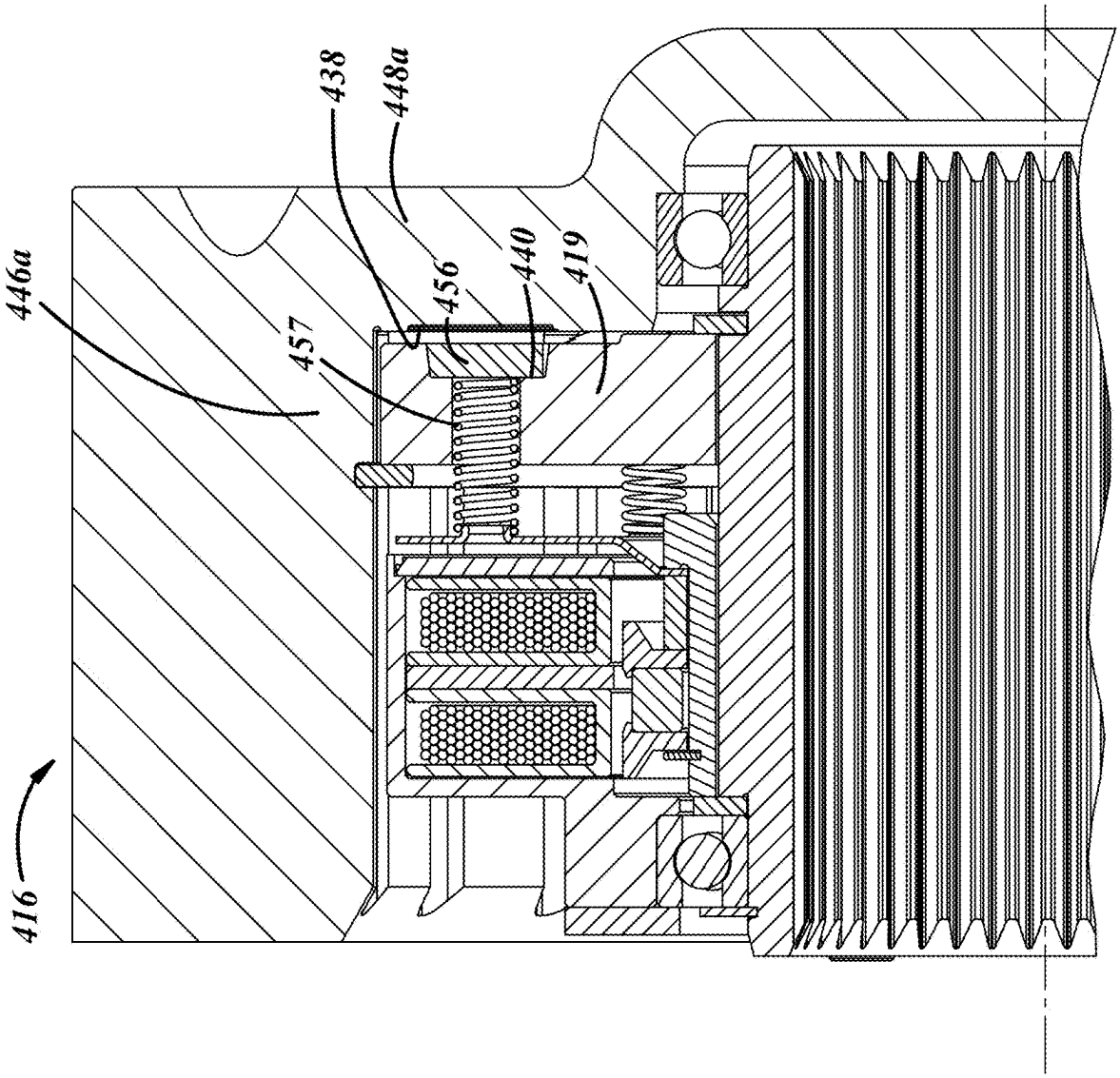

FIG. 17B

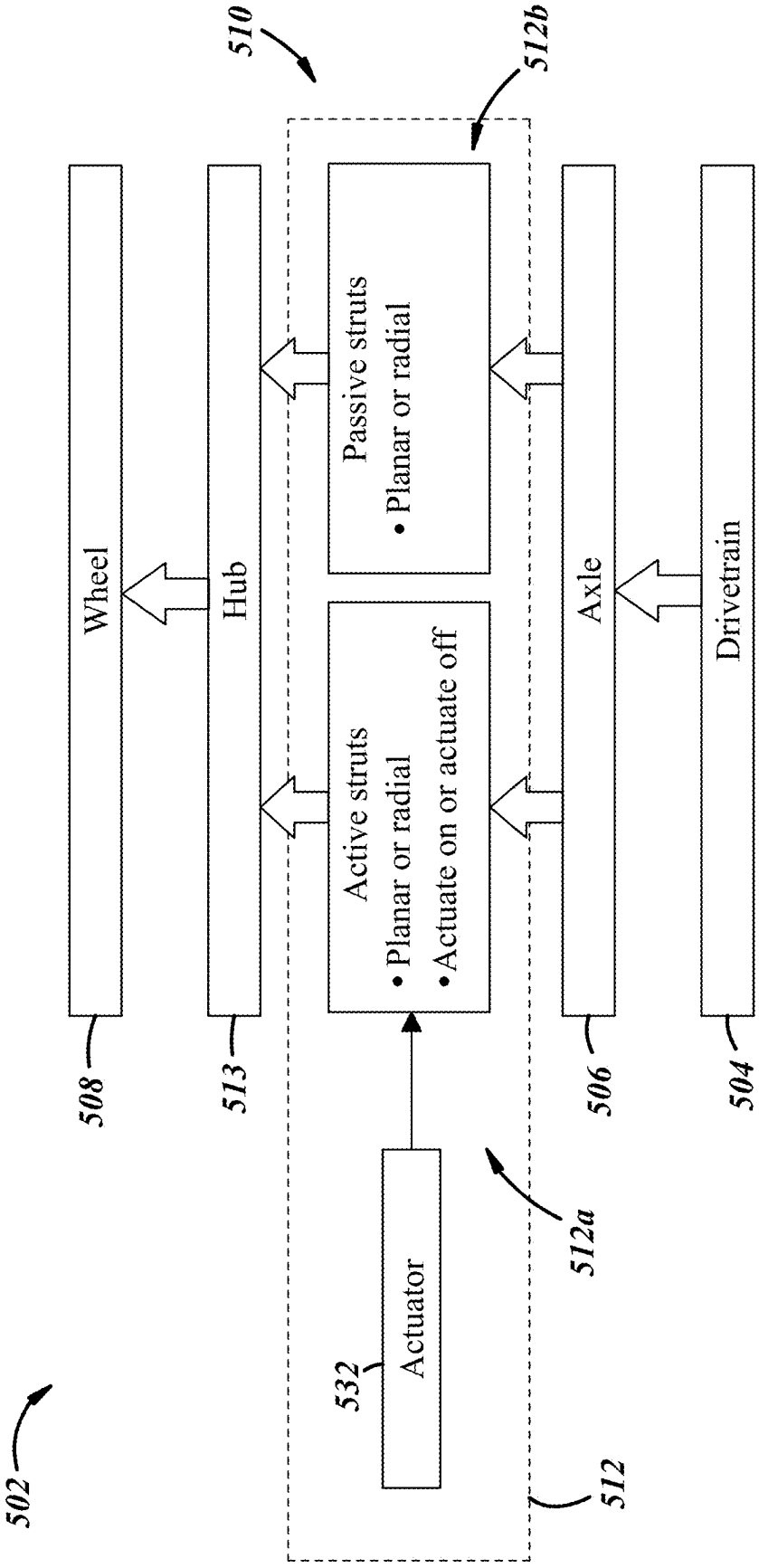
510
512b
Wheel
Hub
Passive struts
• Planar or radial
Axle
Drivetrain
Active struts
• Planar or radial
• Actuate on or actuate off
508
513
506
504
Actuator
532
512a
512
502

FIG. 18

ACTIVE AND PASSIVE OVERRUNNING WHEEL END DISCONNECT

TECHNICAL FIELD

[0001] This disclosure relates generally to vehicles and, more particularly, to drivetrains of vehicles, axles and wheel end systems of drivetrains, wheel hubs and wheel hub clutches of wheel end systems, and components for wheel hub clutches.

BACKGROUND

[0002] Wheeled vehicles include wheels and one or more prime movers, like an internal combustion engine and/or an electric motor, to rotatably drive the wheels. Some such vehicles may drive the wheels directly with an electric motor. Other such vehicles also or instead may include a drivetrain located between the prime mover and the wheels and including an axle to change drive rotation from a longitudinal direction along a length of the vehicle to a transverse direction. The latter vehicles also may include a drive shaft coupled to an input side of the axle and axle shafts extending transversely away from the axle and coupled to the wheels. Some vehicles further may include multiple sets of wheels and multiple axles, usually two rear axles and two sets of wheels driven via the axles. In any case, all such wheels include wheel hubs that couple the wheels (e.g., wheel rim and tire mounted on the rim) to a drivetrain axle shaft, an electric motor shaft, or any other suitable shaft or torque input element. Some wheel hubs include wheel hub clutches configured to disconnect (and reconnect) wheels from a prime mover, for example, to improve fuel economy when a vehicle with multiple driven rear axles is traveling at highway speeds, or to convert a vehicle from four-wheel-drive mode to two-wheel-drive mode.

[0003] But currently available wheel hub clutches may be too bulky or costly, or of poor quality or reliability. In one specific example, such clutches do not favor remote automatic disconnectability between the prime mover and the wheels, and are located too distant from the wheels such that the clutches are not optimal for driveline efficiency. Likewise, currently available wheel hub clutches may lack certain functionality. In another specific example, many such clutches have on/off or engaged/disengaged capability wherein a wheel hub clutch will not actively engage an axle shaft to a wheel hub until a drivetrain speed closely matches a wheel speed, but do not have overrunning or freewheeling clutching capability wherein a wheel hub clutch passively engages an axle shaft to a wheel hub at the moment the drivetrain speed matches the wheel speed.

SUMMARY

[0004] An apparatus includes an axle, a wheel hub, and an active and passive overrunning wheel hub clutch disposed between the axle and the wheel hub.

[0005] An active and passive overrunning wheel hub clutch includes a clutch hub, a wheel hub, an active clutch between the clutch hub and the wheel hub, and a passive clutch between the clutch hub and the wheel hub.

[0006] A wheel end includes a wheel hub cover, and an active and passive overrunning wheel hub clutch coupled to the wheel hub cover.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is an exploded perspective view according to an illustrative embodiment of a wheel end including an illustrative embodiment of a dual plane active and passive overrunning wheel end disconnect.

[0008] FIG. **2** is another exploded perspective view of the wheel end and disconnect of FIG. **1**.

[0009] FIG. **3**A is a cross-sectional view of the wheel end and disconnect of FIG. **1**, illustrating an active strut in a nondeployed position.

[0010] FIG. **3**B is a cross-sectional view of the wheel end and disconnect of FIG. **1**, illustrating the active strut in a deployed position.

[0011] FIG. **4**A is an exploded perspective view according to another illustrative embodiment of a wheel end including an illustrative embodiment of an active radial and passive planar overrunning wheel end disconnect.

[0012] FIG. **4**B is an enlarged fragmentary view of the wheel end disconnect of FIG. **4**A, illustrating an active strut biased toward a deployed position.

[0013] FIG. **4**C is an enlarged fragmentary view of an alternative wheel end disconnect similar to that shown in FIG. **4**A, but illustrating the active strut biased toward a nondeployed position.

[0014] FIG. **5** is another exploded perspective view of the wheel end and disconnect of FIG. **4**.

[0015] FIGS. **6**A and **6**B are cross-sectional views of the wheel end and disconnect of FIG. **4**.

[0016] FIG. **6**C is a fragmentary axial view of the wheel end and disconnect of FIG. **4**.

[0017] FIG. **7** is an exploded perspective view according to a further illustrative embodiment of a wheel end including an illustrative embodiment of an active and passive radial overrunning wheel end disconnect.

[0018] FIG. **8** is another exploded perspective view of the wheel end and disconnect of FIG. **7**.

[0019] FIG. **9**A is a cross-sectional view of the wheel end and disconnect of FIG. **7**.

[0020] FIG. **9**B is a fragmentary axial view of the wheel end and disconnect of FIG. **7**.

[0021] FIG. **10** is an exploded perspective view according to an additional illustrative embodiment of a wheel end including an illustrative embodiment of a single plane active and passive overrunning wheel end disconnect.

[0022] FIG. **11** is another exploded perspective view of the wheel end and disconnect of FIG. **10**.

[0023] FIG. **12** is a cross-sectional view of the wheel end and disconnect of FIG. **10**.

[0024] FIG. **13** is a fragmentary end view of the wheel end and disconnect of FIG. **10**, illustrating active and passive planar struts.

[0025] FIG. **14** is a fragmentary end view of the wheel end and disconnect of FIG. **10**, illustrating notches in a notch plate portion of a wheel end cover.

[0026] FIG. **15** is an exploded perspective view according to yet another illustrative embodiment of a wheel end including an illustrative embodiment of an active planar and passive radial overrunning wheel end disconnect.

[0027] FIG. **16** is another exploded perspective view of the wheel end and disconnect of FIG. **15**.

[0028] FIG. **17**A is a cross-sectional view of the wheel end and disconnect of FIG. **15**, illustrating a passive radial clutch portion.

[0029] FIG. **17**B is a cross-sectional view of the wheel end and disconnect of FIG. **15**, illustrating an active planar clutch portion.

[0030] FIG. **18** is a schematic diagram according to an illustrative embodiment of a vehicle and including a general embodiment of a wheel end and disconnect generic to the illustrative embodiments of FIGS. **1**-**17**B.

DETAILED DESCRIPTION

[0031] In contrast to complex conventional wheel hub clutches or wheel end disconnects, the present disclosure includes a relatively simple wheel hub clutch or wheel end disconnect configured to allow a wheel hub to be operatively engaged and disengaged from an axle of a driveline of a vehicle and having an overrunning or freewheeling mode. In general, the presently disclosed apparatus includes an active and passive overrunning wheel hub clutch including a wheel hub, a clutch hub, an active clutch between the clutch hub and the wheel hub, and a passive clutch between the clutch hub and the wheel hub. The active and passive overrunning wheel hub clutch enables a one way clutch freewheeling or overrunning mode wherein a drivetrain that is rotating relatively slower than vehicle wheels can gradually increase speed and catch up to the rotational speed of the wheels and passively engage the vehicle wheels to impart drive force to the wheels. The wheel hub clutches disclosed herein may be used to engage, disengage, and freewheel, a wheel end, for example, a wheel end like that described in application PCT/US2022/38804, published as WO 2023/048826, filed on Jul. 29, 2022, docket number AAGCM001-US, corresponding to issued U.S. Pat. No. 12,054,041, the contents of which are hereby incorporated herein by reference in their entireties. The novelty of the active and passive overrunning wheel hub clutches and wheel end disconnects lend novelty to a wheel end system, axle, drivetrain, and vehicle, all including the novel wheel hub clutches. The illustrated clutch embodiments shown in the drawings are all shown at a wheel end outboard location, but could also be positioned at a wheel end inboard location and still provide the same or similar benefits, as taught and disclosed in the '804 application.

[0032] Referring specifically to the drawings, FIGS. **1** and **2** show a fragmentary sectional view of an illustrative embodiment of a wheel end **10** including an illustrative embodiment of a wheel hub clutch **12**. The wheel end **10** includes a clutch hub **14** configured to be coupled to an axle shaft (not separately shown), a wheel hub **13** (FIG. **3**A) including a wheel hub body **15** (FIG. **3**A) and a wheel hub cover **16** coupled to the wheel hub body **15** by bolts, studs, or any other suitable fasteners (not shown), and the wheel hub clutch **12** disposed between the clutch hub **14** and the wheel hub **13**. In particular, the wheel hub clutch **12** is disposed between the clutch hub **14** and the wheel hub cover **16**, to couple and decouple the wheel hub **13** relative to the clutch hub **14**. The wheel end **10** is rotatable about a rotational axis A of the wheel end **10**. The wheel hub clutch **12** includes the clutch hub **14**, a first clutch component or race **18** coupled to the clutch hub **14**, and a second clutch component or race **20** coupled to the wheel hub cover **16**. The wheel hub clutch **12** includes an active clutch **12***a* that is operatively disposed between the first and second races **18**, **20**, and a passive clutch **12***b* that is operatively disposed between the first race **18** and the wheel hub cover **16**.

[0033] With reference now to FIGS. **3**A and **3**B, the clutch hub **14** may include an inboard shoulder **22** and an adjacent inboard bearing journal **24** at an inboard end of the clutch hub **14** for carrying an inboard bearing **26** between the inboard shoulder **22** and a snap ring **28** or other retention element that may be coupled to the clutch hub **14** at a location inboard of the inboard shoulder **22**. The inboard bearing **26** may support a stator support **30** for a clutch actuator **32**. The clutch hub **14** may include an internal spline **34** for splined coupling to an axle shaft (not shown). The clutch hub **14** also may include an outboard shoulder **23** and an adjacent outboard bearing journal **25** at an outboard end of the clutch hub **14** for carrying an outboard bearing **27** between the outboard shoulder **23** and a corresponding shoulder **29** of the wheel hub cover **16**.

[0034] The first race (or first coupling member) **18** may be a combination axial pocket plate and axial notch plate, with passive pockets **36** in a passive pocket surface on an outboard side of the first race **18** and active notches **38** in an active notch surface on an inboard side of the first race **18**. In the illustrated embodiment, the first race **18** may be integral with the clutch hub **14** such that the clutch hub **14** and the first race **18** may be unitary. In other embodiments, the first race **18** may be splined or otherwise coupled against relative rotation with respect to the clutch hub **14**. The first race **18** may be axially retained with respect to the wheel hub cover **16** by a snap ring **39** or other retention ring carried in a corresponding groove of the wheel hub cover **16**.

[0035] The second race (or second coupling member) **20** may be a pocket plate, with active pockets **40** on an outboard side and actuator element passages **42** extending through the race **20** between the outboard side and an inboard side and in communication with the active pockets **40**. A strut retainer **41** may be coupled to the second race **20**. The second race **20** may be axially retained with respect to the clutch hub **14** by a snap ring **44** or other retention ring carried in a corresponding groove of the clutch hub **14**. The strut retainer **41** may be fastened to the second race **20** by rivets **47** (FIG. **1**), or bolts, or any other suitable fasteners.

[0036] The wheel hub cover **16** may include a cover sidewall **46**, and a cover endwall **48** coupled to the cover sidewall **46**. The cover endwall **48** may be coupled to the cover sidewall **46** by being unitary therewith, as illustrated, or by being splined, fastened, or otherwise separately connected thereto in any other suitable manner. In any event, a portion of the wheel hub cover **16** serves as a clutch race, in particular, a notch plate, with passive notches **50** on an inboard side. The wheel hub cover **16** may be a cup-shaped member, wherein the cover sidewall **46** includes a longitudinally extending circumferential wall **46***a* that may be internally splined, and wherein the cover endwall **48** includes a transversely extending axial wall **48***a* that may carry the passive notches **50**.

[0037] The clutch actuator **32** includes a stator **52** that is supported by the stator support **30** carried by the bearing **26** on a radially outward side of the bearing **26**. The clutch actuator **32** also includes a translator **54** carried radially outward of the stator **52** and radially inward of a portion, for example, the cover sidewall **46**, of the wheel hub cover **16**.

[0038] The wheel hub clutch illustrated in FIGS. **1** through **3**B is a dual plane active and passive overrunning clutch. Example embodiments of a dual plane clutch are described in U.S. patent application Ser. No. 18/132,800, filed on Apr. 10, 2023, docket number MNS142-US, issued as U.S. Pat.

No. 12,092,172, assigned to the assignee hereof, the contents of which is hereby incorporated herein by reference in its entirety.

[0039] The second race **20** is coupled to the longitudinally extending circumferential wall **46***a* of the wheel hub cover **16** against relative rotation therebetween, and the first race **18** is coupled to the clutch hub **14** and is disposed axially between the second race **20** and the transversely extending axial wall **48***a* of the wheel hub cover **16**. More specifically, the second race **20** may be splined to the longitudinally extending circumferential wall **46***a* of the wheel hub cover **16**. The second race **20** includes the active pockets **40**, which are axial pockets in an axially outboard facing active pocket surface of the second race **20**. The transversely extending axial wall **48***a* of the wheel hub cover **16** includes the passive notches **50**, which are axial notches in an axially inboard facing passive notch surface of the transversely extending axial wall **48***a* of the wheel hub cover **16**. Also more specifically, the first race **18** may be unitary with the clutch hub **14** and includes the active notches **38** in an active notch surface facing the active pocket surface of the second race **20**, and the passive pockets **36** in the passive pocket surface facing the passive notch surface of the transversely extending axial wall **48***a* of the wheel hub cover **16**.

[0040] The active clutch **12***a* includes one or more active struts **56** between the active pockets **40** in the active pocket surface of the second race **20** and the active notches **38** in the active notch surface of the first race **18**. The active struts **56** may be biased to a nondeployed position by return springs **56***a* (FIG. **1**). As used herein, the term nondeployed is synonymous with undeployed, off, deactivated, unactivated, disengaged, unengaged, and like terminology. The active struts **56** of the active clutch **12***a* couple the second race **20** and the first race **18** in a second direction of rotation only. The active clutch **12***a* also may include active actuator elements that may include active springs **57**, wherein the clutch actuator **32** may include the active springs **57** and, in any case, moves the active springs **57** to, in turn, move the active struts **56** pivotally to a deployed position between the second race **20** and the first race **18** such that the first race **18** becomes coupled to the second race **20** in the second direction of rotation. As used herein, the term deployed is synonymous with activated, on, engaged, and like terminology.

[0041] The passive clutch **12***b* includes one or more passive struts **58** between the passive pockets **36** of the first race **18** and the passive notches **50** in the transversely extending axial wall **48***a* of the wheel hub cover **16**. The passive struts **58** of the passive clutch **12***b* couple the first race **18** and the wheel hub cover **16** in a first direction of rotation only and allow the first race **18** to overrun the wheel hub cover **16** in the second direction of rotation that is circumferentially opposite of the first direction of rotation. The passive clutch **12***b* may include passive actuator elements that may include passive advance springs **59** that bias and move the passive struts **58** toward and to a deployed position between the first race **18** and the wheel hub cover **16** such that the first race **18** becomes coupled to the wheel hub cover **16** in a first (forward) direction of rotation and overruns the wheel hub cover **16** in a second (reverse) direction of rotation.

[0042] The clutch actuator **32** includes the stator **52** and the translator **54**, and also may include the active springs **57** that may be carried by a spring plate **60** of the clutch actuator **32** that may be moved by the translator **54**. The clutch actuator **32** also may include a translator carrier **62** that may be used to carry or house other portions of the translator **54** therein, and that may include an outer cylindrical wall **64** that may be splined to the longitudinally extending circumferential wall **46***a* of the wheel hub cover **16** and a shoulder **66** that may extend radially inwardly from the outer cylindrical wall **64** to serve as a stop for the spring plate **60**. The translator carrier **62** may be axially retained with respect to the wheel hub cover **16** by a snap ring **65** or any other component or feature suitable for such retention.

[0043] The stator **52** remains stationary and does not rotate. The stator **52** is supported by the stator support **30** that is carried on the bearing **26** and that may be fastened or otherwise coupled to the stator **52**. The stator **52** or the stator support **30** may include an inboard portion that may include an axially extending arm **68** (FIG. **1**) that may be fastened to, interengaged with, or otherwise coupled to an axle spindle (not shown) or other non-rotatable or stationary component to prevent the stator **52** from rotating. The stator **52** may include an electromagnet including electromagnetically inductive coils **70** carried between axially spaced fingers of a ferromagnetic housing **72**. In other embodiments, the stator **52** may include any suitable structure to produce a magnetic field suitable for use with the wheel hub clutch **12**. In the illustrated example, the stator **52** has two electromagnetically inductive coils **70** to create a magnetic flux when one or both electromagnetically inductive coils **70** are energized. The stator **52** applies a first magnetic control force to the translator **54** one way when the electromagnetically inductive coils **70** are energized to cause the translator **54** to move along the rotational axis A. The translator **54** reacts to the magnetic control force by moving the spring plate **60** and corresponding active springs **57** along the rotational axis A. By reversing the current direction in the electromagnetically inductive coils **70**, the translator **54** causes the spring plate **60** and corresponding active springs **57** to move in the opposite direction along the rotational axis A.

[0044] The translator **54** rotates with the wheel hub cover **16**. The translator **54** is supported for translational movement relative to the stator **52** along the rotational axis A between first and second axial end positions, corresponding to different operating modes of the wheel hub clutch **12**. The translator **54** may include a magnet carrier **74**, a permanent magnet **76** carried by the magnet carrier **74**, a spring plate spacer **78** that may be coupled to the spring plate **60** and disposed between the magnet carrier **74** and the spring plate **60**, and a snap ring **79** that may fit in a corresponding groove in the outer cylindrical wall **64** of the translator carrier **62** or any other suitable retention element or feature to limit travel of the magnet carrier **74**. The spring plate spacer **78** may be unitary with the outer cylindrical wall **64** of the translator carrier **62** as illustrated, or may be a separate component.

[0045] The illustrated wheel end includes the wheel hub cover **16**, and the active and passive overrunning wheel hub clutch **12** coupled to the wheel hub cover **16** that constitute a cartridge or self-contained assembly. For example, the active and passive overrunning wheel hub clutch **12** may be retained to the wheel hub cover **16** by at least one the several retainer rings. In any event, such a self-contained assembly can be used with a newly designed wheel end or to retrofit an existing wheel end, for example, as an after-market product to upgrade an existing vehicle with additional functionality. Accordingly, an existing wheel hub cover can

be removed from an existing wheel hub and an existing axle shaft can be replaced with a longer axle shaft having a splined end, and the new clutch hub **14** can be splined to the longer axle shaft, and the new wheel hub cover **16** can be bolted to the existing wheel hub with longer threaded bolts or studs. The apparatus may be self-contained for easy handling and transport such that all components of the apparatus may be retained together as an assembly by snap rings, screws, and/or any other suitable retainers and/or fasteners.

[0046] FIGS. **4**A-**6**C show another illustrative embodiment of a wheel end **110** including another embodiment of a wheel hub clutch **112**. The wheel hub clutch **112** includes a clutch hub **114**, a first or clutch component or race **119** coupled to the clutch hub **114**, and a wheel hub cover **116**. The wheel hub clutch **112** includes an active clutch **112***a* that is operatively disposed between the clutch component or race **119** and the wheel hub cover **116**, and a passive clutch **112***b* that is operatively disposed between the clutch component or race **119** and the wheel hub cover **116**.

[0047] With reference to FIGS. **6**A and **6**B, the clutch hub **114** may include an inboard shoulder **122**, and an adjacent inboard bearing journal **124** at an inboard end of the clutch hub **114** for carrying an inboard bearing **126** between the inboard shoulder **122**, a thrust washer **121** located between the inboard shoulder **122** and the inboard bearing **126**, and a snap ring **128** or other retention element that may be coupled to the clutch hub **114** at a location inboard of the inboard shoulder **122**. The inboard bearing **126** may support a stator support **130** for a clutch actuator **132**. The clutch hub **114** may include an internal spline **134** for splined coupling to an axle shaft (not shown). The clutch hub **114** also may include an outboard shoulder **123** and an adjacent outboard bearing journal **125** at an outboard end of the clutch hub **114** for carrying an outboard bearing **127** between the outboard shoulder **123** and a corresponding shoulder **129** of the wheel hub cover **116**.

[0048] The clutch race **119** may be a combination radial pocket plate and axial pocket plate, with passive axial notches **150** (FIG. **6**B) in an outboard side and active radial pockets **140** (FIG. **6**A) in a radially outward portion. In the illustrated embodiment, the clutch race **119** may be splined to the clutch hub **114**. In other embodiments, the clutch race **119** may be integral with the clutch hub **114** such that the components are unitary, or the clutch race **119** may be otherwise coupled against relative rotation with respect to the clutch hub **114** in any other suitable manner. The clutch race **119** may be axially retained with respect to the wheel hub cover **116** by a snap ring **139** or other retention ring carried in a corresponding groove of the wheel hub cover **116** or other suitable retention component(s) or feature(s) and may be axially retained with respect to the clutch hub **114** by a snap ring **145** or other retention ring carried in a corresponding groove in the clutch hub **114** or other suitable retention component(s) or feature(s).

[0049] The clutch actuator **132** includes a stator **152** that may be carried within an inner diameter of the wheel hub cover **116**. The clutch actuator **132** also includes a translator **154** that may be carried radially outward of the clutch hub **114** between the stator **152** and the clutch hub **114**.

[0050] The wheel hub clutch **112** illustrated in FIGS. **4**-**6**B is an active radial and passive planar overrunning clutch. Example embodiments of a relevant clutch are described in U.S. patent application Ser. No. 18/132,800, filed on Apr. 10, 2023, docket number MNS142-US, now U.S. Pat. No. 12,092,172, assigned to the assignee hereof, the contents of which is hereby incorporated herein by reference in its entirety.

[0051] The clutch race **119** is coupled to the clutch hub **114** against relative rotation therebetween, and is disposed axially between the clutch actuator **132** and a transversely extending axial wall **148***a* of the wheel hub cover **116**. More specifically, the clutch race **119** may be splined to the clutch hub **114**. In other embodiments, the clutch race **119** may be integral with the clutch hub **114** such that the components are unitary. The clutch race **119** includes the radial pockets **140** (FIG. **6**A), which are active pockets in a radially outboard facing active pocket surface of the clutch race **119**. The transversely extending axial wall **148***a* of the wheel hub cover **116** includes axial pockets **136** (FIG. **6**B), which are passive notches in an axially inboard facing passive notch surface of the transversely extending axial wall **148***a* of the wheel hub cover **116**. Also more specifically, a longitudinally extending circumferential wall **146***a* of the wheel hub cover **116** includes active notches **138** in an active notch surface facing the active pocket surface of the clutch race **119**, such that the wheel hub cover **116** serves as a radial clutch race, more particularly, a notch race. Similarly, the axial notches **150**, are passive pockets, in the passive pocket surface facing the passive notch surface of the transversely extending axial wall **148***a* of the wheel hub cover **116**, such that the wheel hub cover serves as an axial or planar clutch race, more particularly a notch plate.

[0052] The active clutch **112***a* includes one or more active struts **156** between the active pockets **140** in the active pocket surface of the clutch race **119** and the active notches **138** in the active notch surface of wheel hub cover **116**. The active struts **156** may be biased toward a deployed position by active advance springs **156"** (FIG. **4**B). The active struts **156** of the active clutch **112***a* couple the clutch race **119** in the second direction of rotation only. The active clutch **112***a* also may include active actuator elements that may include active plungers **157**, wherein the clutch actuator **132** may include the active plungers **157** and, in any case, moves the active plungers **157** to, in turn, move the active struts **156** pivotally to an undeployed position between the clutch race **119** and wheel hub cover **116** such that the clutch race **119** becomes uncoupled from the wheel hub cover **116**. In another embodiment, illustrated by FIG. **4**C, the active struts **156** may be biased toward a nondeployed position by return springs **156'**, wherein the active plungers **157** move the active struts **156** pivotally to a deployed position between a clutch race **119'** and the wheel hub cover **116** such that the clutch race **119'** couples to the wheel hub cover **116**.

[0053] The passive clutch **112***b* includes one or more passive struts **158** between the passive notches **150** of the clutch race **119** and the passive pockets **136** in the transversely extending axial wall **148***a* of the wheel hub cover **116**. The passive struts **158** of the passive clutch **112***b* couple the clutch race **119** and the wheel hub cover **116** in a first direction of rotation only and allows the clutch race **119** to overrun the wheel hub cover **116** in a second direction of rotation. The passive struts **158** may be biased to a deployed position by passive advance springs **159** (FIG. **6**B). More specifically, the passive clutch **112***b* also may include passive actuator elements that may include the advance springs **159** that bias and move the passive struts **158** toward and to a deployed position between the clutch race **119** and the

wheel hub cover **116** such that the clutch race **119** becomes coupled to the wheel hub cover **116** in a first (forward) direction of rotation and overruns the wheel hub cover **116** in a second (reverse) direction of rotation.

[0054] With reference to FIGS. **6**A and **6**B, the clutch actuator **132** includes the stator **152** and the translator **154**, and also may include the active plungers **157** that may be carried by a plunger carrier, for example, a plunger plate **160**, of the clutch actuator **132** that may be moved by the translator **154**. The clutch actuator **132** also may include a translator carrier **162** that may be used to carry or house other portions of the translator **154** thereon, and that may include an inner cylindrical wall **164** that may be splined to the clutch hub **114** and a shoulder **166** that may extend radially inwardly from the inner cylindrical wall **164** to serve as a stop for the plunger plate **160**. The translator carrier **162** may be axially retained with respect to the clutch hub **114** by the thrust washer **121** or any other component or feature suitable for such retention.

[0055] The stator **152** remains stationary and does not rotate. The stator **152** is supported by the stator support **130** that is carried on the bearing **126** and that may be an integral or unitary portion of the stator **152** or may be separately fastened or otherwise coupled thereto. The stator **152** or the stator support **130** may include an inboard portion that may include an axially extending arm **168** that may be fastened to, interengaged with, or otherwise coupled to an axle spindle (not shown) or other non-rotatable or stationary component to prevent the stator **152** from rotating. The stator **152** may include an electromagnet including electromagnetically inductive coils **170** carried between axially spaced fingers of a ferromagnetic housing **172**. In other embodiments, the stator **152** may include any suitable structure to produce a magnetic field suitable for use with the wheel hub clutch **112**. In the illustrated example, the stator **152** has two electromagnetically inductive coils **170** to create a magnetic flux when one or both electromagnetically inductive coils **170** are energized. The stator **152** applies a first magnetic control force to the translator **154** one way when the electromagnetically inductive coils **170** are energized to cause the translator **154** to move along the rotational axis A. The translator **154** reacts to the magnetic control force by moving the plunger plate **160** and corresponding plungers **157** along the rotational axis A. By reversing the current direction in the electromagnetically inductive coils **170**, the translator **154** causes the plunger plate **160** and corresponding plungers **157** to move in the opposite direction along the rotational axis A.

[0056] The translator **154** rotates with the clutch hub **114**, for example, by being splined thereto or otherwise coupled thereto against relative rotation. The translator **154** is supported for translational movement relative to the stator **152** along the rotational axis A between first and second axial end positions, corresponding to different operating modes of the wheel hub clutch **112**. The translator **154** may include a magnet carrier **174**, a permanent magnet **176** carried by the magnet carrier **174**, a plunger plate hub **178** that may be coupled to the plunger plate **160** and disposed between the magnet carrier **174** and the plunger plate **160**, and a snap ring **179** that may fit in a corresponding groove in the inner cylindrical wall **164** of the translator carrier **162** or any other suitable retention element or feature to limit travel of the magnet carrier **174**.

[0057] FIGS. **7-9**B show a further illustrative embodiment of a wheel end **210** including a further embodiment of a wheel hub clutch **212**. The wheel hub clutch **212** includes the clutch hub **114**, a clutch component or race **219** coupled to the clutch hub **114**, an active clutch **212***a* operatively disposed between the clutch race **219** and the wheel hub cover **216**, and a passive clutch **212***b* operatively disposed between the clutch race **219** and the wheel hub cover **216**.

[0058] The clutch race **219** may be a dual radial pocket plate having a first set of radial pockets **240** carrying first radial locking members or struts **256** and a second set of radial pockets **236** carrying second radial locking members or struts **258**, in a radially outward portion of the clutch race **219**. The first radial locking members or struts **256** may be actively actuated by a clutch actuator **232** and the second radial locking members or struts **258** may be passively actuated. The first and second struts **256**, **258** are oriented in circumferentially opposite directions.

[0059] The wheel hub clutch illustrated in FIGS. **7-9** is an active and passive radial overrunning clutch. An example embodiment of a relevant clutch is described in U.S. Pat. No. 7,484,605, assigned to the assignee hereof, the contents of which is hereby incorporated herein by reference in its entirety. Another example embodiment of a relevant clutch, is described in U.S. Pat. No. 10,590,999, assigned to the assignee hereof, the contents of which is hereby incorporated herein by reference in its entirety. In the '999 patent, one set of radial pawls may be actively controlled, and a different set of radial pawls may be actively controllable but whose control is deactivated or turned off so as to operate in a passive overrunning mode.

[0060] Much of the wheel end **210** may be substantially the same as the wheel end **110** of FIGS. **4**A-**6**C, including the bearings **126**, **127**, stator support **130**, snap rings **128**, **139**, **145**, thrust washer **121**, and even the clutch hub **114** and the clutch actuator **132** including the stator **152** and the translator **154**. The wheel hub clutch **212** itself and the wheel hub cover **216** have some similarities to that shown in FIGS. **4**A-**6**C, but are different, as discussed below.

[0061] The clutch race **219** is coupled to the clutch hub **114** against relative rotation therebetween, and is disposed axially between the clutch actuator **132** and a transversely extending axial wall **248***a* of the wheel hub cover **216**. More specifically, the clutch race **219** may be splined to the clutch hub **114**. In other embodiments, the clutch race **219** may be integral with the clutch hub **114** such that the components are unitary. The clutch race **219** includes the radial pockets **240**, which are active pockets in a radially outboard facing pocket surface of the clutch race **219**. A longitudinally extending circumferential wall **246***a* of the wheel hub cover **216** includes notches **251** in a notch surface facing the pocket surface of the clutch race **219**, and the notches **251** serve as both passive and active notches, such that the wheel hub cover **216** serves as a clutch race, more particularly, a notch race.

[0062] With reference to FIG. **9**B, the active clutch **212***a* includes one or more active struts **256** between the active pockets **240** in the pocket surface of the clutch race **219** and the notches **251** in the notch surface of wheel hub cover **116**. The active struts **256** may be biased to a deployed position by advance springs **256***a*. The active struts **256** of the active clutch **212***a* couple the clutch race **219** to the wheel hub cover **216** in the second direction of rotation only. The active clutch **212***a* also may include active actuator elements that

may include the active plungers **157**, wherein the clutch actuator **132** may include the active plungers **157** and, in any case, moves the active plungers **157** to, in turn, move the active struts **256** pivotally to a nondeployed position between the clutch race **219** and the wheel hub cover **216** such that the clutch race **219** becomes uncoupled from the wheel hub cover **216**.

[0063] The passive clutch **212***b* includes one or more passive struts **258** between the notches **251** of the clutch race **219** and the passive pockets **236** in the radially outwardly facing pocket surface of the clutch race **219**. The passive struts **258** of the passive clutch **212***b* couple the clutch race **219** and the wheel hub cover **216** in a first direction of rotation only and allows the clutch race **219** to overrun the wheel hub cover **216** in a second direction of rotation. The passive struts **258** may be biased to a deployed position by passive advance springs **259**. More specifically, the passive clutch **212***b* also may include passive actuator elements that may include the passive advance springs **259** that bias and move the passive struts **258** toward and to a deployed position between the clutch race **219** and the wheel hub cover **216** such that the clutch race **219** becomes coupled to the wheel hub cover **216** in a first (forward) direction of rotation and overruns the wheel hub cover **216** in a second (reverse) direction of rotation.

[0064] FIGS. **10-14** show an additional illustrative embodiment of a wheel end **310** including an additional embodiment of a wheel hub clutch **312**. The wheel hub clutch **312** includes a clutch hub **314**, a clutch component or race **319** coupled to the clutch hub **314**, an active planar clutch **312***a* operatively disposed between the clutch race **319** and the wheel hub cover **316**, and a passive planar clutch **312***b* operatively disposed between the clutch race **319** and the wheel hub cover **316**.

[0065] With reference to FIG. **12**, the clutch hub **314** may include an inboard shoulder **322** and an adjacent inboard bearing journal **324** at an inboard end for carrying the inboard bearing **126** between the inboard shoulder **322** and the snap ring **128** or other retention element, wherein the thrust washer **121** may be disposed between the inboard shoulder **322** and the inboard bearing **126**. The inboard bearing **326** may support a stator support **330** for a clutch actuator **332**. The clutch hub **314** also may include an outboard shoulder **323** and an adjacent outboard bearing journal **325** at an outboard end for carrying the outboard bearing **127** at the outboard end radially between the clutch hub **314** and a shoulder **329** of a corresponding portion (such as a wheel hub cover) of the wheel hub cover **316** and/or a snap ring **331** carried in a corresponding groove of the clutch hub **314**. The clutch hub **314** may include an internal spline for splined coupling to an axle shaft (not shown).

[0066] With reference to FIG. **12**, the clutch actuator **332** may include a stator **352** supported by the stator support **330**, and a translator **354** carried radially between the stator **352** and the clutch hub **314** between the bearing journals **324**, **325** and may be axially retained thereto by the snap ring **128**, the thrust washer, **121**, and/or any other retention member(s) (not shown) coupled to the clutch hub **314**.

[0067] With reference to FIG. **13**, the clutch component or race **319** may be a single plane pocket plate having a plurality of active pockets **340** carrying a plurality of active locking members or struts **356** and a plurality of passive pockets **336** carrying a plurality of passive locking members or struts **358**, in an outboard side of the clutch race **319**. The clutch race **319** also may include a plurality of actuator passages **342** (FIG. **10**) extending through the clutch race **319** between the outboard side and an inboard side and in communication with the plurality of active pockets **340**. The clutch race **319** may be splined or otherwise coupled against rotation with respect to the clutch hub **314**, and may be axially retained with respect to the wheel hub cover **316** by the snap ring **139** (FIG. **12**) or other retention member coupled to the wheel hub cover **316**.

[0068] The wheel hub clutch **312** illustrated in FIGS. **10-14** is a single plane active and passive overrunning clutch. Example embodiments of a relevant clutch are described in U.S. patent application Ser. No. 17/994,310, filed on Nov. 26, 2022, docket number MINS135CIP-US and published as US 2023/0160461, assigned to the assignee hereof, the contents of which is hereby incorporated herein by reference in its entirety.

[0069] Much of the wheel end **310** may be substantially the same as the wheel end **210** of FIGS. **7-9**B, including the bearings **126**, **127**, snap rings **128**, **139**, and the thrust washer **121**, except a snap ring **347** that may be carried in a corresponding groove of the wheel hub cover **316** to retain the outboard bearing **127**. But the wheel hub clutch **312** itself and the wheel hub cover **316** have some similarities to that shown in FIGS. **7-9**B, but are different, as discussed below.

[0070] The clutch race **319** is coupled to the clutch hub **314** against relative rotation therebetween, and is disposed axially between the actuator **332** and a transversely extending axial wall **348***a* of the wheel hub cover **316**. More specifically, the clutch race **319** may be splined to the clutch hub **314**. In other embodiments, the clutch race **319** may be integral with the clutch hub **314** such that the components are unitary. The clutch race **319** includes the active pockets **340**, which are axial pockets in an axially outboard facing pocket surface of the clutch race **319**. The transversely extending axial wall **348***a* of the wheel hub cover **316** includes notches **351** in a notch surface facing the pocket surface of the clutch race **319**, and the notches **351** serve as both passive and active notches, such that the wheel hub cover **316** serves as a clutch race, more particularly, a notch plate. The notches have active strut engagement features **351***a*, and passive strut engagement features **351***b* that are oriented circumferentially opposite of the active strut engagement features **351***a*.

[0071] With reference to FIGS. **10-11**, the active clutch **312***a* includes one or more active struts **356** between the active pockets **340** in the pocket surface of the clutch race **319** and the notches **351** in the notch surface of wheel hub cover **316**. The active struts **356** may be biased to a nondeployed position by return springs **356***a*. The active struts **356** of the active clutch **312***a* couple the clutch race **319** in the second direction of rotation only. The active clutch **312***a* also may include active actuator elements that may include active plungers **357**, wherein the clutch actuator **332** may include the active plungers **357** and, in any case, moves the active plungers **357** to, in turn, move the active struts **356** pivotally to a deployed position between the clutch race **319** and the wheel hub cover **316** such that the clutch race **319** becomes coupled to the wheel hub cover **316** in the second direction of rotation. The active plungers **357** may include coil springs, as illustrated, or plungers with conical heads, or any other suitable strut actuator elements.

[0072] The passive clutch **312***b* includes one or more passive struts **358** carried in the passive pockets **336** of the clutch race **319** and between the clutch race **319** and the axial notches **351** in the axially inwardly facing notch surface of the wheel hub cover **316**. The passive struts **358** of the passive clutch **312***b* couple the clutch race **319** and the wheel hub cover **316** in a first direction of rotation only and allow the clutch race **319** to overrun the wheel hub cover **316** in the second direction of rotation. More specifically, the passive clutch **312***b* may include passive actuator elements that may include passive advance springs **359** (FIG. **10**) that bias and move the passive struts **358** toward a deployed position between the clutch race **319** and the wheel hub cover **316** such that the clutch race **319** becomes coupled to the wheel hub cover **316** in a first (forward) direction of rotation and overruns the wheel hub cover **316** in a second (reverse) direction of rotation.

[0073] FIGS. **15**-**17**B show yet another illustrative embodiment of a wheel end **410** including yet another embodiment of a wheel hub clutch **412**. The wheel end **410** and clutch **412** are most similar to that illustrated in FIGS. **4**A-**6**C. The wheel hub clutch **412** includes the clutch hub **114**, a clutch component or race **419** coupled to the clutch hub **114**, an active planar clutch **412***a* that is operatively disposed between the race **419** and a wheel hub **416**, and a passive radial clutch **412***b* that is operatively disposed between the race **419** and the wheel hub **416**.

[0074] The race **419** may be a combination radial pocket plate and axial pocket plate, with axial pockets **440** on an outboard side and radial pockets **436** on a radially outward portion. In the illustrated embodiment, the race **419** may be splined to the clutch hub **114**. In other embodiments, the race **419** may be integral with the clutch hub **114** such that the components are unitary, or the race **419** may be otherwise coupled against relative rotation with respect to the clutch hub **114**.

[0075] Much of the wheel end **410** may be substantially the same as the wheel end **410** of FIGS. **4**A-**6**C, including the bearings **126**, **127**, stator support **130**, snap rings **128**, **139**, **145**, thrust washer **121**, and even the clutch hub **114** and the clutch actuator **132** including the stator **152**. The wheel hub clutch **412** itself and the wheel hub cover **416** have some similarities to that shown in FIGS. **4**A-**6**C, but are different, as discussed below.

[0076] The wheel hub clutch **412** illustrated in FIGS. **15**-**17**B is an active planar and passive radial overrunning clutch. Example embodiments of a relevant clutch are described in U.S. Pat. No. 8,079,453, assigned to the assignee hereof, the contents of which is hereby incorporated herein by reference in its entirety.

[0077] The clutch race **419** may be a combination radial pocket plate and axial pocket plate, with passive radial pockets **436** (FIG. **15**) in a radially outward portion and active axial pockets **440** (FIG. **16**) in an axial outboard side. A transversely extending axial wall **448***a* of a wheel hub cover **416** includes axial notches **438**, which are passive notches in an axially inboard facing passive notch surface of the transversely extending axial wall **448***a* of the wheel hub cover **416**. Also more specifically, a longitudinally extending circumferential wall **446***a* of the wheel hub cover **416** includes passive notches **150** in a passive notch surface facing the passive pocket surface of the clutch race **419**, such that the wheel hub cover **416** serves as a clutch race, more particularly, a notch race. Similarly, the axial pockets **440**, are active pockets, in the active pocket surface facing the active notch surface of the transversely extending axial wall **448***a* of the wheel hub cover **416**, such that the wheel hub cover **416** additionally serves as a clutch race, more particularly a notch plate.

[0078] The active clutch **412***a* includes one or more active struts **456** between the active pockets **440** in the active pocket surface of the clutch race **419** and the active notches **438** in the active notch surface of wheel hub cover **416**. The active struts **456** may be biased toward a nondeployed position by return springs **456***a*. The active struts **456** of the active clutch **412***a* couple the clutch race **419** in the second direction of rotation only. The active clutch **412***a* also may include active actuator elements that may include active plungers **457**, wherein the clutch actuator **432** may include the active plungers **457** and, in any case, moves the active plungers **457** to, in turn, move the active struts **456** pivotally to a deployed position between the clutch race **419** and wheel hub cover **416** such that the clutch race **419** becomes coupled to the wheel hub cover **416**.

[0079] The passive clutch **412***b* includes one or more passive struts **458** between the passive pockets **436** of the clutch race **119** and the passive notches **450** of the wheel hub cover **116**. The passive struts **458** of the passive clutch **412***b* couple the clutch race **419** and the wheel hub cover **416** in a first direction of rotation only and allows the clutch race **419** to overrun the wheel hub cover **416** in a second direction of rotation. The passive struts **458** may be biased to a deployed position by passive advance springs **458***a*. More specifically, the passive clutch **412***b* also may include passive actuator elements that may include the passive advance springs **458***a* that bias and move the passive struts **458** toward a deployed position between the clutch race **419** and the wheel hub cover **416** such that the clutch race **419** becomes coupled to the wheel hub cover **416** in a first (forward) direction of rotation and overruns the wheel hub cover **416** in a second (reverse) direction of rotation.

[0080] FIG. **18** schematically shows an embodiment of a vehicle **502** that includes an apparatus including a drivetrain **504**, an axle **506**, a wheel **508**, and a wheel end **510** that includes a wheel hub **513** and that couples the wheel **508** to the axle **506** via a wheel hub clutch **512** between the axle **506** and the wheel hub **513**. The wheel hub clutch **512** includes an active clutch **512***a* and a passive clutch **512***b*. The active clutch **512***a* is actuated by an actuator **532** and includes planar struts and/or radial struts. The actuator **532** may actuate the struts from an off or disengaged position to an on or engaged position, or the actuator **532** may actuate the struts from the on or engaged position to the off or disengaged position. The passive struts may include planar and/or radial struts and are normally biased toward an engaged position. Although not shown, the clutch **512** also may include a clutch hub, one or more clutch components or races, and/or any of the other components described and/or illustrated in the embodiments of FIGS. **1**-**17**B. Accordingly, FIGS. **1**-**17**B show several specific examples that are encompassed by the apparatus of FIG. **18**.

[0081] The vehicle **502** may be a wheeled vehicle of any suitable type having wheels, for example, a passenger automobile, a cargo truck, an all-terrain vehicle, a camper, a bus, a tractor, a motorcycle, a trike, or any other vehicle suitable for use with the presently disclosed subject matter. Although not separately shown, the drivetrain **504** may include, or may be powered by, one or more prime movers, for example,

an electric motor and/or a combustion engine. Accordingly, the drivetrain **504** may be part of a powertrain that may include an internal combustion engine, a transmission having an upstream end coupled to the engine and a downstream end coupled to the drivetrain, or simply may be an output shaft of an electric motor, or may be provided according to any other configuration suitable with the presently disclosed subject matter. The axle **506** may be a downstream portion of the drivetrain **504** or may be a separate entity downstream of the drivetrain **504** and may include an axle shaft for coupling to the wheel hub clutch **512**, for instance, to a clutch hub of the wheel hub clutch **512**.

[0082] The wheel hub clutch **512** operates in a one-way clutch mode or a fixed mode. A one-way clutch mode direction is set according to a vehicle forward direction and, therefore, would be rotationally clockwise on one side of the vehicle **502** and rotationally counter-clockwise for an opposite side of the vehicle **502**. During normal driving operation, the clutch **512** can operate in the fixed mode in which forward and reverse torque can be applied from the drivetrain **504** to the wheel **508** in vehicle forward and reverse directions as well as back driven from the wheel **508** during engine braking, regenerative braking, or the like. The clutch **512** can also switch from the fixed mode to the one-way clutch mode, wherein the vehicle **502** can coast in the vehicle forward direction and the wheel **508** can move faster than or overrun the drivetrain **504**. This mode provides low drag during vehicle coasting for better efficiency without the need to shift the drivetrain **504** of the vehicle **502** to a neutral state. From this one-way clutch mode, the rotational speed of the drivetrain **504** can be increased (e.g., by increasing prime mover rotational speed) so that the clutch **512** reengages the axle **506** to the wheel hub **513** as the rotational speed of the driveline **504** increases to match the rotational speed of the wheel **508**. This one-way clutch mode is also useful during towing of the vehicle **502** wherein the drivetrain **504** is not back driven during towing, which back driving would cause excessive drag to a tow truck and possible damage to the drivetrain **504** and/or prime mover. The two clutch modes can be changed during vehicle operation to switch back and forth to the desired mode via the actuator **532** coupled to the active clutch **512***a*. Depending on a particular vehicle implementation, the actuator **532** can act to move the active clutch **512***a* from an engaged state to a disengaged state, or from the disengaged state to the engaged state. Drivetrain torque, speed, and packaging space may dictate which configuration is the best with many different combinations of planar and radial style struts in the active and passive portion of the clutch **512**.

[0083] The presently disclosed clutches may be characterized as having 0/1, 1/1 strut/pawl positions according to the following nomenclature. The clutches may have multiple strut/pawl positions, for example, up/out/uncovered or down/in/covered. The nomenclature (/) refers to rotational direction, clockwise and counterclockwise (CW/CCW), wherein the first refers to the clockwise direction, and the second refers to the counterclockwise direction. A 1 means struts/pawls up/out/uncovered/advanced, either in a clutch lock or overrun condition, whereas a 0 means strut down/in/covered/retracted, free in either rotational direction such that clutch races are disengaged relative to one another. For example, (1/1) means both strut/pawl sets up, lock in both CW and CCW rotational directions, and (0/1) means lock in CCW rotation, or overrun with CW rotation. The term "disengaged" means that the struts are actively retracted such that the races are freely rotatable relative to one another in either circumferential direction at any instant. The term "overrun" generally means that one rotational member is free to rotate relatively faster than another rotational member and, specifically means with respect to a strut clutch that the struts extend, or are free to extend, toward their advanced positions but are rotationally bypassed (and may be contacted) by one of the races such that the struts do not carry torque between the races. CW and CCW may be considered from a viewpoint looking in an axially outboard-toward-inboard direction, as if looking at a wheel on a vehicle along an axis of an axle shaft for the wheel. For example, a right wheel of a vehicle will rotate clockwise in a vehicle forward direction whereas a left wheel of a vehicle will rotate counter clockwise in a vehicle forward direction. Consequently the right wheel may have a CW-drive configured clutch whereas the left wheel may have a CCW-drive configured clutch, for instance, as a mirror image of the CW-drive configured clutch.

[0084] Although the illustrated struts are shown as planar struts and radial struts pivotable about a single axis, the struts may be configured as spherical struts, sprag struts or sprag-like struts, roller struts, or any other strut shape configurations pivotable about one or more axes, and suitable to be advanced and retracted toward and away from engagement with a clutch race.

[0085] The descriptions of the several embodiments described and incorporated above and illustrated in the drawing figures are hereby incorporated by reference into one another, and descriptions of subject matter common to the embodiments generally may not be repeated. Accordingly, from the disclosure and teachings herein combined with the disclosure and teachings in the incorporated documents, a multitude of combinations of structures and functions are disclosed even if not all explicitly illustrated in the drawing figures.

[0086] Finally, the subject matter of this application is presently disclosed in conjunction with several explicit illustrative embodiments and modifications to those embodiments, using various terms. All terms used herein are intended to be merely descriptive, rather than necessarily limiting, and are to be interpreted and construed in accordance with their ordinary and customary meaning in the art, unless used in a context that requires a different interpretation. And for the sake of expedience, each explicit illustrative embodiment and modification is hereby incorporated by reference into one or more of the other explicit illustrative embodiments and modifications. As such, many other embodiments, modifications, and equivalents thereto, either exist now or are yet to be discovered and, thus, it is neither intended nor possible to presently describe all such subject matter, which will readily be suggested to persons of ordinary skill in the art in view of the present disclosure. Rather, the present disclosure is intended to embrace all such embodiments and modifications of the subject matter of this application, and equivalents thereto, as fall within the broad scope of the accompanying claims.

1. An active and passive overrunning wheel hub clutch, comprising:

a clutch hub;

a wheel hub;

an active clutch between the clutch hub and the wheel hub; and

a passive clutch between the clutch hub and the wheel hub.

2. The clutch of claim **1** further comprising:

a first clutch component coupled to the clutch hub;

a second clutch component coupled to the wheel hub;

the active clutch between the first and second clutch components; and

the passive clutch between the first clutch component and the wheel hub,

wherein the clutch is a dual plane clutch.

3. The clutch of claim **2** wherein

the wheel hub includes a wheel hub cover that is a cup-shaped member having a transversely extending axial wall and a longitudinally extending circumferential wall that is internally splined;

the second clutch component is a race coupled to the longitudinally extending circumferential wall of the wheel hub cover; and

the first clutch component is a race coupled to the clutch hub and is disposed between the second clutch component and the transversely extending axial wall of the wheel hub cover.

4. The clutch of claim **3** wherein:

the second clutch component is splined to the longitudinally extending circumferential wall of the wheel hub cover and includes an active pocket in an active pocket surface;

the transversely extending axial wall of the wheel hub cover includes a passive notch in a passive notch surface; and

the first clutch component is splined to the clutch hub and includes an active notch in an active notch surface facing the active pocket surface of the second clutch component, and a passive pocket in a passive pocket surface facing the passive notch surface of the transversely extending axial wall of the wheel hub cover.

5. The clutch of claim **4** wherein:

the active clutch includes an active strut between the active pocket in the active pocket surface of the second clutch component and the active notch in the active notch surface of the first clutch component; and

the passive clutch includes a passive strut between the passive pocket of the first clutch component and the passive notch in the transversely extending axial wall of the wheel hub cover.

6. (canceled)

7. The clutch of claim **2** wherein:

The passive clutch includes a passive spring and a passive strut, the passive spring moves the passive strut to a deployed position between the first clutch component and wheel hub such that the first clutch component is coupled to the wheel hub in a first direction of rotation and overruns the wheel hub in a second direction of rotation; and

the active clutch includes an active spring, an active strut, and an actuator, the actuator acting on the active spring to move the active strut pivotally to a deployed position between the second clutch component and the first clutch component such that the first clutch component is coupled to the second clutch component in the second direction of rotation.

8. The clutch of claim **7** wherein the actuator includes:

a stator structure;

a translator structure; and

a strut actuator element positioned between the translator structure and the active strut.

9. The clutch of claim **1** further comprising:

a clutch component coupled to the clutch hub;

the active clutch between the clutch component and the wheel hub; and

the passive clutch between the clutch component and the wheel hub.

10. The clutch of claim **9** wherein

the active clutch is an active radial clutch ox an active planar clutch; and

the passive clutch is a passive planar clutch or a passive radial clutch.

11. The clutch of claim **10** wherein

the active clutch includes a radial pocket in a radially outer portion of the clutch component, a radial notch in a radially inner portion the wheel hub, and a radial strut carried in the radial pocket; and

the passive clutch includes an axial pocket in an outboard face of the clutch component, an axial notch in an inboard face of the wheel hub, and a planar strut carried in the axial pocket.

12. The clutch of claim **10** wherein

the active clutch further includes an actuator to radially outwardly displace a strut, wherein the clutch component is disposed axially between the actuator and an inboard face of the wheel hub.

13. The clutch of claim **12** wherein

the actuator is coupled to the wheel hub radially within a longitudinally extending circumferential wall of the wheel hub.

14. (canceled)

15. The clutch of claim **10** wherein

the active clutch includes an active radial pocket in an active radially outer portion of the clutch component, an active radial notch in an active radially inner portion the wheel hub, and an active radial strut carried in the active radial pocket; and

the passive clutch includes a passive axial pocket in a passive radially outer portion of the clutch component circumferentially spaced from the active radially outer portion, a passive axial notch in a passive radially inner portion of the wheel hub circumferentially spaced from the active radially inner portion, and a passive radial strut carried in the passive radial-axial pocket.

16. (canceled)

17. (canceled)

18. (canceled)

19. The clutch of claim **10** wherein

the clutch is a single plane clutch;

the active clutch includes an active axial pocket in an outboard face of the clutch component, an active axial notch in an inboard face of the wheel hub, and an active axial strut carried in the active axial pocket; and

the passive clutch includes a passive axial pocket in the outboard face of the clutch component, a passive axial notch in the inboard face of the wheel hub, and a passive axial strut carried in the passive axial pocket, wherein the passive axial pocket, the passive axial notch, and the passive axial strut are all circumferentially spaced from the active axial pocket, the active axial notch, and the active axial strut.

20. (canceled)

21. (canceled)

22. (canceled)

23. The clutch of claim **10** wherein

the passive clutch includes a radial pocket in a radially outer portion of the clutch component, a radial notch in a radially inner portion the wheel hub, and a radial strut carried in the radial pocket; and

the active clutch includes an axial pocket in an outboard face of the clutch component, an axial notch in an inboard face of the wheel hub, and a planar strut carried in the axial pocket.

24. (canceled)

25. (canceled)

26. An apparatus, comprising:

an axle;

a wheel hub; and

an active and passive overrunning wheel hub clutch disposed between the axle and the wheel hub.

27. The apparatus of claim **26**, wherein the active and passive overrunning wheel hub clutch includes:

a clutch hub;

a wheel hub;

an active clutch between the clutch hub and the wheel hub; and

a passive clutch between the clutch hub and the wheel hub.

28. A vehicle, comprising:

the apparatus of claim **26**;

a drivetrain coupled to the axle; and

a wheel coupled to the wheel hub.

29. A wheel end, comprising:

a wheel hub cover, and

an active and passive overrunning wheel hub clutch coupled to the wheel hub cover.

30. The wheel end of claim **29**, wherein the active and passive overrunning wheel hub clutch is retained to the wheel hub cover by at least one retainer ring such that the wheel hub cover and the active and passive overrunning wheel hub clutch constitute a self-contained assembly.

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