US009371624B2

(12) **United States Patent**
Suver et al.

(10) **Patent No.: US 9,371,624 B2**
(45) **Date of Patent: Jun. 21, 2016**

(54) **ACCESSORY CONNECTION SYSTEMS AND METHODS FOR USE WITH HELICAL PILEDRIVING SYSTEMS**

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(73) Assignee: **American Piledriving Equipment, Inc.**, Kent, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 66 days.

(21) Appl. No.: **14/321,632**

(22) Filed: **Jul. 1, 2014**

(65) **Prior Publication Data**

US 2015/0016893 A1 Jan. 15, 2015

Related U.S. Application Data

(60) Provisional application No. 61/843,294, filed on Jul. 5, 2013.

(51) **Int. Cl.**
E02D 7/22 (2006.01)
E02D 5/56 (2006.01)

(52) **U.S. Cl.**
CPC ***E02D 7/22*** (2013.01)

(58) **Field of Classification Search**
CPC E02D 7/22; E02D 5/56; E02D 5/22; E21B 10/44; E21B 17/22
See application file for complete search history.

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(57) **ABSTRACT**

An accessory mounting system a swivel assembly has a swivel member defining first and second swivel member connector portions, a swivel housing, and first and second bearings operatively arranged between the swivel member and the swivel housing. The accessory mounting system operatively connects a helical pile driving system having a rotational drive system and at least one clamp system to an accessory. The first swivel member connector portion is adapted to operatively connect the swivel member to the drive system. The second swivel member connector portion is adapted to operatively connect the swivel member to the accessory. The swivel housing is adapted to engage the at least one clamp system such that the clamp system may be operated to fix a position of the swivel housing relative to the drive system. The first and second bearings are configured to allow rotation of the swivel member relative to the swivel housing.

18 Claims, 15 Drawing Sheets

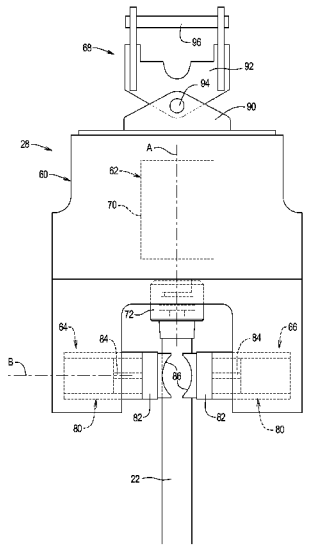

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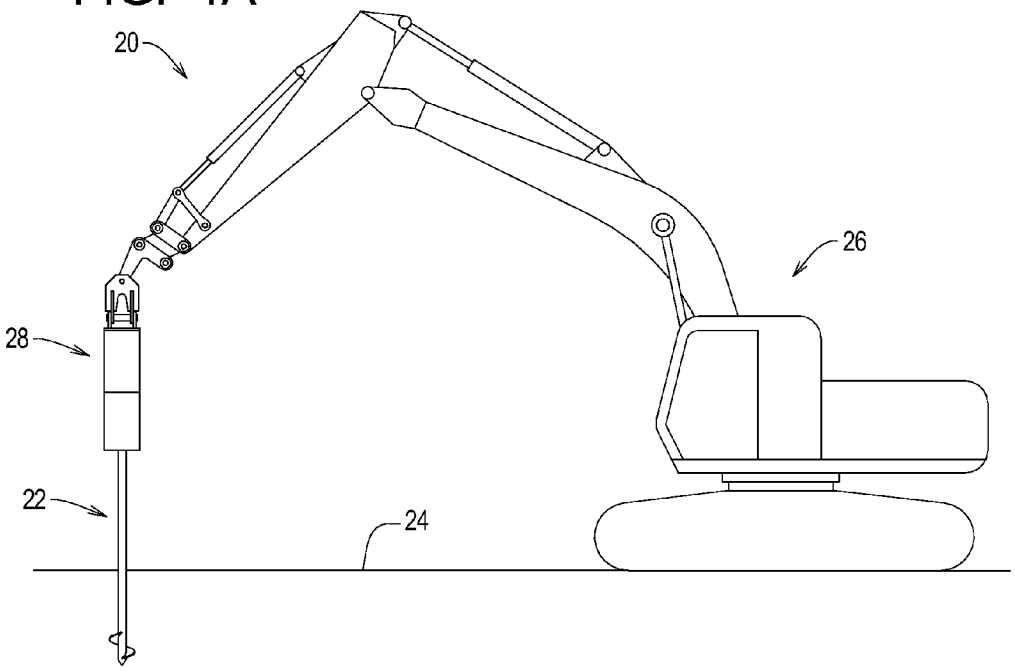
FIG. 1A



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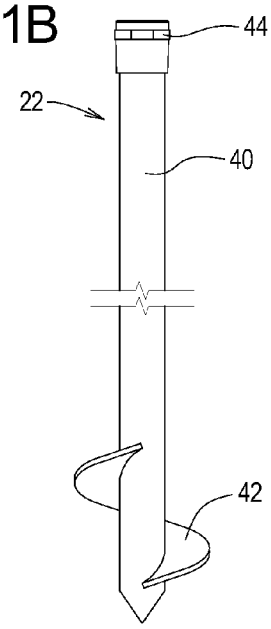
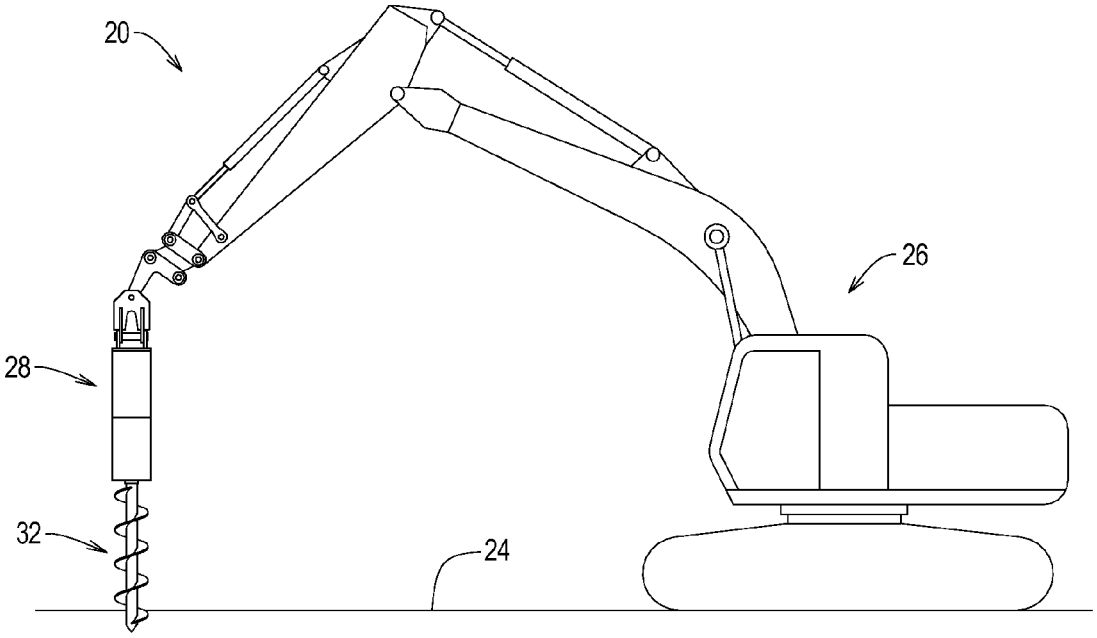


FIG. 2A



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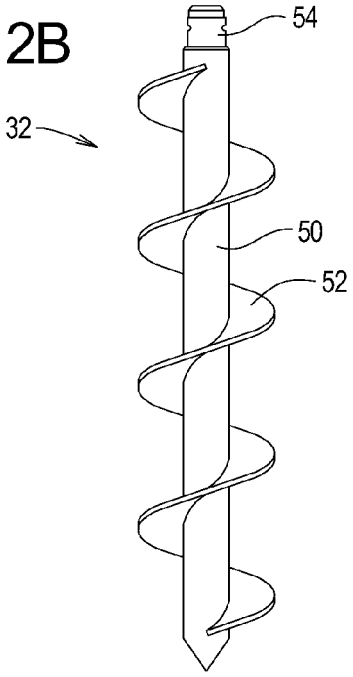

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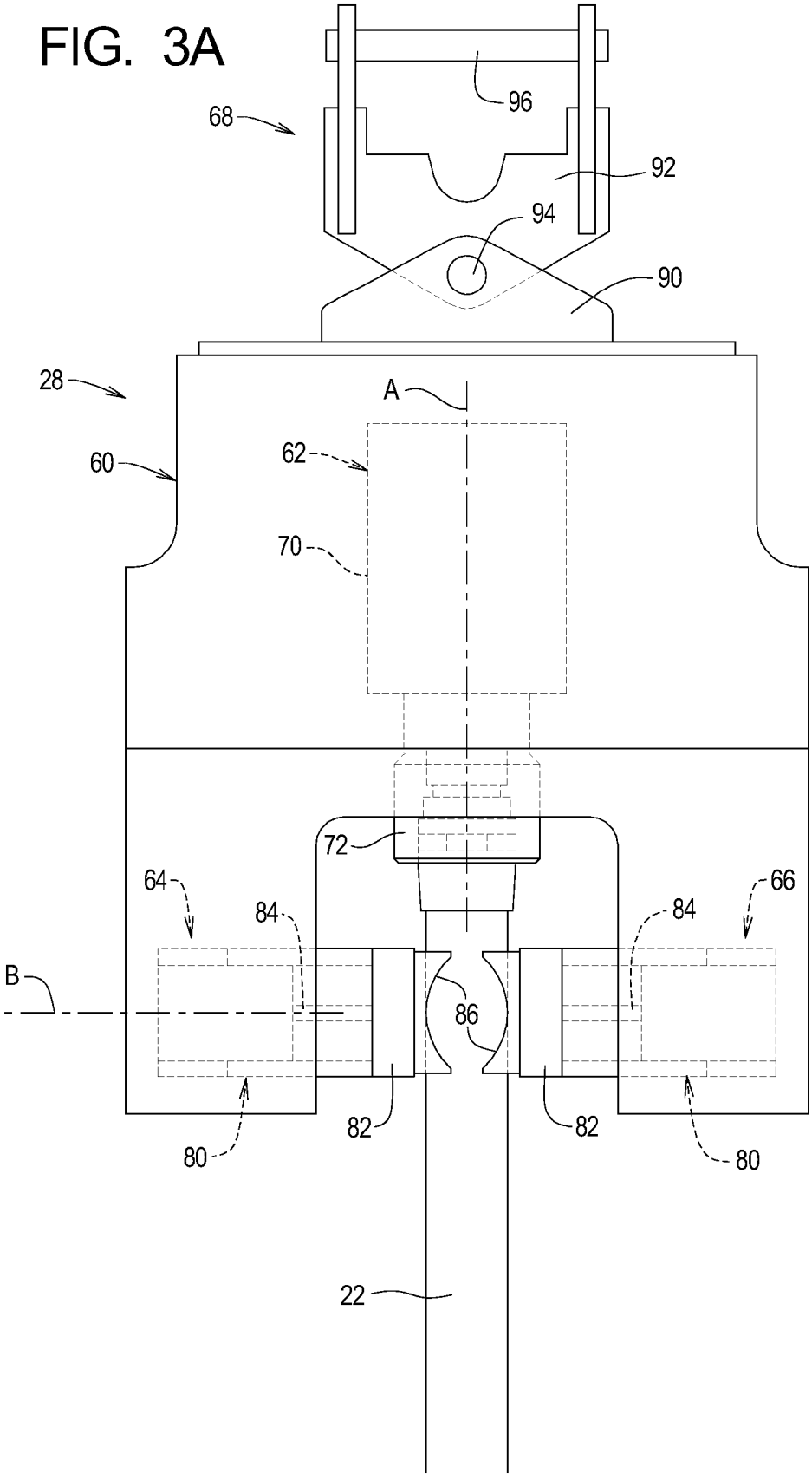

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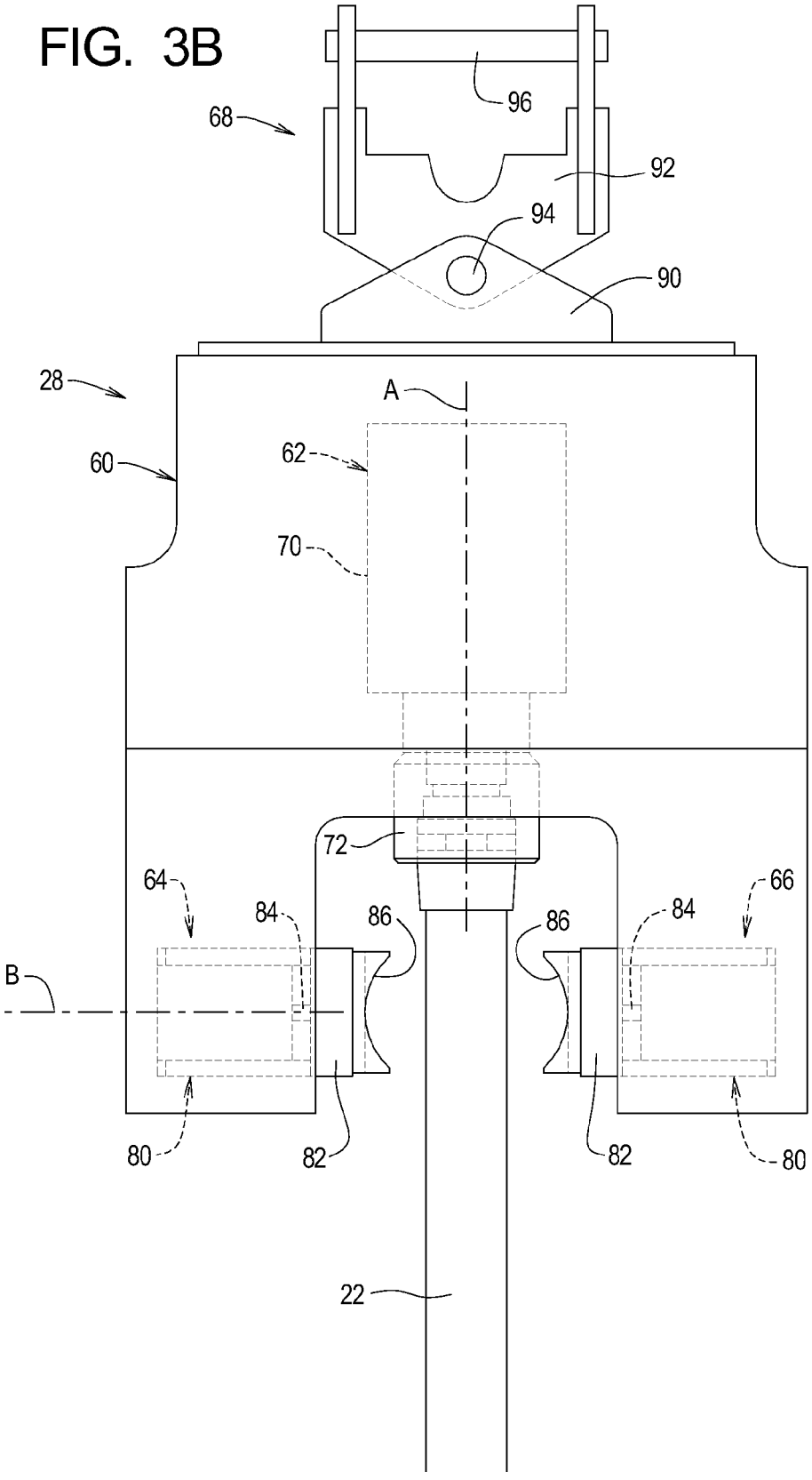
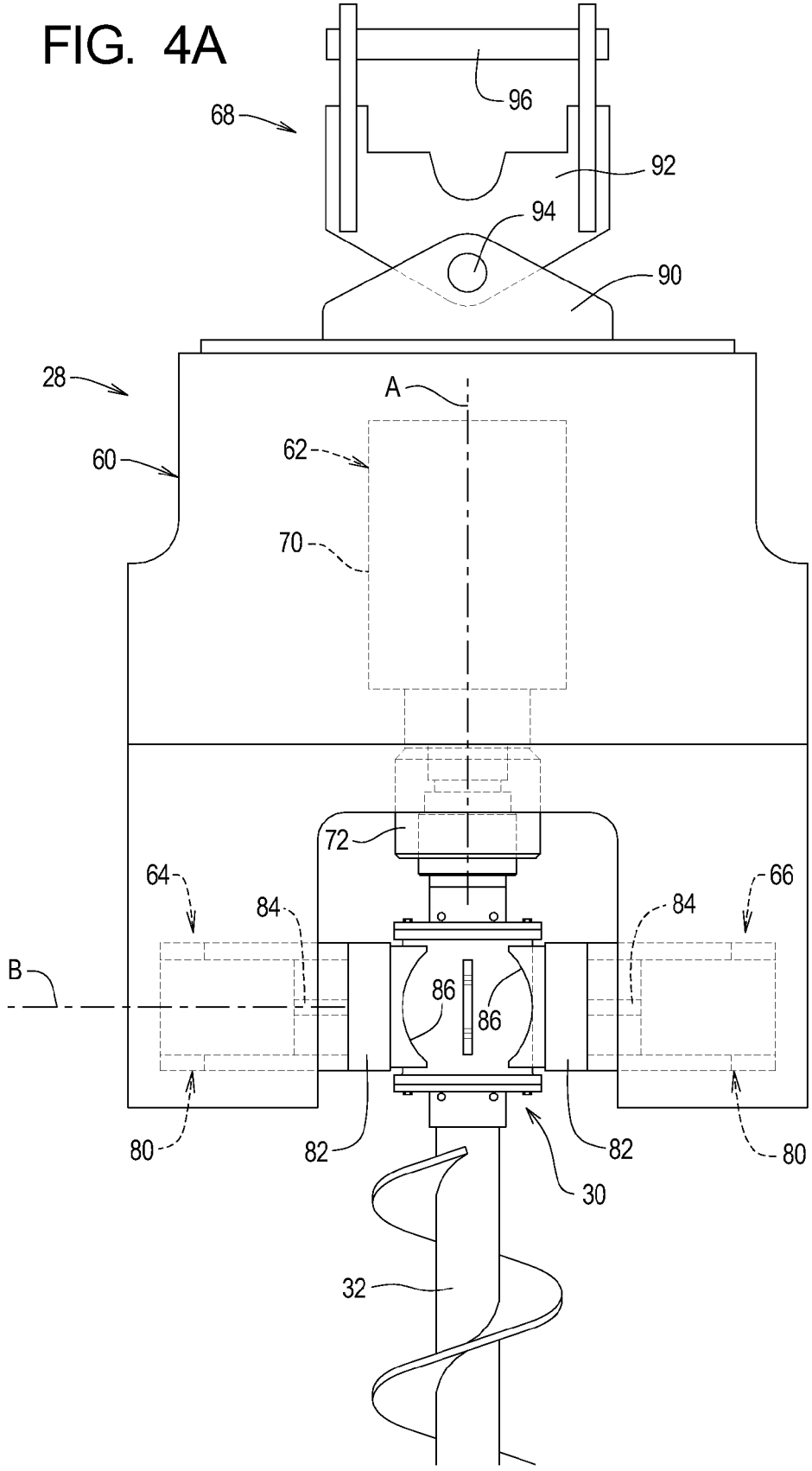


FIG. 4A



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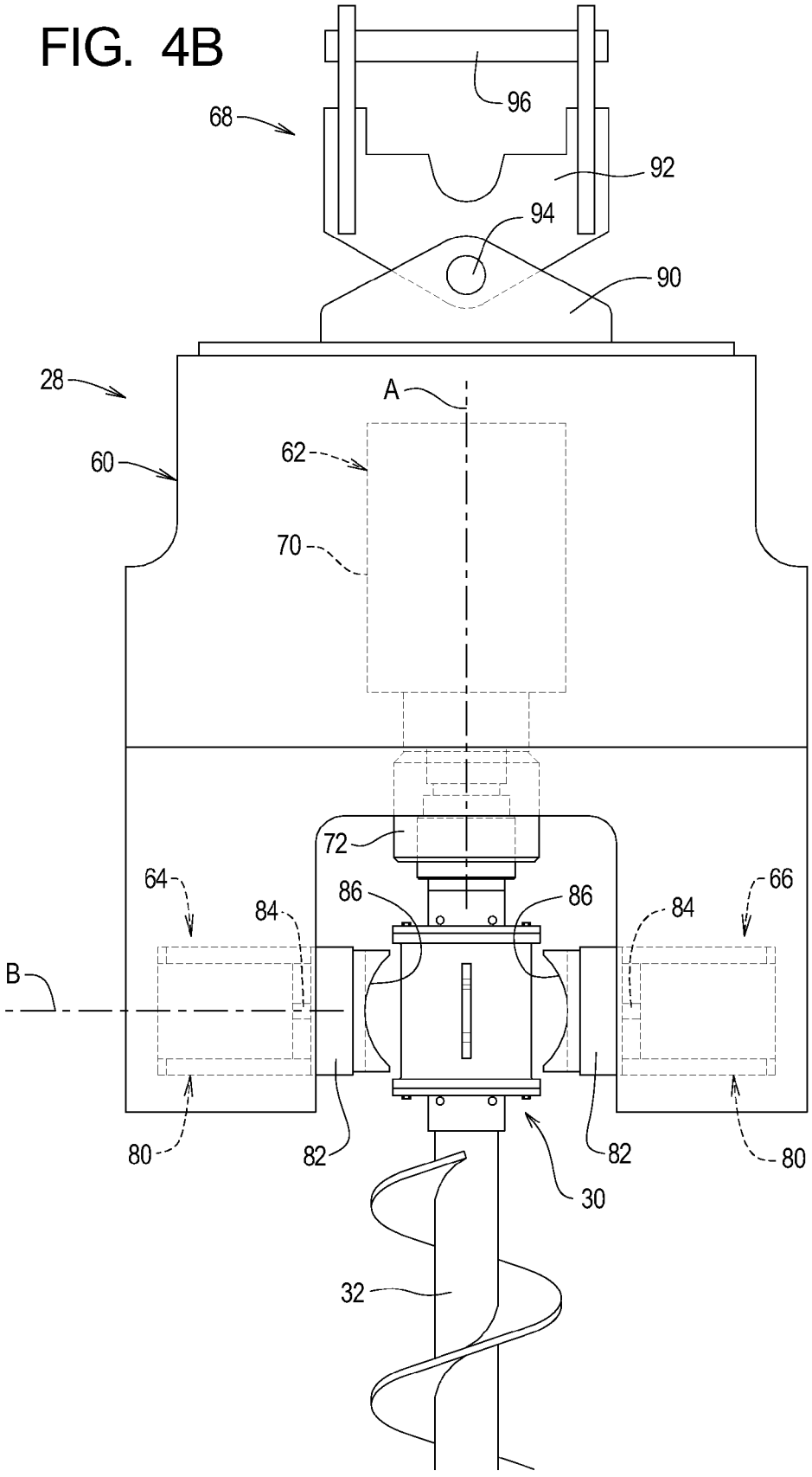

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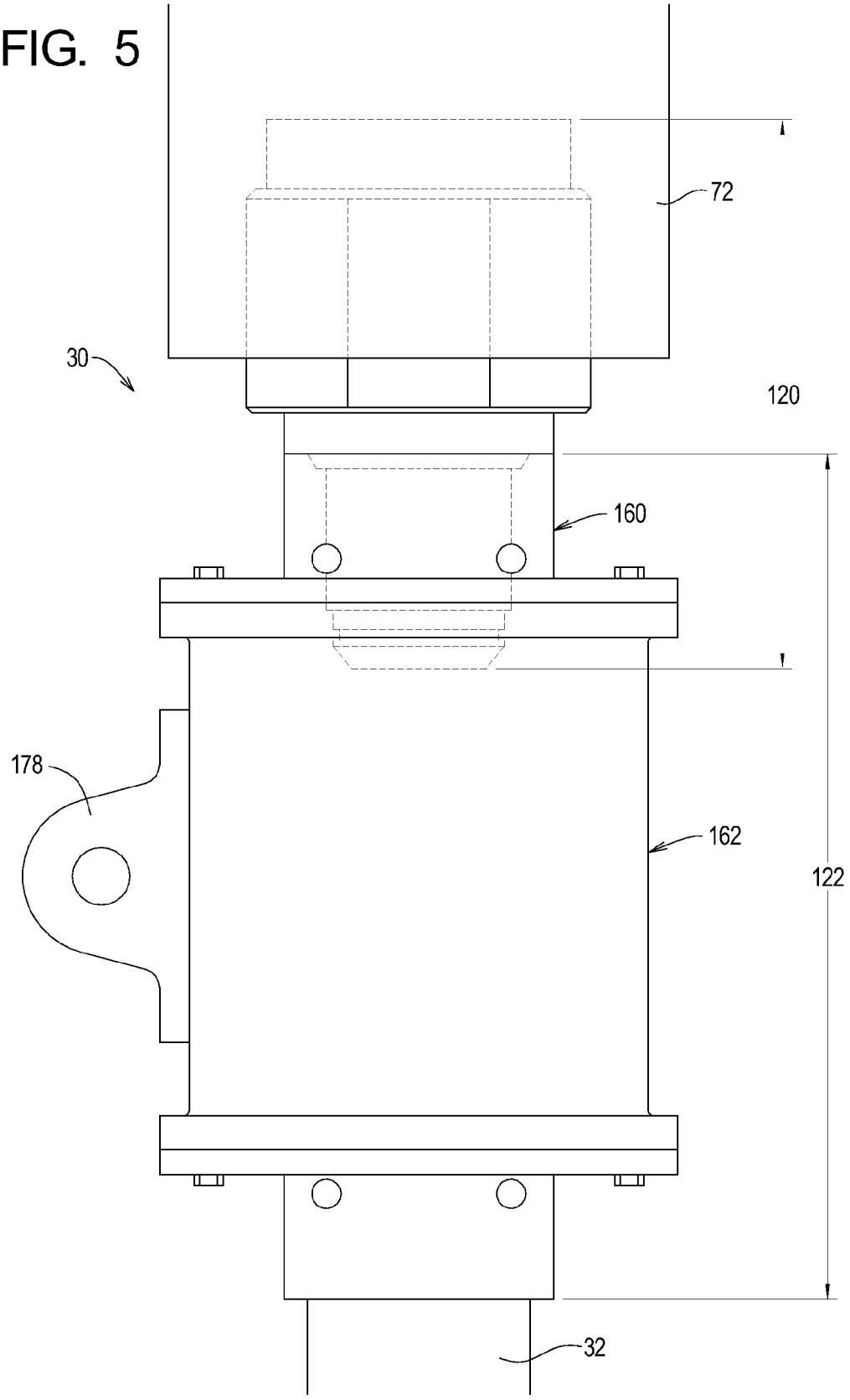

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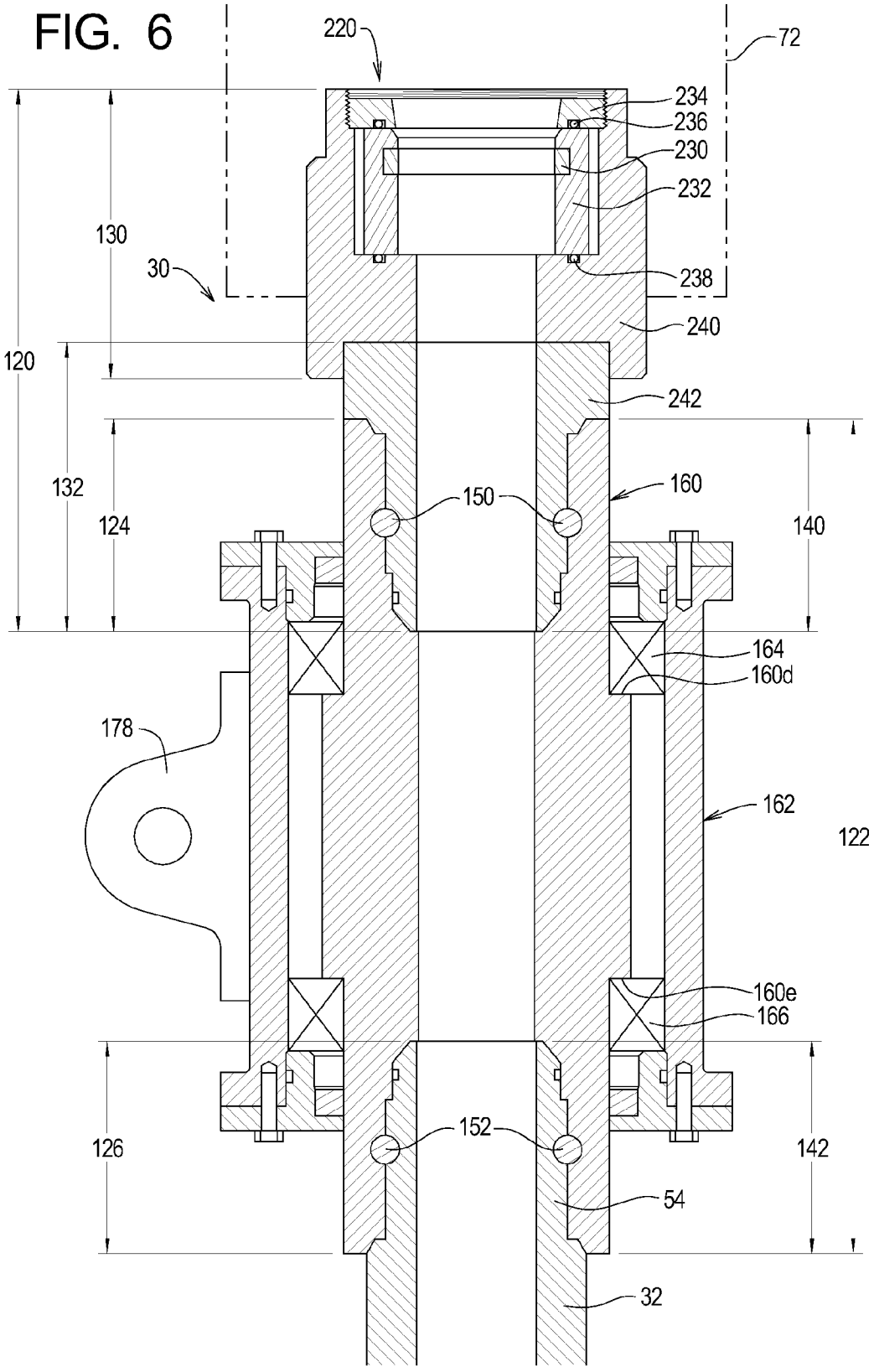
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FIG. 7

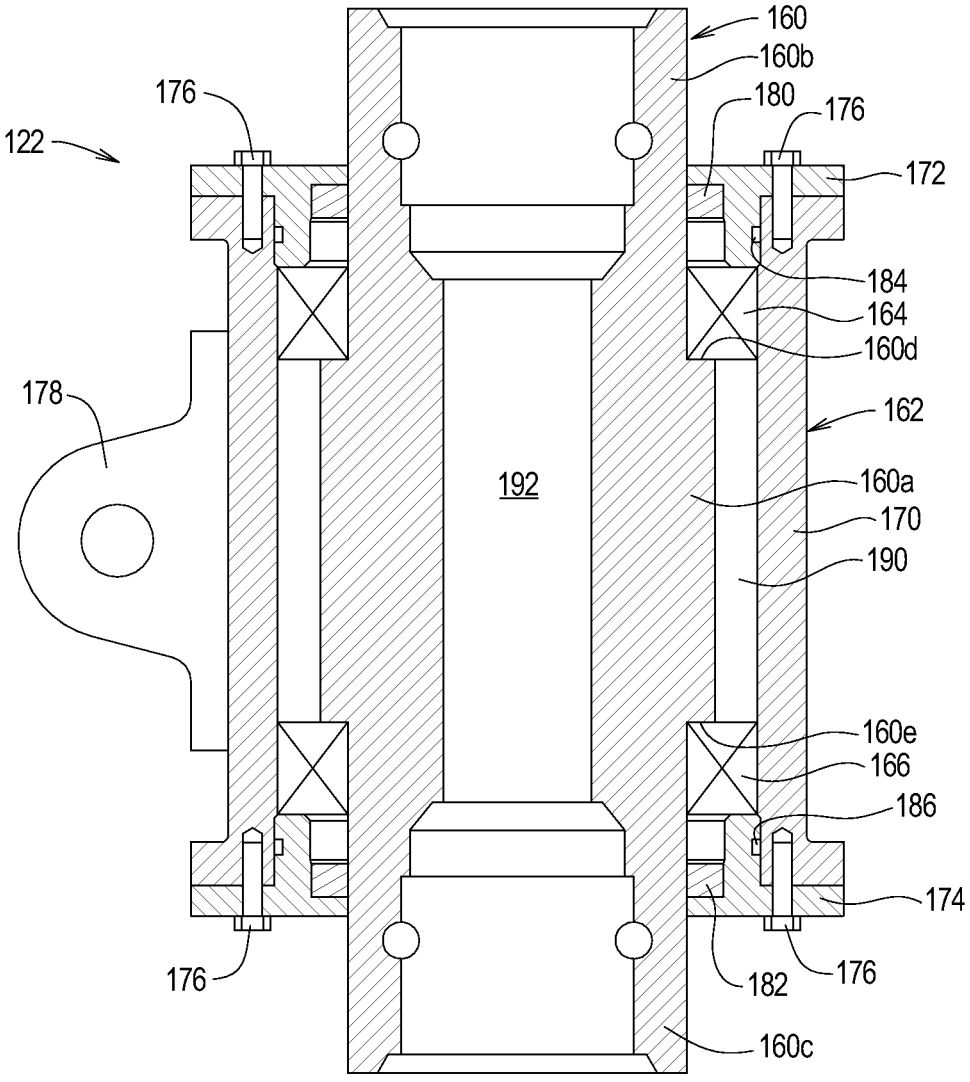
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FIG. 8

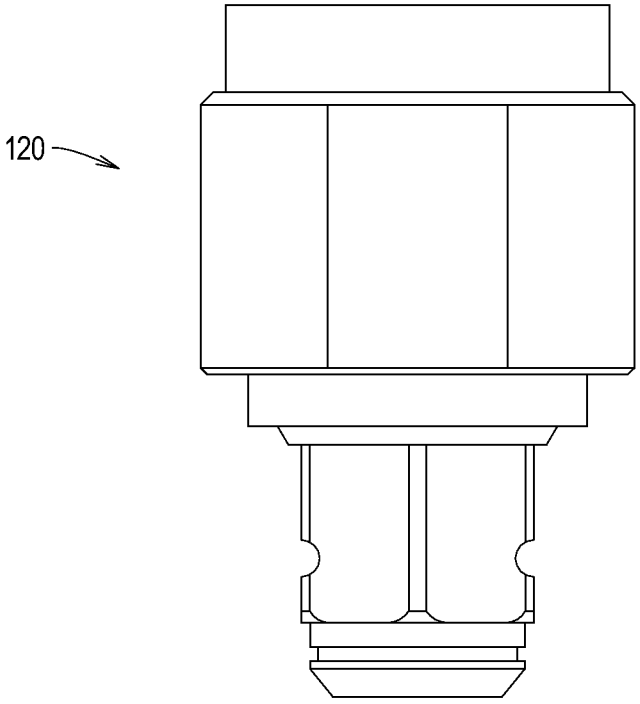

FIG. 9

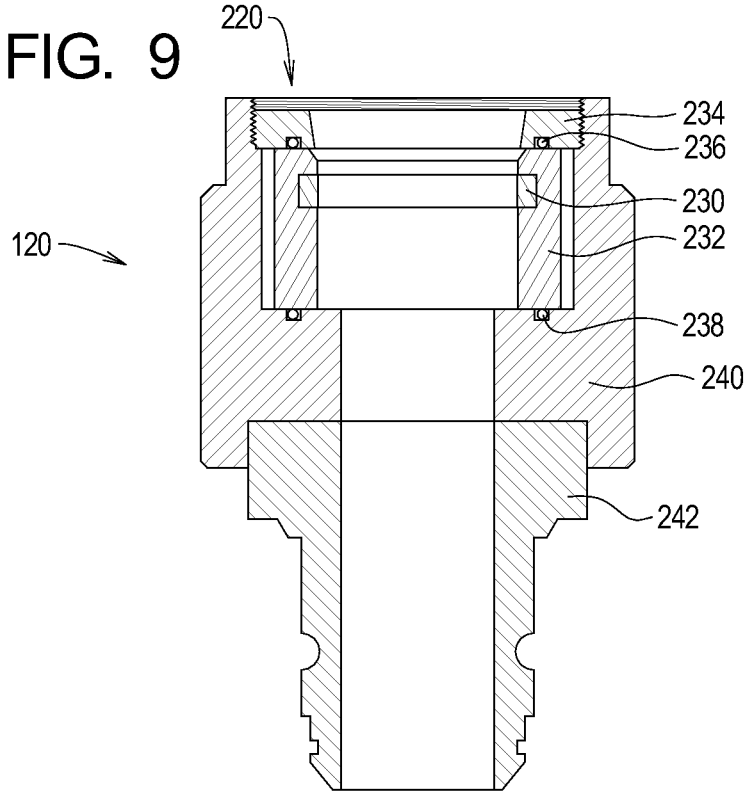

FIG. 10

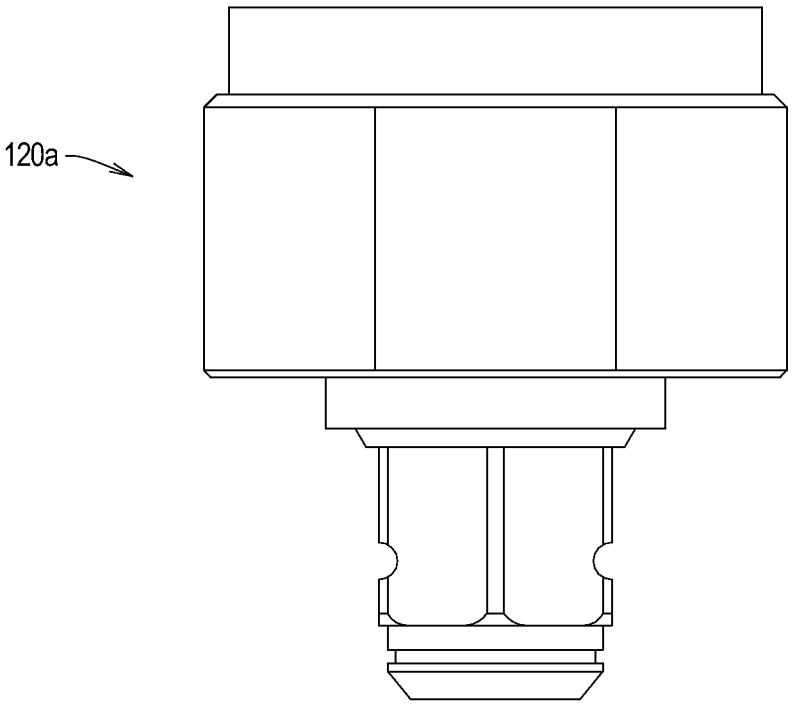

FIG. 11

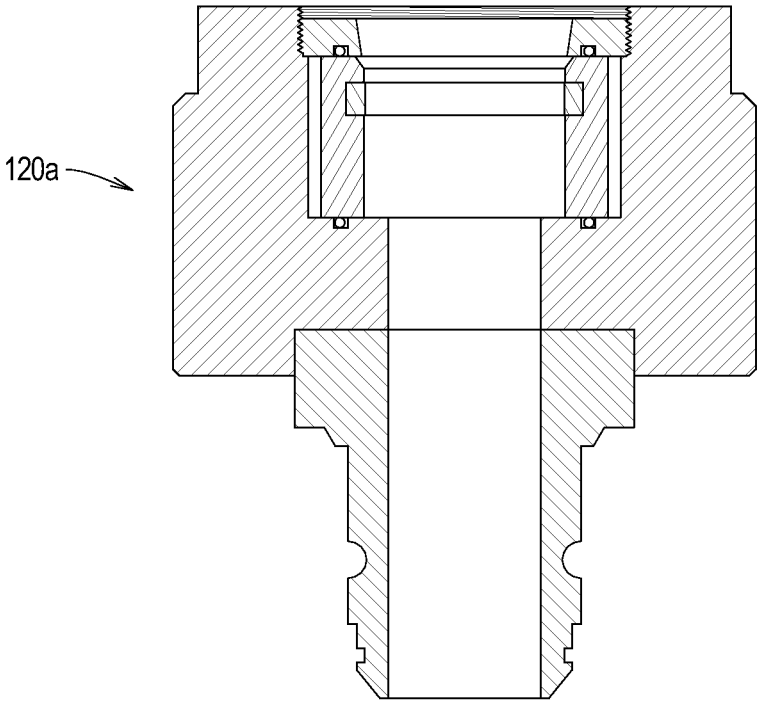

FIG. 12

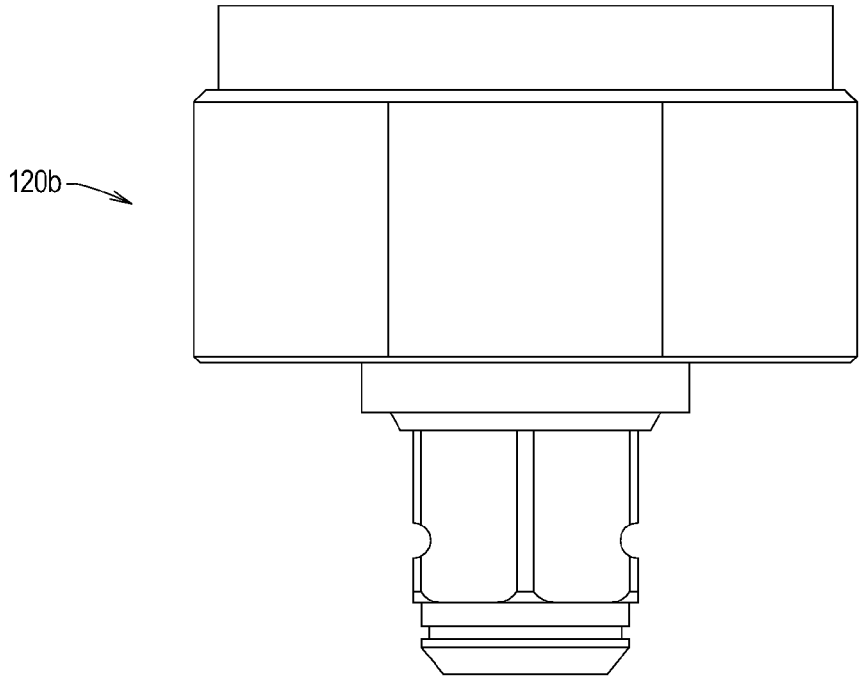

FIG. 13

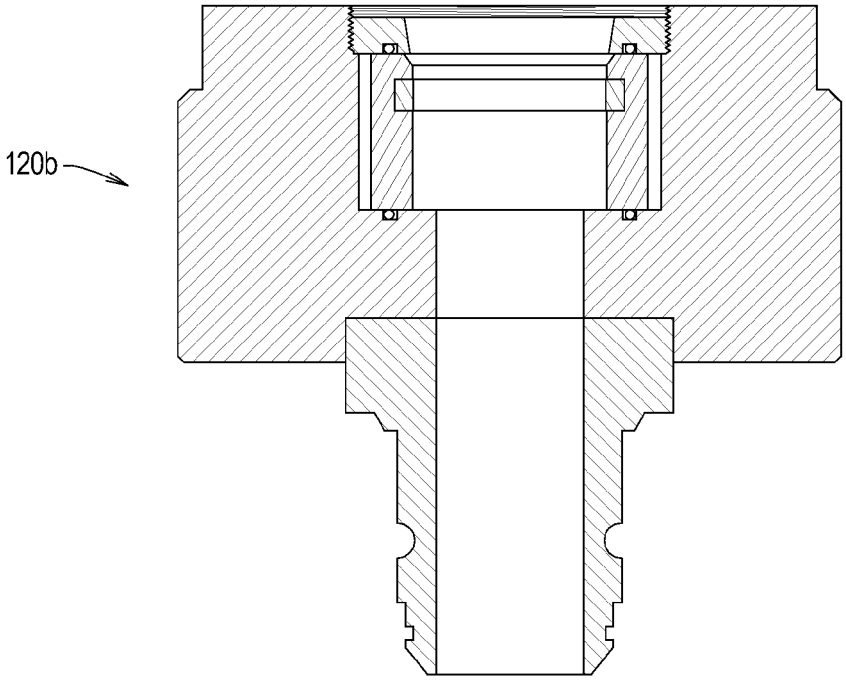

FIG. 14

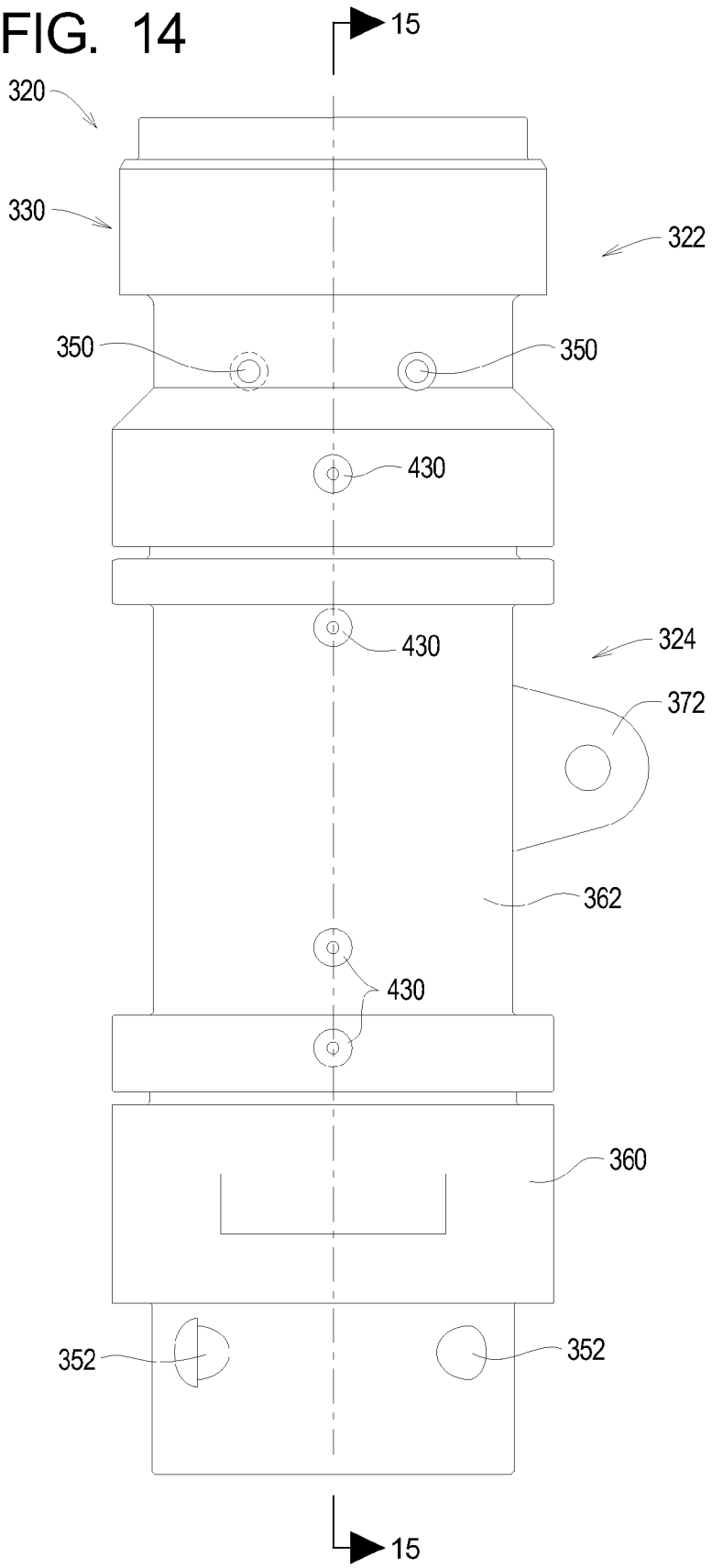

FIG. 15

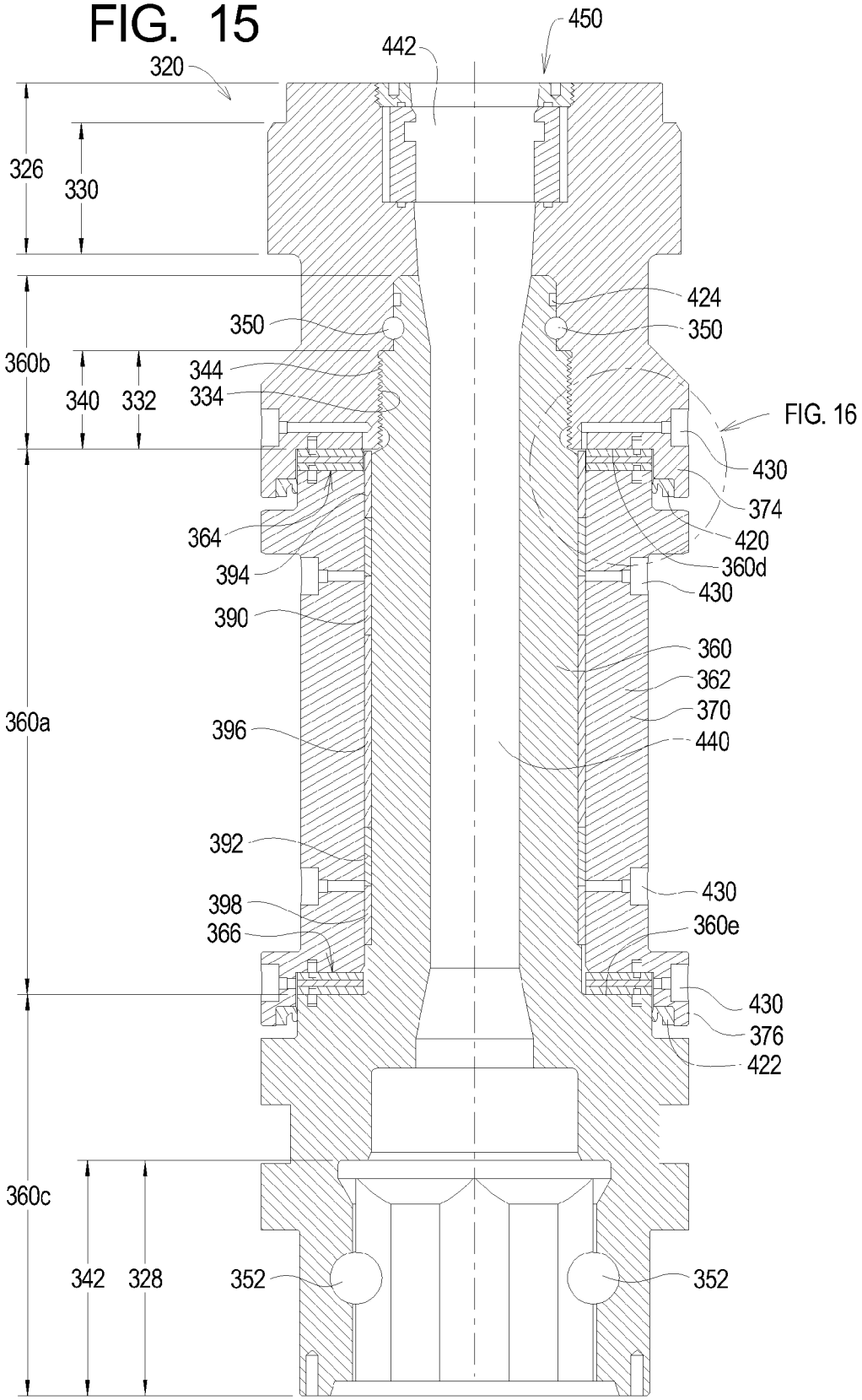
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FIG. 16
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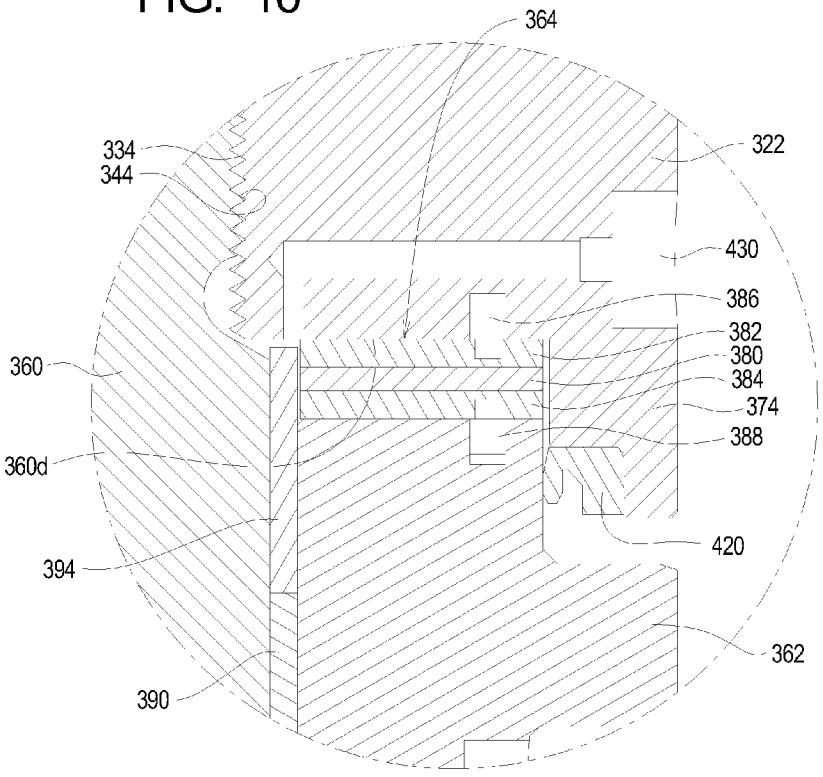
FIG. 16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ACCESSORY CONNECTION SYSTEMS AND METHODS FOR USE WITH HELICAL PILEDRIVING SYSTEMS

RELATED APPLICATIONS

This application, U.S. patent application Ser. No. 14/321,632 filed Jul. 2, 2014 claims benefit of U.S. Provisional Application Ser. No. 61/843,294 filed Jul. 5, 2013, the contents of which are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to systems and methods for forming holes in the earth and, more particularly, to systems and methods for forming holes in the earth using a helical pile installation device.

BACKGROUND

Helical piles are elongate members having a helical blade at the lower end. The helical pile is supported upright with the helical blade adjacent to a desired insertion point and rotated such that the helical blade draws the helical pile into the earth at the desired insertion point.

In some situations, the conditions of the earth may prevent easy insertion of the helical pile using a standard helical pile driving system. In this case, another type of earthwork equipment must be procured and used to form a pilot hole or the like. Once the pilot hole has been formed, the standard helical pile driving system may be used to drive the helical pile in a conventional manner. The procurement of another type of earthwork equipment can result in delays on the jobsite.

The need thus exists for improved systems and methods for driving helical piles using standard helical pile driving systems.

SUMMARY

The present invention may be embodied as an accessory mounting system for operatively connecting a helical pile driving system comprising a rotational drive system and at least one clamp system to an accessory. The accessory mounting system comprises a swivel assembly comprising a swivel member defining first and second swivel member connector portions, a swivel housing, and first and second bearings operatively arranged between the swivel member and the swivel housing. The first swivel member connector portion is adapted to operatively connect the swivel member to the drive system. The second swivel member connector portion is adapted to operatively connect the swivel member to the accessory. The swivel housing is adapted to engage the at least one clamp system such that the clamp system may be operated to fix a position of the swivel housing relative to the drive system. The first and second bearings are configured to allow rotation of the swivel member relative to the swivel housing.

The present invention may also be embodied as a method of operatively connecting a helical pile driving system comprising a rotational drive system and at least one clamp system to an accessory. A method of the present invention may comprise the following steps. A swivel member defining first and second swivel member connector portions is provided. A swivel housing is provided. First and second bearings and provided. The first and second bearings are arranged between the swivel member and the swivel housing to allow rotation of the swivel member relative to the swivel housing. The swivel member is operatively connected to the drive system using the first swivel member connector portion. The swivel member is operatively connected to the accessory using the second swivel member connector portion. The clamp system is operated to fix a position of the swivel housing relative to the drive system by engaging the swivel housing with the at least one clamp system.

The present invention may also be embodied as a system for driving a helical pile comprising a rotational drive system adapted to drive the helical pile, at least one clamp system, at least one accessory, and a swivel assembly. The swivel assembly comprises a swivel member defining first and second swivel member connector portions, a swivel housing, and first and second bearings operatively arranged between the swivel member and the swivel housing. The first swivel member connector portion is adapted to operatively connect the swivel member to the drive system. The second swivel member connector portion is adapted to operatively connect the swivel member to the at least one accessory. The swivel housing is adapted to engage the at least one clamp system such that the clamp system may be operated to fix a position of the swivel housing relative to the drive system. The first and second bearings are configured to allow rotation of the swivel member relative to the swivel housing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a side elevation view of an example drive system for helical piles driving an example helical pile;

FIG. **1**B is side elevation view of the example helical pile being driven in FIG. **1**;

FIG. **2**A is a side elevation view of the example helical pile driving system of FIG. **1** using an accessory mounting system of the present invention to use an accessory;

FIG. **2**B is side elevation view of the example accessory being used in FIG. **2**;

FIG. **3**A is a front elevation view of a rotational drive system connected to the helical pile, with the rotational drive system being depicted in a clamped configuration;

FIG. **3**B is a front elevation view of a rotational drive system connected to the helical pile, with the rotational drive system being depicted in an unclamped configuration;

FIG. **4**A is a front elevation view of an example accessory connection system connected between the rotational drive system and a drive accessory, with the rotational drive system being depicted in the clamped configuration;

FIG. **4**B is a front elevation view of the example accessory connection system connected between the rotational drive system and the drive accessory, with the rotational drive system being depicted in the unclamped configuration;

FIG. **5** is an elevation view illustrating the example accessory connection system;

FIG. **6** is a section, elevation view the example accessory connection system;

FIG. **7** is a section, elevation view of a swivel assembly of the example accessory connection system;

FIG. **8** is an elevation view of a first example adapter assembly of the example accessory connection system;

FIG. **9** is a section, elevation view of the first example adapter assembly;

FIG. **10** is an elevation view of a second example adapter assembly of the example accessory connection system;

FIG. **11** is a section, elevation view of the second example adapter assembly;

FIG. **12** is an elevation view of a third example adapter assembly of the example accessory connection system; and

FIG. **13** is a section, elevation view of the third example adapter assembly.

FIG. **14** is a side elevation view of a second accessory mounting system of the present invention;

FIG. **15** is section view taken along lines **15-15** in FIG. **14**; and

FIG. **16** is an enlarged view of a portion of FIG. **15**.

DETAILED DESCRIPTION

FIGS. **1**A, **3**A, and **3**B depict an example helical pile driving system **20** for driving helical piles **22** into the earth **24**. The helical pile driving system **20** comprises a support system **26** and a rotational drive system **28** connected to the support system **26**. The example support system **26** is or may be formed by a conventional excavator. The example rotational drive system **28** is or may be the HD70 Helical Pile Driver sold by American Piledriving Equipment, Inc., but the principles of the present invention may be applied to other rotational drive systems. The support system **26** and rotational drive system **28** are thus both known in the art and will not be described in detail herein beyond that extent necessary for a complete understanding of the present invention.

FIGS. **4**A, **4**B, **5**, and **6** illustrate an example accessory mounting system **30** and an accessory **32** that may be used with the helical pile driving system **20** to facilitate driving of the helical piles **22** under certain conditions. The accessory **32** may be a device such as an auger, a drill, a downhole hammer, or the like. The example accessory mounting system **30** allows the accessory **32** to be quickly and easily connected to and disconnected from the rotational drive system **28** as will be described in further detail below.

As shown in FIG. **1**B, the example helical pile **22** comprises a shaft **40**, a blade **42**, and a drive projection **44**. The blade **42** and drive projection **44** are rigidly connected to the shaft **40** such that a rotational force applied to the drive projection **44** is transmitted through the shaft **40** to the blade **42**.

In use as shown in FIGS. **1**A and **3**A, the rotational drive system **28** is detachably attached to the helical pile **22**. The support system **26** then supports the rotational drive system **28** such that the helical pile **22** is held in contact with the earth **24**. The rotational drive system **28** is then operated such that a rotational force causes axial rotation of the shaft **40** and thus the blade **42**. With the blade **42** in contact with the earth **24**, the blade **42** will engage the earth such that the shaft **40** is displaced along its axis into the earth **24**. However, under some conditions, it may be difficult or impossible for the blade **42** alone to penetrate the earth **24** and thereby drive the helical pile **22** into the earth **24**. In these conditions, it may be desirable to form a pilot hole for the helical pile **22** using the accessory **32**.

As depicted in FIG. **2**B, the example accessory **32** is an auger and comprises an auger shaft **50**, an auger blade **52**, and an auger male connector **54**. The use of the example accessory **32** in the form of an auger to form a pilot hole will be described herein. However, the example accessory mounting system **30** may be configured to allow other types of accessories, such as drills and downhole hammers, and be used for purposes other than rotating a helical pile, including forming a pilot hole in the earth **24** for a helical pile. Accordingly, whenever formation of a hole in the earth is required, the example accessory mounting system **30** allows such holes to be driven with a helical pile driving device such as the example rotational drive system **28**, even outside of the context of driving a helical pile.

Turning now to FIGS. **3**A, **3**B, **4**A, and **4**B, it can be seen that the example rotational drive system **28** comprises a housing **60**, a drive system **62** defining a drive axis A, and first and second clamp systems **64** and **66** defining a clamp axis B. A hitch assembly **68** is formed on the housing **60**. The example drive **62** comprises a drive motor **70** and a drive socket **72**. The first and second clamp systems **64** and **66** each comprise an actuator **80**, a piston member **82**, and an actuator shaft **84**. A gripping surface **86** is formed on the piston member **82**. The hitch assembly **68** comprises a hitch plate **90** rigidly connected to the housing **60**, a hitch member **92**, and first and second hitch pins **94** and **96**. The hitch plate **90** is rigidly connected to the housing **60**, and the first hitch pin **94** rotatably attaches the hitch member **92** to the hitch plate **90**. The second hitch pin **96** rotatably attaches the hitch member **92** to the support system **26**.

During use of the rotational drive system **28**, operation of the drive motor **70** causes axial rotation of the drive socket **72** relative to the housing **60**. Operation of the actuators **80** causes the piston members **82** to move relative to the housing **60** towards and away from the drive axis A along the piston axis B.

When used to drive the helical piles **22**, the rotational drive system **28** is arranged such that the drive projection **44** on a selected pile **22** is adjacent to the drive socket **72**. The clamp systems **64** and **66** are then operated to grip the pile **22**. The support system **26** may then be operated to lift at least a first or upper end of the pile **22** and move the pile **22** such that a second or lower end of the pile **22** is held at a desired location relative to the earth **24**. The piston members **82** axially rotate about the clamp axis B to allow the pile **22** to rotate into a desired angle relative to horizontal as the pile **22** is lifted. At this point, the drive axis A is substantially aligned with the longitudinal axis of the pile **22**. The clamp systems **64** and **66** are then operated in the unclamped configurations to allow the drive projection **44** to enter the drive socket **72**. The example drive projection **44** and the example drive socket **72** have conforming octagonal shapes such that rotational movement of the drive socket **72** is transferred to the drive projection **44**. At this point, the drive motor **70** is operated such that the pile blade **42** engages the earth **24** to drive the pile **22** into the earth **24**.

Turning now to FIGS. **4**A, **4**B, and **5-9**, the example accessory mounting system **30** will be described. The example accessory mounting system **30** comprises an adapter assembly **120** as shown in FIGS. **4**A, **4**B, **5**, **6**, **8** and **9** and a swivel assembly **122** as shown in FIGS. **5**, **6**, and **7**. As perhaps best shown in FIG. **6**, a first connection system **124** connects the adapter assembly **120** to the swivel assembly **122**, and a second connection system **126** connects the swivel assembly **122** to the accessory **32**. The first and second connection systems **124** and **126** are or may be industry standard 120 mm Jeffrey couplers or connectors.

In particular, the adapter assembly **120** comprises a drive portion **130** and an adapter male connector **132**. The swivel assembly **122** comprises a first female connector **140** and a second female connector **142**. The first female connector **140** receives the adapter male connector **132**, and adapter connector pins **150** join the adapter assembly **120** to the swivel assembly **122**. The second female connector **142** receives the auger male connector **54**, and accessory connector pins **152** join the accessory **32** to the swivel assembly **122**.

As perhaps best shown in FIG. **7**, the swivel assembly **122** comprises a swivel member **160**, a swivel housing assembly **162**, and first and second bearings **164** and **166**. The swivel member **160** comprises a middle portion **160***a* and first and second end portions **160***b* and **160***c*. Bearing surfaces **160***d* and **160***e* are formed at the junctures of the middle portion **160***a* and the first end portion **160***b* and of the middle portion **160***a* and the second end portion **160***c*, respectively. The

swivel housing assembly **162** comprises a housing member **170**, a first housing cap **172**, and a second housing cap **174**. Bolts **176** secure the first and second caps **172** and **174** to the housing member **170** to form the swivel housing assembly **162**. A swivel tab **178** is rigidly connected to the swivel housing member **170** to facilitate handling of the accessory mounting system **30**.

When the swivel assembly **122** is formed, the swivel member **160** is arranged within the swivel housing assembly **162** such that the first bearing **164** is held between the first cap **172** and the first bearing surface **160***d* and the second bearing **166** is held between the second cap and the second bearing surface **160***e*. The bearings **164** and **166** thus allow axial rotation of the swivel member **160** relative to the swivel housing assembly **162**.

In addition, the example swivel assembly **122** comprises first and second end seals **180** and **182** and first and second side seals **184** and **186**. The first and second end seals **180** and **182** are arranged to form seals between the end caps **172** and **174** and the swivel member **160**, respectively. The first and second side seals **184** and **186** are arranged to form seals between the first and second end caps **172** and **174** and the swivel member **160**, respectively.

In the example swivel assembly **122**, an annular swivel chamber **190** is formed within the swivel housing assembly **162** around the swivel member **160**. The swivel chamber **190** may be filed with lubricant such as oil to lubricate the bearings **164** and **166**. The swivel member **160** may further define an inner chamber **192** extending between the first and second female connectors **140** and **142**. The inner chamber **192** reduces weight of the accessory mounting system **30** and allows fluid to flow through the accessory mounting system **30** as will be described in further detail below.

When required, the accessory mounting system **30** may be used to attach the accessory **32** to the rotational drive system **28** as shown in FIGS. **4**A, **4**B, **5**, and **6**. With the accessory **32** joined to the accessory mounting system **30** using the first connection system **124**, the rotational drive system **28** is arranged such that the drive portion of the adapter assembly **120** is adjacent to the drive socket **72** of the drive system **62**. The clamp systems **64** and **66** are then operated to engage the housing member **170** and thus grip the accessory mounting system **30**. The support system **26** may then be operated to lift at least a first or upper end of the accessory mounting system **30** and accessory **32** attached thereto and move the accessory mounting system **30** and accessory **32** such that a second or lower end of the accessory **32** is held at a desired location relative to the earth **24**. The piston members **82** axially rotate about the clamp axis B to allow the accessory **32** to rotate into a desired angle relative to horizontal as the accessory **32** is lifted. At this point, the drive axis A is substantially aligned with the longitudinal axis of the accessory **32**.

The clamp systems **64** and **66** are then operated in the unclamped configurations to allow the drive portion **130** to enter the drive socket **72**. The example drive portion **130** and the example drive socket **72** have conforming octagonal shapes such that rotational movement of the drive socket **72** is transferred to the drive portion **130**. At this point, the clamp systems **64** and **66** are operated to prevent relative movement of the accessory mounting system **30** relative to the housing **60** and stabilize the accessory **32** relative to the housing **60**. The drive motor **70** may then be operated such that auger blade **52** of the example accessory **32** drills a pilot hole for a helical pile **22**. As generally described above, other accessories may be rotated using the accessory mounting system **30** in a similar manner.

After one or more pilot holes are drilled, the accessory mounting system **30** and accessory **32** may be quickly and easily detached from the rotational drive system **28**, and helical piles **22** may be lifted and driven with the assistance of the previously driven pilot hole or holes.

As mentioned above, the inner chamber **192** allows fluid to flow between the first and second female connectors. The American Piledriving Equipment HD70 rotational drive system allows the helical pile **22** to be filled with grout as the pile **22** is being driven as described herein. Other fluids such as water, drilling fluids, and/or air may be pumped through the inner chamber **192** and the accessory **32** to facilitate operation of the accessory **32**. In this case, a seal assembly **220** may be formed within the drive portion **130** of the adapter assembly **120** as shown in FIGS. **6** and **9**. The example seal assembly **220** comprises a seal member **230**, a seal ring **232**, a retaining ring **234**, a first gasket **236**, and a second gasket **238**. This seal assembly **220** cooperates with the drive socket **72** of the rotational drive system **28** to allow pressurized fluid to flow through the inner chamber **192**.

FIGS. **6** and **9** further show that the example adapter assembly **120** is formed by a first member **240** and a second member **242**. These example first and second members **240** and **242** are welded together, but any configuration that forms a rigid structure that is fluid tight and rigidly transfers rotational forces applied to the first member **240** to the second member **242** may be used.

As described above, the drive socket **72** has an octagonal shape to transfer rotational movement generated by the drive motor **72** to the drive projection **44** of the pile **22** in one configuration and to the drive portion **130** of the adapter assembly **120** in another configuration. However, the dimensions of the drive socket **72** will vary depending upon such factors as the specifications of helical piles being driven for a particular job.

FIGS. **8** and **9** depict an adapter assembly **120** configured to mate with the first example drive socket **72**. FIGS. **10** and **11** depict a second adapter assembly **120***a* configured to mate with a second example drive socket that is the same shape as the first example drive socket **72** but is larger in cross-sectional area. FIGS. **12** and **13** depict a third example adapter assembly **120***b* configured to mate with a third example drive socket that is the same shape as the first and example drive sockets but is larger in cross-sectional area than the second example drive socket. The use of multiple adapter assemblies **120**, **120***a*, and **120***b* thus allow the accessory mounting system **30** to be easily and quickly modified or adapted to use accommodate drive sockets of different sizes.

Turning now to FIGS. **14-16**, a second example accessory mounting system **320** will be described. The second example accessory mounting system **320** is used, in a manner similar to that of the first example accessory mounting system **30** described above, to connect the rotational drive system **28** to the helical pile **22**. The second example accessory mounting system **32** is, however, optimized for use with higher capacity rotational drive systems and larger helical piles.

The second example accessory mounting system **320** comprises an adapter assembly **322** and a swivel assembly **324**. A first connection system **326** formed on the adapter assembly **322** connects the accessory mounting system **320** to the drive system **28**, and a second connection system **328** formed on the swivel assembly **324** connects the accessory mounting system **320** to the accessory **32**. The second connection system **328** is or may be an industry standard Jeffrey coupler or connector or the like.

The example adapter assembly **322** comprises a drive portion **330** and an adapter female connector **332** defining a

threaded portion **334**. The example swivel assembly **324** comprises a swivel assembly male connector **340** and a swivel assembly female connector **342**. The swivel assembly male connector **340** defines a threaded portion **344** that receives the threaded portion **334** of the adapter female connector **332**, and adapter connector pins **350** secure the adapter assembly **322** to the swivel assembly **324**. The second female connector **342** receives the auger male connector **54**, and accessory connector pins **352** join the accessory **32** to the swivel assembly **324**.

The example swivel assembly **324** comprises a swivel member **360**, a swivel housing **362**, and first and second bearings **364** and **366**. The swivel member **360** comprises a middle portion **360***a* and first and second end portions **360***b* and **360***c*. Bearing surfaces **360***d* and **360***e* are formed at the junctures of the middle portion **360***a* and the first end portion **360***b* and of the middle portion **360***a* and the second end portion **360***c*, respectively. The swivel housing **362** comprises a housing member **370**. A swivel tab **372** (FIG. **14**) is rigidly connected to the swivel housing member **370** to facilitate handling of the accessory mounting system **30**.

When the swivel assembly **324** is formed, the swivel member **360** is arranged within the swivel housing **362** such that part of the first bearing system **364** is held between the first cap **374** and part of the first bearing surface **360***d* and the second bearing system **366** is held between the second cap **376** and the second bearing surface **360***e*. In particular, the threaded surfaces **334** and **344** engage each other to pull the swivel member **360** towards the adapter assembly **322** such that the swivel member **360** clamps the bearing systems **364** and **366** on either end of the swivel housing **362** as shown in FIG. **15**

In particular, as perhaps best shown in FIG. **16**, each of the example bearing systems **364** and **366** comprises a thrust bearing **380** arranged between first and second thrust washers **382** and **384**. The example thrust bearing **380** is made of aluminum bronze, and the thrust washers **382** and **384** are made of stainless steel. The thrust washers **382** and **384** are pinned to the adapter assembly **322** and the swivel housing **362** by first and second pins **386** and **388**, respectively. And as perhaps best shown in FIG. **15**, first and second radial bearings **390** and **392** isolate the swivel member **360** from the swivel housing **362** to address radial loads. First, second, and third spacers **394**, **396**, and **398** maintain the radial bearings **390** and **392** at desired locations along the longitudinal axis of the swivel member **360** during operation of the accessory mounting system **320**. The bearing systems **364** and **366** thus allow axial rotation of the swivel member **360** relative to the swivel housing **362**.

The second example accessory mounting system **320** further comprises first and second lip seals **420** and **422** and an end seal **424**. The first and second lip seals **420** and **422** are arranged to form seals between the end caps **374** and **376** and the swivel member **360**, respectively. The end seal **424** is arranged to form a seal between the adapter assembly **322** and the swivel member **360**.

In the example swivel assembly **324**, a plurality of lubrication ports **430** are formed in the swivel housing **362**. The lubricating ports **430** allow the application of lubricant such as oil to lubricate the bearing systems **364** and **366**. The swivel member **360** may further define a swivel chamber **440**, while the adapter assembly **322** defines an adapter chamber **442**. The swivel chamber **440** reduces weight of the accessory mounting system **30** and allows fluid to flow from the adapter chamber **442** and through the accessory mounting system **30** as generally described above.

When required, the second accessory mounting system **320** may be used to attach the accessory **32** to the rotational drive system **28** in the same general manner as the first example accessory mounting system **30** described above. The rotational drive system **28** may then be operated to rotate the accessory **32** using the second accessory mounting system **320** to, for example, drill a pilot hole for a helical pile **22**. As generally described above, other accessories may be rotated using accessory mounting system **30** in a similar manner. After one or more pilot holes are drilled, the second example accessory mounting system **320** and the accessory **32** may be quickly and easily detached from the rotational drive system **28**, and helical piles **22** may be lifted and driven with the assistance of the previously driven pilot hole or holes.

As mentioned above, the swivel chamber **440** allows fluid to flow through the second example accessory mounting system **320**. The American Piledriving Equipment HD70 rotational drive system allows the helical pile **22** to be filled with grout as the pile **22** is being driven as described herein. Other fluids, such as water, drilling fluids, and/or air, may be pumped through the swivel chamber **440** and through, into, or around the accessory **32** to facilitate operation of the accessory **32**. In this case, a seal assembly **450** may be formed within the drive portion **330** of the adapter assembly **322** as shown in FIG. **15**. This seal assembly **450** cooperates with the drive socket **72** of the rotational drive system **28** to allow pressurized fluid to flow through the swivel chamber **440**.

What is claimed is:

1. A mounting system for operatively connecting a helical pile driving system comprising a rotational drive system defining a drive connector and at least one clamp system to a helical pile defining a pile connector and to an accessory defining an accessory connector, the accessory mounting system comprising:

a swivel assembly defining a swivel assembly first connector and a swivel assembly second connector, the swivel assembly comprising

a swivel housing,

a swivel member a middle portion, where the swivel member comprising is arranged at least partly within the swivel housing such that

the middle portion and the swivel housing define a swivel chamber,

the swivel assembly first connector extends from an upper end of the middle portion, and

the swivel assembly second connector extends from a lower end of the middle portion,

and

first and second bearings operatively arranged between the swivel member and the swivel housing to support the swivel member for axial rotation relative to the swivel housing; wherein the mounting system operates in

a first mode in which

the swivel assembly first connector engages the drive connector to connect the swivel member to the rotational drive system;

the swivel assembly second connector engages the accessory connector to connect the swivel member to the accessory;

the at least one clamp system engages the swivel housing such that the clamp system secures the swivel housing to the rotational drive system, and

operation of the rotational drive system causes rotation of the accessory; and

a second mode in which

the pile connector engages the drive connector to connect the helical pile to the rotational drive system, and

operation of the rotational drive system causes rotation of the helical pile.

2. A mounting system as recited in claim **1**, in which the swivel housing comprises:

a swivel housing member;

a first housing cap secured to the swivel housing member; and

a second housing cap secured to the swivel housing member.

3. A mounting system as recited in claim **2**, in which:

the swivel housing member defines first and second bearing surfaces;

the first bearing is held against the first bearing surface by the first housing cap; and

the second bearing is held against the second bearing surface by the second housing cap.

4. A mounting system as recited in claim **1**, in which the swivel member defines an inner chamber extending between the swivel assembly first and second connectors to channel fluid flow from the rotational drive system, through the swivel member, and into one of the helical pile and the accessory connected to the swivel assembly.

5. A mounting system as recited in claim **1**, in which

the swivel member defines an inner chamber extending between the swivel assembly first and second connectors to allow fluid flow through the swivel member.

6. A mounting system as recited in claim **1**, further comprising an adapter assembly defining the swivel assembly first connector.

7. A mounting system as recited in claim **6**, in which:

the adapter member defines a first adapter connector; and the swivel member defines a second adapter connector; wherein

the first adapter connector engages the second adapter connector to connect the adapter assembly to the swivel member.

8. A mounting system as recited in claim **1**, in which:

the mounting system comprises a plurality of different rotational drive systems; and

the swivel assembly further comprises a plurality of adapter assemblies, where each adapter assembly is configured to transmit to the swivel member rotational movement of one of the plurality of different rotational drive systems.

9. A mounting system as recited in claim **1**, in which the accessory is selected from a group of accessories consisting of an auger, a drill, and a downhole hammer.

10. A method of operatively connecting a helical pile driving system comprising a rotational drive system and at least one clamp system to a helical pile and to an accessory, the method comprising the steps of:

providing a swivel member defining first and second swivel member connector portions;

providing a swivel housing;

providing first and second bearings;

forming a swivel assembly by arranging the first and second bearings between the swivel member and the swivel housing to allow rotation of the swivel member relative to the swivel housing;

operating in a first mode by

operatively connecting the swivel member to the drive system using the first swivel member connector portion,

operatively connecting the swivel member to the accessory using the second swivel member connector portion,

operating the clamp system to secure the swivel housing to the drive system by engaging the swivel housing with the at least one clamp system, and

operating the rotational drive system to cause rotation of the accessory; and

operating in a second mode by

operatively connecting the helical pile to the rotational drive system, and

operating the rotational drive system to cause rotation of the helical pile.

11. A method as recited in claim **10**, in which the step of forming the swivel assembly further comprises the steps of:

providing an adapter assembly defining an adapter drive connector and an adapter swivel connector;

engaging the adapter swivel connector to the first swivel member connector portion to connect the adapter assembly to the swivel member; and

engaging the adapter drive connection to the rotational drive system to operatively connect the adapter assembly to the rotational drive system.

12. A method as recited in claim **11**, further comprising the steps of:

providing a plurality of different rotational drive systems;

providing a plurality of different adapter assemblies;

selecting one of the plurality of rotational drive systems;

selecting one of the plurality of different adapter assemblies based on the selected rotational drive system;

connecting the selected adapter assembly to the swivel member; and

connecting the selected adapter assembly to the selected rotational drive system.

13. A method as recited in claim **10**, in which the step of forming the swivel assembly further comprises the step of forming a swivel chamber between the swivel housing and the swivel member.

14. A method as recited in claim **10**, in which the step of providing the swivel member comprises the step of forming an inner chamber in the swivel member that extends between the first and second swivel member connectors to allow fluid flow through the swivel member.

15. A method as recited in claim **10**, in which the accessory is one of a group of accessories consisting of an auger, a drill, and a downhole hammer, the method further comprising the step of identifying a selected one of the accessories in the group of accessories.

16. A drive system for driving a helical pile, comprising:

a rotational drive system adapted to drive the helical pile;

at least one clamp system;

at least one accessory; and

a swivel assembly comprising

a swivel member defining first and second swivel member connector portions,

a swivel housing,

first and second bearings operatively arranged between the swivel member and the swivel housing to allow rotation of the swivel member relative to the swivel housing, and

at least one adapter member defining first and second adapter member connector portions; wherein

the first swivel member connector portion is adapted to engage the first adapter member connector portion to operatively connect the swivel member to the adapter member;

the second adapter member connector portion is adapted to engage the rotational drive system to operatively connect the at least one adapter member to the rotational drive system;

the second swivel member connector portion is adapted to engage the at least one accessory to operatively connect the swivel member to the at least one accessory;

wherein

the first adapter member connector portion engages the first swivel member connector portion to detachably attach the at least one adapter member to the swivel member;

the second adapter member connector portion engages the rotational drive system to detachably attach the swivel member to the rotational drive system;

the second swivel member connector portion engages the at least one accessory to attach the swivel member to the at least one accessory;

the at least one clamp system engages the swivel housing such that the clamp system secures the swivel housing relative to the rotational drive system, and

operation of the rotational drive system causes rotation of the accessory.

17. A drive system as recited in claim **16**, in which the accessory is selected from a group of accessories consisting of an auger, a drill, and a downhole hammer.

18. A drive system as recited in claim **16**, further comprising:

a plurality of different rotational drive systems; and

the swivel assembly further comprises a plurality of adapter assemblies, where each adapter assembly is configured to transmit rotational movement of one of the plurality of different rotational drive systems.

* * * * *