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(54) **COMPLETION LOCATOR ASSEMBLY**

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CPC ***E21B 23/02*** (2013.01); ***E21B 17/0283*** (2020.05); ***E21B 17/07*** (2013.01); ***E21B 23/03*** (2013.01)

(58) **Field of Classification Search**
CPC E21B 17/028; E21B 17/0283; E21B 23/02; E21B 17/07
See application file for complete search history.

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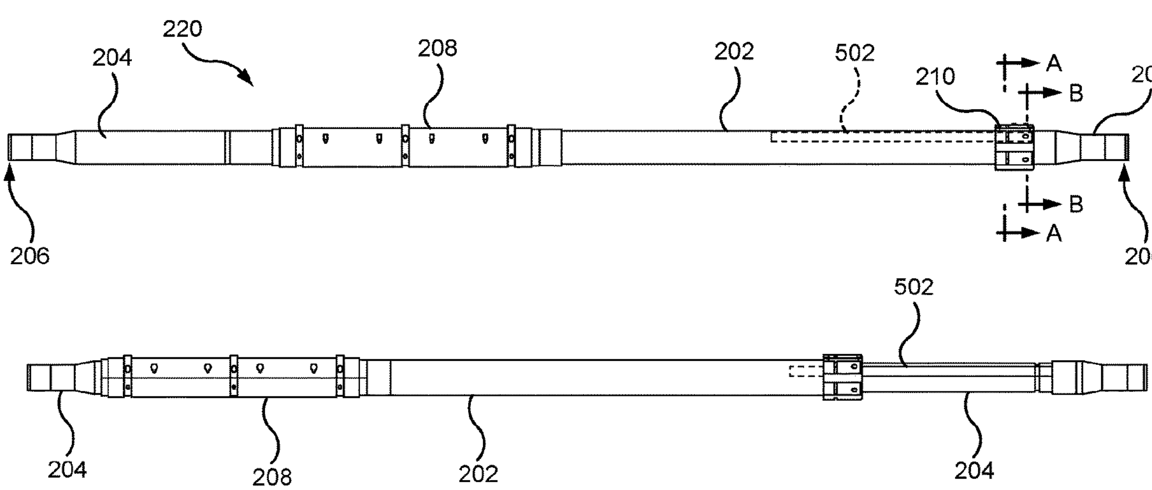
(57) **ABSTRACT**

An alignment assembly for use with a well string having a downhole tool to be positioned within a cased wellbore. The alignment assembly may include an outer assembly, an inner assembly positioned at least partially within the outer assembly, a locator, and a compensator. The locator may releasably couple the outer assembly to the inner assembly and be shaped to engage with a shoulder of the casing to align the downhole tool with a location along the casing. The compensator may be coupled to the outer assembly, positioned
(Continued)



about the inner assembly, and configured to limit relative axial movement between the outer assembly and the inner assembly.

18 Claims, 7 Drawing Sheets

(51) **Int. Cl.**
E21B 17/07 (2006.01)
E21B 23/03 (2006.01)

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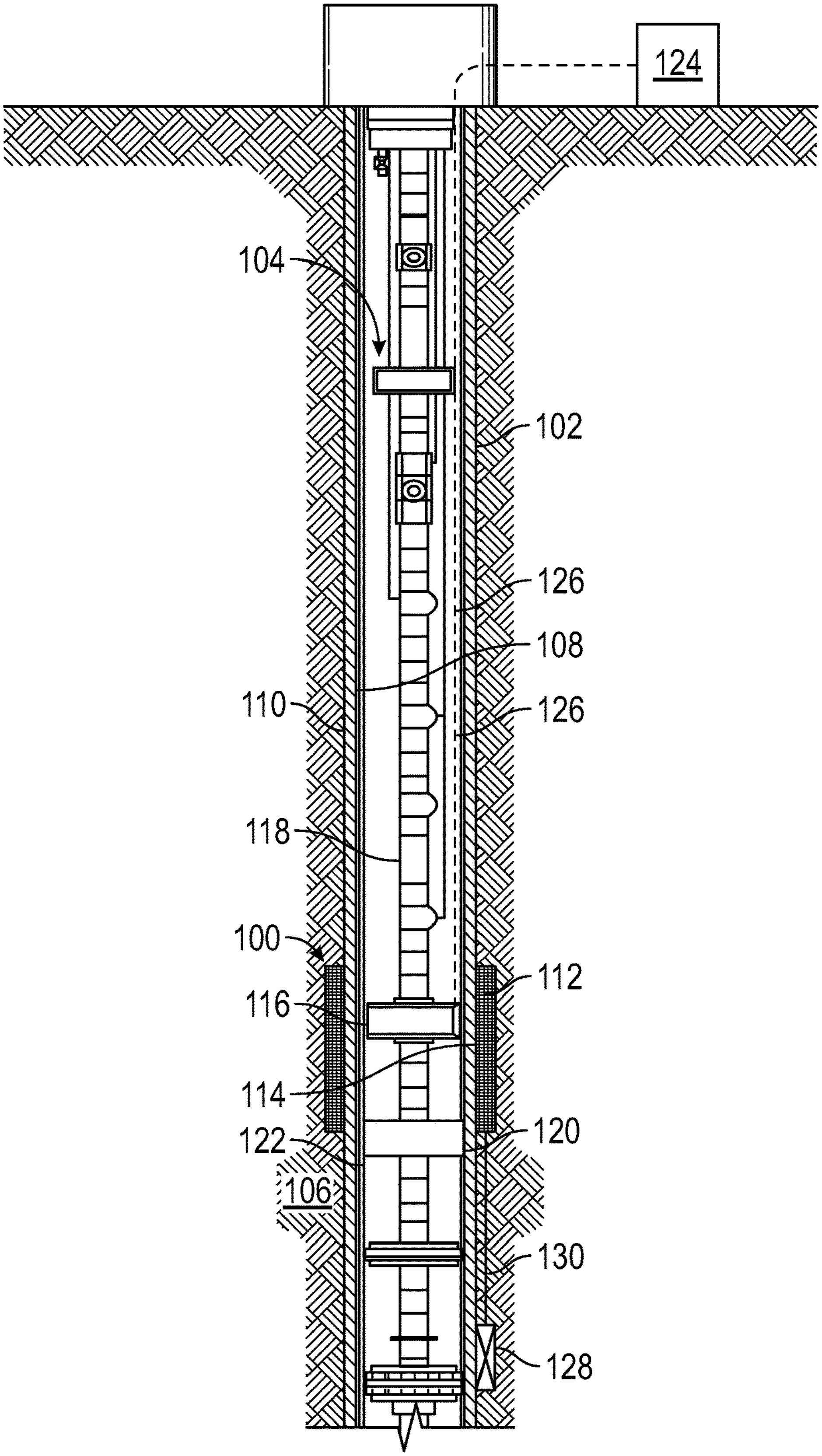
124
104
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128

FIG. 1

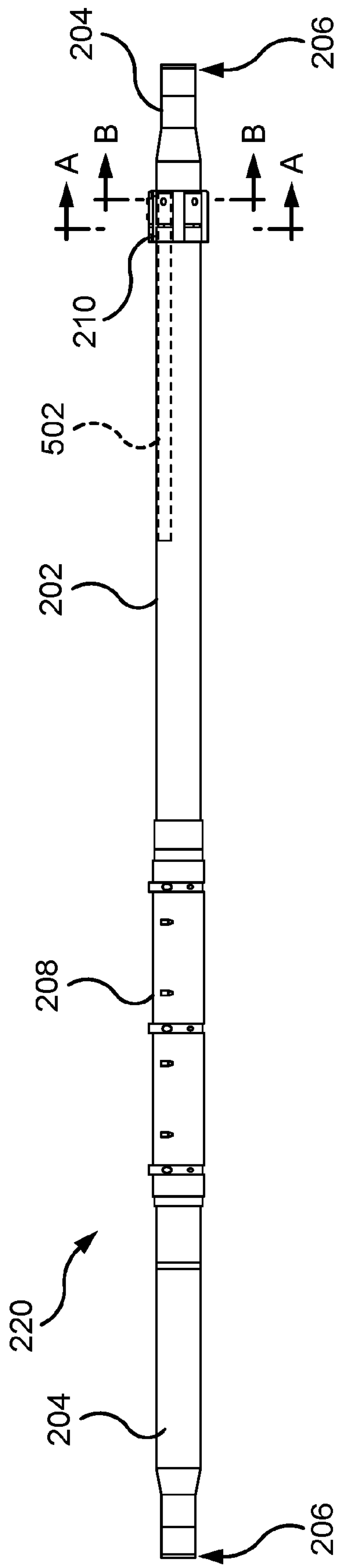

FIG. 2

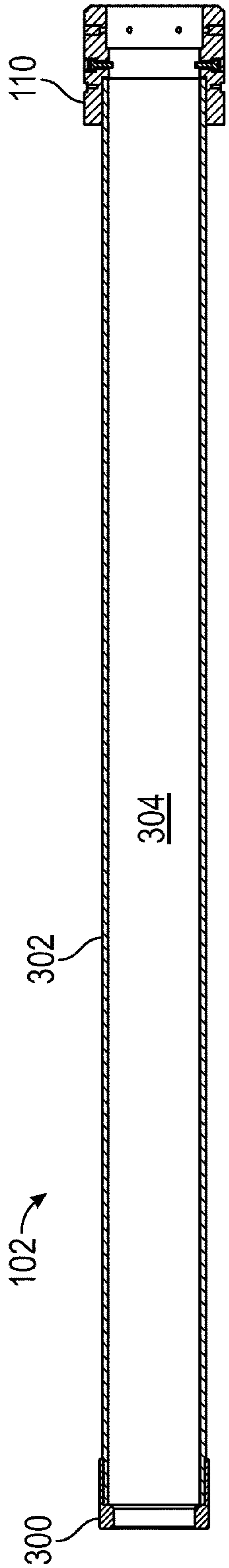

FIG. 3

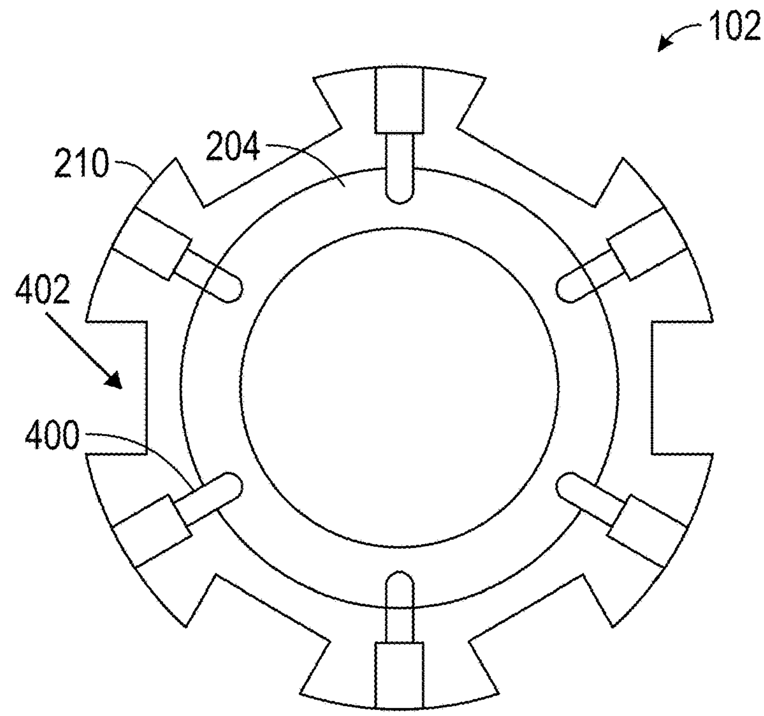

FIG. 4

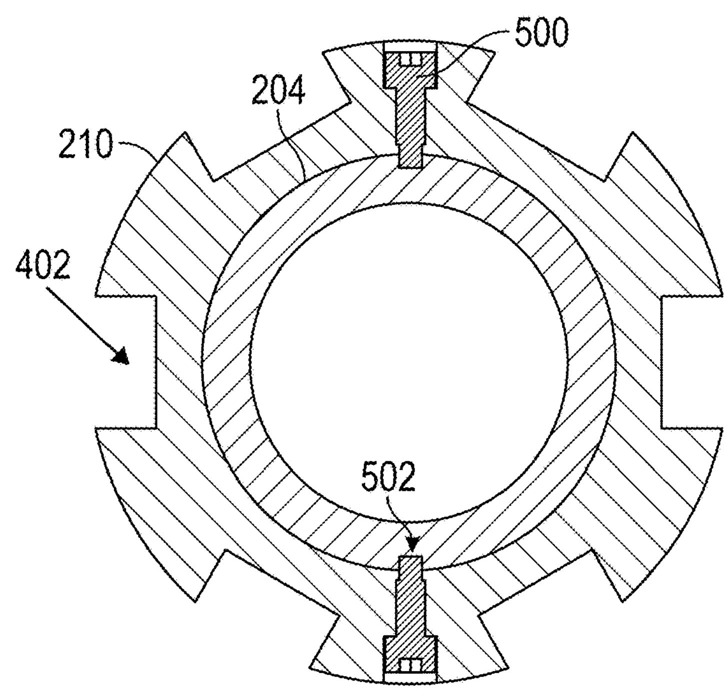

FIG. 5

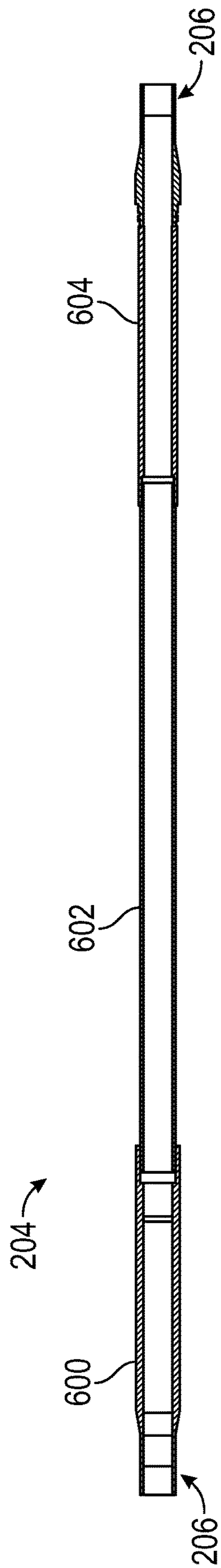

FIG. 6

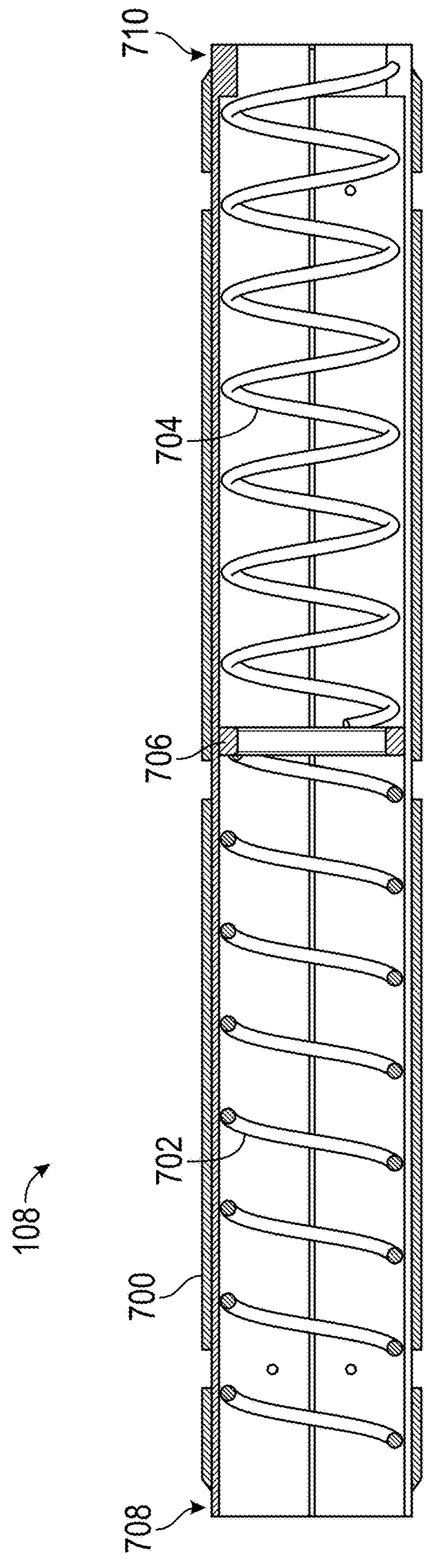

FIG. 7

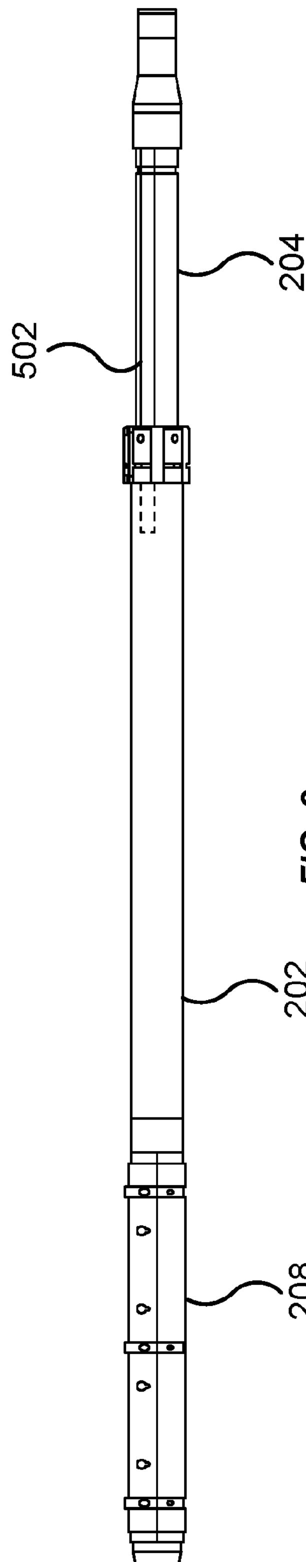

FIG. 8

COMPLETION LOCATOR ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a national stage entry under 35 U.S.C. 371 of International Application No. PCT/US2022/049805 entitled "Completion Locator Assembly," filed Nov. 14, 2022, which claims the benefit of U.S. Provisional Application No. 63/280,402 entitled "Compensated No-Go Locator," filed Nov. 17, 2021, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

Many different downhole tools are typically used in the drilling of a borehole and in the production of hydrocarbons. These tools are typically located on tubing strings that are run into the borehole. In some instances, it may be necessary to align inductive couplers, a downhole tool, or other downhole components located on the tubing string within the borehole and/or a casing that lines the borehole. Additionally, it may be beneficial to allow limited axial movement of the downhole tool and/or downhole components to ensure proper spacing of the downhole tool on the tubing string.

SUMMARY

According to one or more embodiments of the present disclosure, an alignment assembly for use with a well string having a downhole tool to be positioned within a cased wellbore includes an outer assembly, an inner assembly positioned at least partially within the outer assembly, a locator, and a compensator. The locator releasably couples the outer assembly to the inner assembly and is shaped to engage with a shoulder of the casing to align the downhole tool with a location along the casing. The compensator is coupled to the outer assembly, positioned about the inner assembly, and configured to limit relative axial movement between the outer assembly and the inner assembly.

According to one or more embodiments of the present disclosure, a completion system for use within a cased wellbore includes a well string, a downhole tool coupled to the well string, and an alignment assembly coupled to the well string proximate the downhole tool. The alignment assembly includes an outer assembly, an inner assembly positioned at least partially within the outer assembly, a locator, and a compensator. The locator releasably couples the outer assembly to the inner assembly and is shaped to engage with a shoulder of the casing to align the downhole tool with a location along the casing. The compensator is coupled to the outer assembly, positioned about the inner assembly, and configured to limit relative axial movement between the outer assembly and the inner assembly.

According to one or more embodiments of the present disclosure, a method of positioning a well string a wellbore includes running a tubing string comprising an alignment assembly into the wellbore. The method also includes engaging a locator of the alignment assembly with a shoulder of a casing positioned within the wellbore to align a downhole tool with a location along the casing. The method further includes releasing an inner assembly of the alignment assembly from an outer assembly of the alignment assembly to allow relative axial movement between the outer assembly and the inner assembly. The method also includes limiting relative axial movement between the outer assembly and the inner assembly via a compensator.

However, many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Certain embodiments of the disclosure will hereafter be described with reference to the accompanying drawings, wherein like reference numerals denote like elements. It should be understood, however, that the accompanying figures illustrate the various implementations described herein and are not meant to limit the scope of various technologies described herein, and:

FIG. **1** is a schematic illustration of an example of an inductive coupler located along a well casing deployed in a wellbore, according to one or more embodiments of the present disclosure;

FIG. **2** is an alignment assembly for a tubing string, according to one or more embodiments of the present disclosure;

FIG. **3** is the outer assembly of the alignment assembly of FIG. **2**;

FIG. **4** is a cross-sectional view of the locator of the alignment assembly of FIG. **2** along line AA;

FIG. **5** is a cross-sectional view of the locator of the alignment assembly of FIG. **2** along line BB;

FIG. **6** is the inner assembly of the alignment assembly of FIG. **2**;

FIG. **7** is the compensator assembly of the alignment assembly of FIG. **2**; and

FIG. **8** is the alignment assembly of FIG. **2** in a compressed position.

DETAILED DESCRIPTION

In the following description, numerous details are set forth to provide an understanding of some embodiments of the present disclosure. However, it will be understood by those of ordinary skill in the art that the system and/or methodology may be practiced without these details and that numerous variations or modifications from the described embodiments may be possible.

In the specification and appended claims, the terms "connect," "connection," "connected," "in connection with," and "connecting," are used to mean "in direct connection with," in connection with via one or more elements." The terms "couple," "coupled," "coupled with," "coupled together," and "coupling" are used to mean "directly coupled together," or "coupled together via one or more elements." The term "set" is used to mean setting "one element" or "more than one element." As used herein, the terms "up" and "down," "upper" and "lower," "upwardly" and "downwardly," "upstream" and "downstream," "uphole" and "downhole," "above" and "below," "top" and "bottom," and other like terms indicating relative positions above or below a given point or element are used in this description to more clearly describe some embodiments of the disclosure. Commonly, these terms relate to a reference point at the surface from which drilling operations are initiated as being the top point and the total depth being the lowest point, wherein the well (e.g., wellbore, borehole) is vertical, horizontal, or slanted relative to the surface.

Embodiments described herein use induction principles to enable power and/or information data to be conveyed between the male and female inductive couplers. The male inductive coupler and the female inductive coupler each may comprise at least one coil, a magnetic core, and a metal sleeve enclosing the at least one coil and magnetic core. The coil and magnetic core of the male inductive coupler are radially aligned with the coil and magnetic core of the female inductive coupler to facilitate inductive transfer of power and/or data signals.

A magnetic field is created by running electrical current through the coil or coils of one of the inductive couplers. The electrical current induces a current flow in the opposed coil or coils of the other inductive coupler. This allows power and/or data signals to be transferred across the casing, i.e. across the casing wall.

Referring generally to FIG. **1**, an example of an inductive coupler system **100** is illustrated as disposed along a casing **102**. By way of example, the casing **102** may be disposed along a wellbore **104** drilled into a subterranean formation **106**. In some well applications, the well casing **102** is formed of non-magnetic, low conductivity metal. The casing **102** has an interior surface **108** and an exterior surface **110**. An outer or female inductive coupler **112** of inductive coupler system **100** is illustrated as positioned at a desired exterior location along the exterior surface **110** of casing **102**. The female inductive coupler **112** may be constructed with a circular interior **114** sized to encircle the casing **102**. Once positioned in the desired location, the female inductive coupler **112** can be secured by suitable fasteners and/or devices.

The inductive coupler system **100** also comprises a male inductive coupler **116** positioned along a tubing string **118** run within the casing **102**. As shown in FIG. **1**, the tubing string **118** includes an alignment assembly **120**, as described in more detail below, that contacts a shoulder **122** or similar feature within the casing **102** to prevent further downhole movement of the tubing string, thus aligning the male and female inductive couplers **116**, **112**. In other embodiments, the male inductive coupler **116** may be mounted on a well tool or well completion that carries the coupler **116** to the desired interior location.

As further illustrated in FIG. **1**, the inductive coupler system **100** may be connected to a control system **124**, such as a surface control system. The control system **124** may be used to send and/or receive power and data signals via a suitable communication line **126**, such as a wired or wireless communication line. By way of example, the control system **124** may be designed to send power and data signals downhole while receiving data signals from an electrical device **128** (or devices **128**) located downhole. In the example illustrated, the electrical device **128** is connected with female inductive coupler **112** and positioned externally of casing **102**. The electrical device **128** may be connected directly with female inductive coupler **112** or connected via a suitable cable **130**, e.g. a permanent downhole cable. The electrical device **128** also may comprise a variety of sensors or other devices used to accumulate data on formation parameters or other well related parameters. In some applications, the electrical device **128** may comprise one or more pressure sensors to monitor pressure outside of casing **102**.

Turning now to FIG. **2**, FIG. **2** is an alignment assembly **220** for a tubing string, according to one or more embodiments of the present disclosure. The alignment assembly **220** includes an outer assembly **202**, an inner assembly **204**, the end portions **206** of which are coupled to the tubing string, and a compensator assembly **208**. The alignment assembly **220** also includes a locator **210** that couples the inner assembly **204** to the outer assembly **202**.

As described above, a downhole tool or a downhole component, such as an inductive coupler, is coupled to the alignment assembly **220**, which is then run into a wellbore. The alignment assembly **220** ensures that the downhole tool or downhole component proximate the alignment assembly is properly aligned with a desired location along a casing cemented within the wellbore or aligned with a counterpart component coupled to the casing. Additionally, the compensator assembly **208** allows for limited axial movement of the inner assembly **204** relative to the outer assembly **202** to maintain axial alignment of the downhole tool or downhole component with the component on the casing.

Turning now to FIG. **3**, FIG. **3** is the outer assembly **202** of FIG. **2**. The outer assembly includes a top nut **300** and an outer pup **302**. The top nut **300** is coupled to a first end of the outer pup **302** and the locator **210** is coupled to the opposite end of the downhole pup. Additionally, the length of the outer pup **302** can vary to allow different sizes of downhole tools or downhole components to be coupled to the exterior of the outer pup **302**. The bore **304** of the outer pup **302** is sized to allow the inner assembly to pass through the outer pup **302** to allow for relative axial movement between the outer assembly **202** and the inner assembly **204**.

Turning now to FIGS. **4** and **5**, FIGS. **4** and **5** are cross-sectional views of the locator **210** of FIG. **2**, along lines AA and BB, respectively. As shown in FIG. **4**, the locator **210** is coupled to the inner assembly **204** via shear pins **400**. However, the invention is not thereby limited. Other embodiments may include shear rings or releasable retaining devices in addition to or in place of the shear pins **400**. The locator **210** may also include grooves or channels formed into the outer surface of the locator **210** to allow control lines to pass around the locator **210**. Although six channels **402** are shown in FIGS. **4** and **5**, the locator may include more or fewer channels **402** without departing from the scope of this disclosure.

In operation, as the alignment assembly **220** is run downhole, the locator **210** contacts a shoulder, such as the shoulder **122** described above with reference to FIG. **1**, coupled to the wellbore or casing, or formed from the casing. Once the locator **210** contacts the shoulder, additional force is applied to tubing string to shear the shear pins **400** coupling the inner assembly **204** to the locator **210**. Once the shear pins **400** are sheared, the inner assembly **204** can move axially relative to the outer assembly **202** and the locator **210**. Additionally, the locator **210** may include guide pins **500** that extend through the locator **210** and into respective channels **502** (FIGS. **2**, **5**, and **8**) formed in the inner assembly **204**. The guide pins **500** and the channels **502** reduce or prevent relative radial movement between the locator **210** and the inner assembly **204**.

Turning now to FIG. **6**, FIG. **6** is the inner assembly **204** of FIG. **2**. The inner assembly **204** includes a top sub **600**, an inner pup **602**, and a lower sub **604**. As discussed above, the inner assembly **204** is coupled to the tubing string at both end portions. Additionally, the inner pup **602** and a portion of the lower sub **604** are disposed within the outer assembly **202** and the lower sub is coupled to the locator **210**, as discussed above.

Turning now to FIG. **7**, FIG. **7** is the compensator assembly **208** of FIG. **1**. The compensator assembly **208** includes an outer housing **700** surrounding two springs **702**, **704** that are separated by a spacer **706**. The compensator assembly **208** is installed around the inner assembly **204** and is retained in position via engagement between the top sub **600** of the inner assembly **204** and the spring **702** or a spacer above the spring **702** on the uphole end portion **708** of the compensator assembly **208** and engagement between the top nut **300** of the outer assembly **202** and the outer housing **700** on the downhole end portion **710** of the compensator assembly **208**.

In operation, the relative axial movement of the inner assembly **204** and the outer assembly **202** compresses the springs **702**, **704** within the compensator assembly **208**, shifting the outer housing **700** compensator assembly **208** relative to the inner assembly **204**, as shown in FIG. **8**. The compensator assembly **208** limits the relative axial movement of the outer assembly **202** and the inner assembly **204**, while the springs **702**, **704** within the compensator assembly **208** act as a damping mechanism.

As used herein, a range that includes the term between is intended to include the upper and lower limits of the range; e.g., between 50 and 150 includes both 50 and 150. Additionally, the term "approximately" includes all values within 5% of the target value; e.g., approximately 100 includes all values from 95 to 105, including 95 and 105. Further, approximately between includes all values within 5% of the target value for both the upper and lower limits; e.g., approximately between 50 and 150 includes all values from 130.5 to 157.5, including 130.5 and 157.5.

Although a few embodiments of the disclosure have been described in detail above, those of ordinary skill in the art will readily appreciate that many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

What is claimed is:

1. An alignment assembly for use with a well string having a downhole tool to be positioned within a cased wellbore, the alignment assembly comprising:
- an outer assembly;
- an inner assembly positioned at least partially within the outer assembly, and including a plurality of channels;
- a locator releasably coupling the outer assembly to the inner assembly and shaped to engage with a shoulder of the casing to align the downhole tool with a location along the casing, the locator including guide pins engaged with corresponding channels of the plurality of channels and configured to permit relative axial movement between the outer assembly and the inner assembly, and limit relative rotational movement between the locator and the inner assembly; and
- a compensator assembly coupled to the outer assembly and positioned about the inner assembly configured to limit the relative axial movement between the outer assembly and the inner assembly.

2. The alignment assembly of claim **1**, wherein the compensator assembly further comprises a damping mechanism.

3. The alignment assembly of claim **2**, wherein the damping mechanism comprises a plurality of springs disposed within a housing of the compensator assembly.

4. The alignment assembly of claim **3**, wherein a first spring of the plurality of springs is separated from a second spring of the plurality of springs via a spacer.

5. The alignment assembly of claim **1**, wherein the locator is configured to releasably couple the outer assembly to the inner assembly via shear pins extending through the locator and into channels formed in the inner assembly.

6. The alignment assembly of claim **1**, wherein the locator comprises additional channels formed in an outer surface of the locator.

7. A completion system for use within a cased wellbore, the completion system comprising:
- a well string;
- a downhole tool coupled to the well string; and
- an alignment assembly coupled to the well string and proximate the downhole tool, the alignment assembly comprising:
  - an outer assembly;
  - an inner assembly positioned at least partially within the outer assembly, and including a plurality of channels;
  - a locator releasably coupling the outer assembly to the inner assembly and shaped to engage with a shoulder of the casing to align the downhole tool with a location along the casing, the locator including guide pins engaged with corresponding channels of the plurality of channels and configured to permit relative axial movement between the outer assembly and the inner assembly, and limit relative rotational movement between the locator and the inner assembly; and
  - a compensator assembly positioned about the inner assembly configured to limit the relative axial movement between the outer assembly and the inner assembly.

8. The completion system of claim **7**, wherein the compensator assembly further comprises a damping mechanism.

9. The completion system of claim **8**, wherein the damping mechanism comprises a plurality of springs disposed within a housing of the compensator assembly.

10. The completion system of claim **9**, wherein a first spring of the plurality of springs is separated from a second spring of the plurality of springs via a spacer.

11. The completion system of claim **7**, wherein the locator is configured to releasably couple the outer assembly to the inner assembly via shear pins extending through the locator and into channels formed in the inner assembly.

12. The completion system of claim **7**, wherein the locator comprises additional channels formed in an outer surface of the locator.

13. The completion system of claim **7**, wherein the downhole tool comprises a male inductive coupler.

14. The completion system of claim **13**, further comprising a female inductive coupler couplable to an exterior of the casing.

15. The completion system of claim **14**, further comprising an electrical device in electronic communication with the female inductive coupler.

16. The completion system of claim **14**, further comprising a control system in electronic communication with the downhole tool.

17. A method of positioning a well string within a wellbore, the method comprising:
- running a tubing string comprising an alignment assembly into the wellbore;
- engaging a locator of the alignment assembly with a shoulder of a casing positioned within the wellbore to align a downhole tool with a location along the casing, the locator including guide pins engaged with corresponding channels in an inner assembly configured to permit relative axial movement between an outer assembly and the inner assembly, and limit relative rotational movement between the locator and the inner assembly;
- releasing the inner assembly of the alignment assembly from the outer assembly of the alignment assembly to

allow the relative axial movement between the outer assembly and the inner assembly; and

limiting the relative axial movement between the outer assembly and the inner assembly via a compensator.

18. The method of claim **17**, wherein engaging the locator with the shoulder of the casing comprises aligning a male inductive coupler of the downhole tool with a female inductive coupler positioned at the location along the casing.

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