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(54) **DOWNHOLE DEVICE ACTUATOR AND METHOD**

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(57) **ABSTRACT**

An actuator to actuate a device received on a tubular string adjacent the device. The actuator comprises an energy storage member, such as a spring, restrained in a compressed mode between a stop collar and an outer sleeve threadedly received on a threaded portion of a non-magnetic tubular segment. An outer magnet is coupled to the outer sleeve to magnetically interact with an inner magnet coupled to an inner pipe string. The inner pipe string is run into the bore of the tubular string and the outer sleeve to position the inner magnet proximal the outer magnet to form a magnetic clutch. The inner pipe string rotates to transfer torque to the outer sleeve via a magnetic clutch, to rotate and threadedly disengage the outer sleeve from the tubular segment to release energy from the energy storage member to displace the outer sleeve to engage and actuate the device.

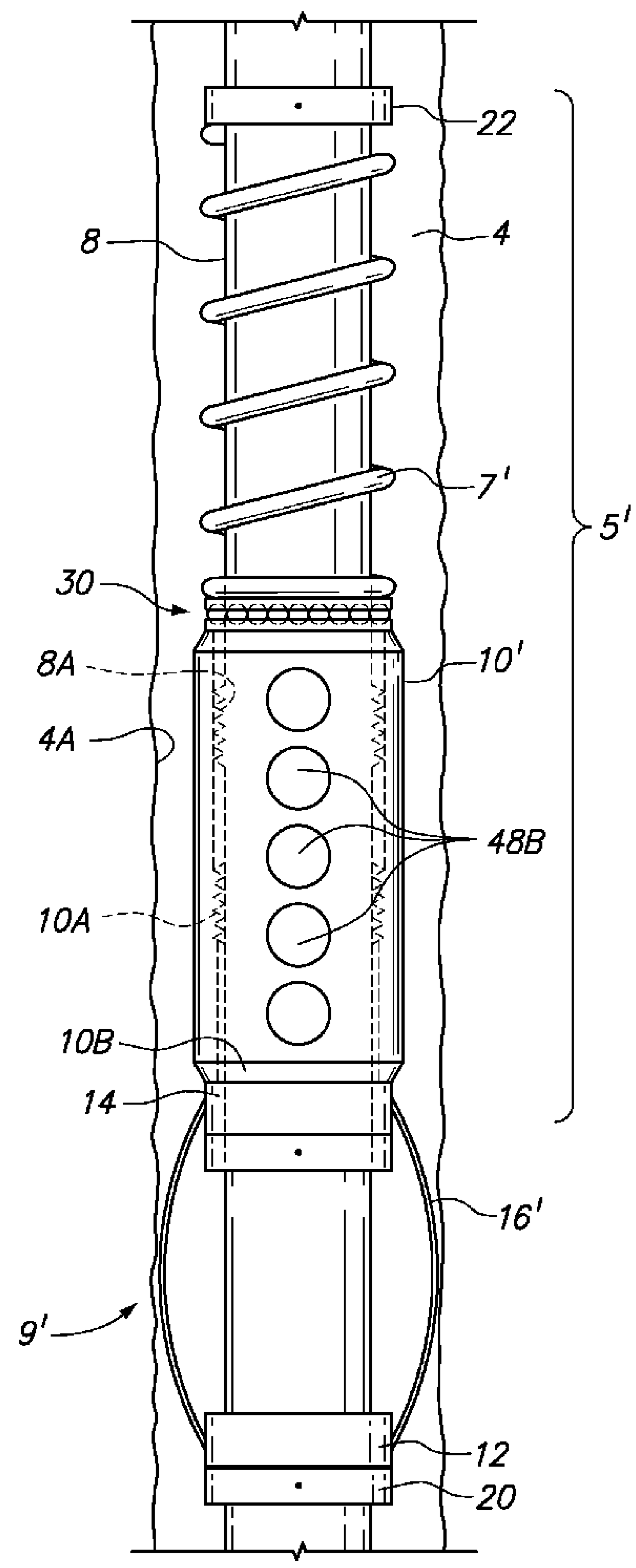


FIG. 1

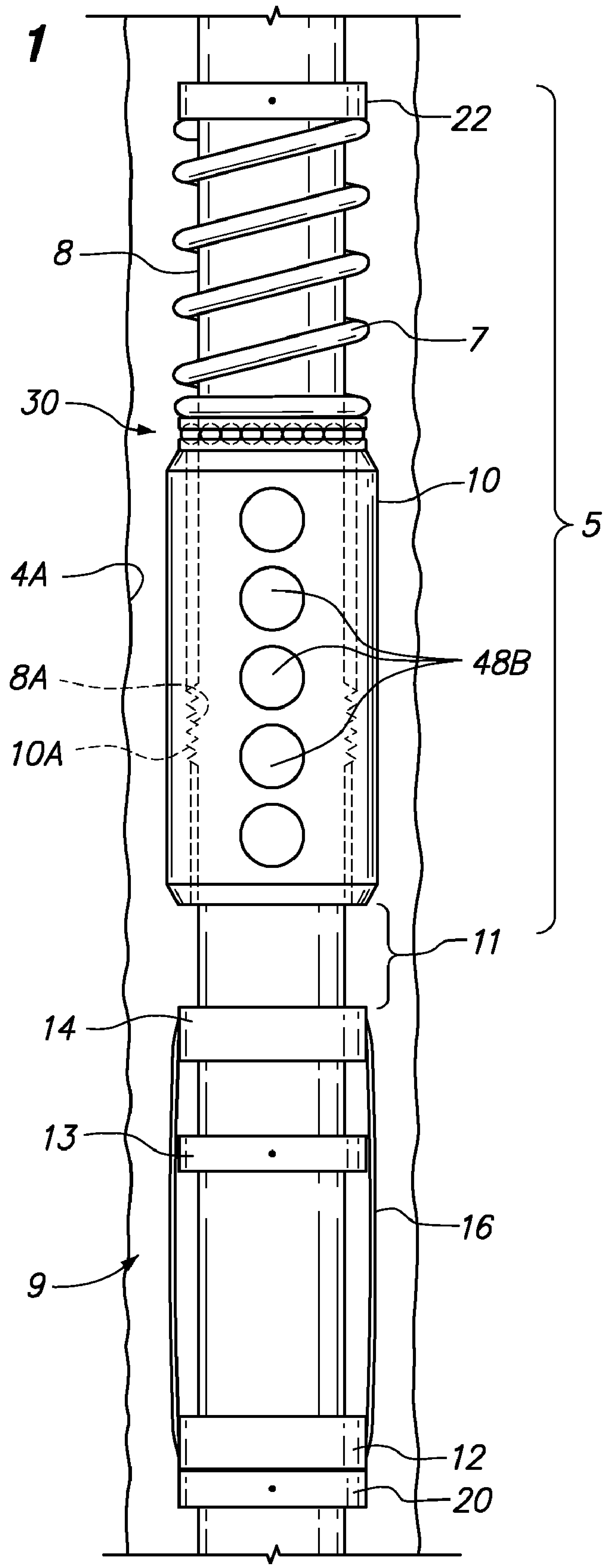


FIG. 2

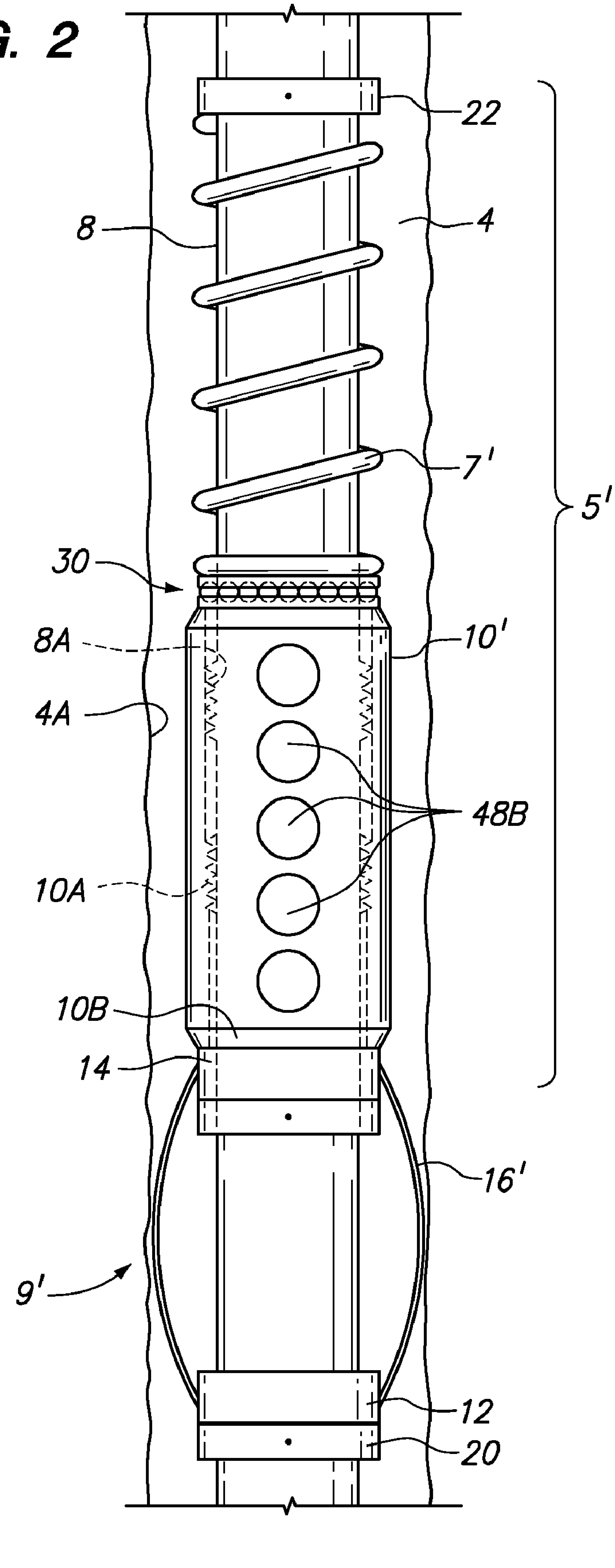


FIG. 3

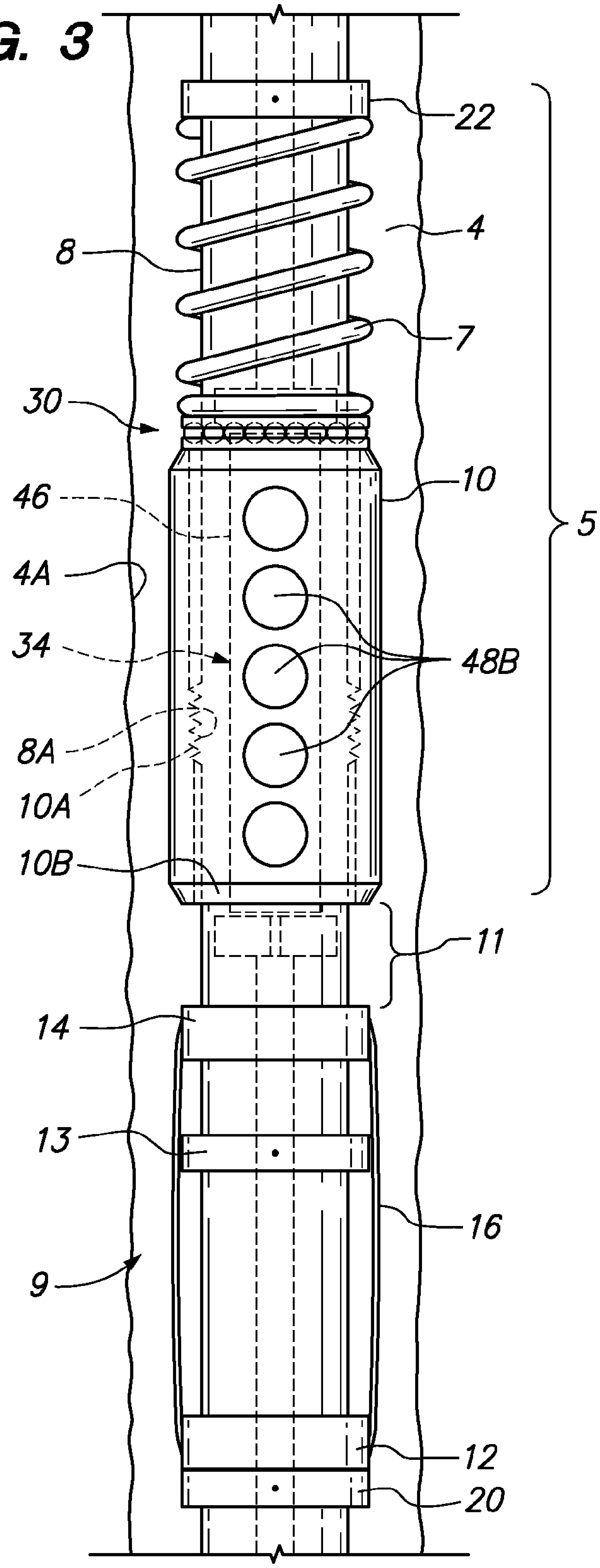

22
4
8
7
30
10
5
46
4A
34
48B
8A
10A
10B
11
14
13
16
9
12
20

FIG. 3A

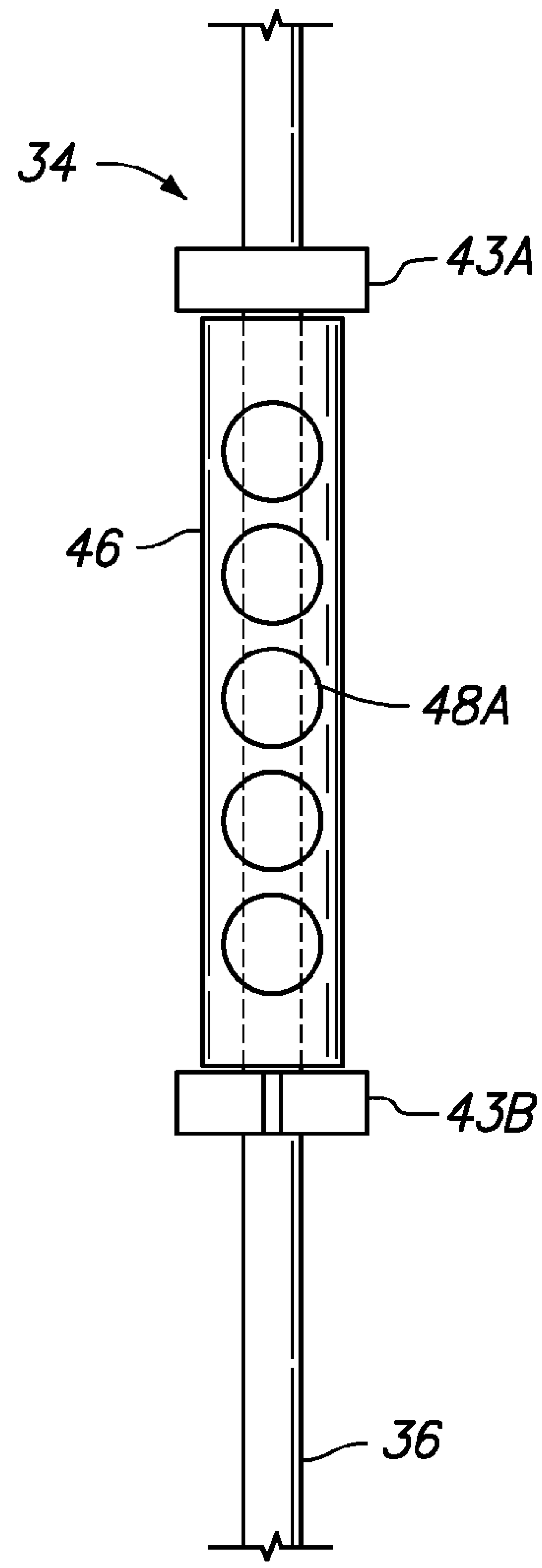

34
43A
46
48A
43B
36

FIG. 4A

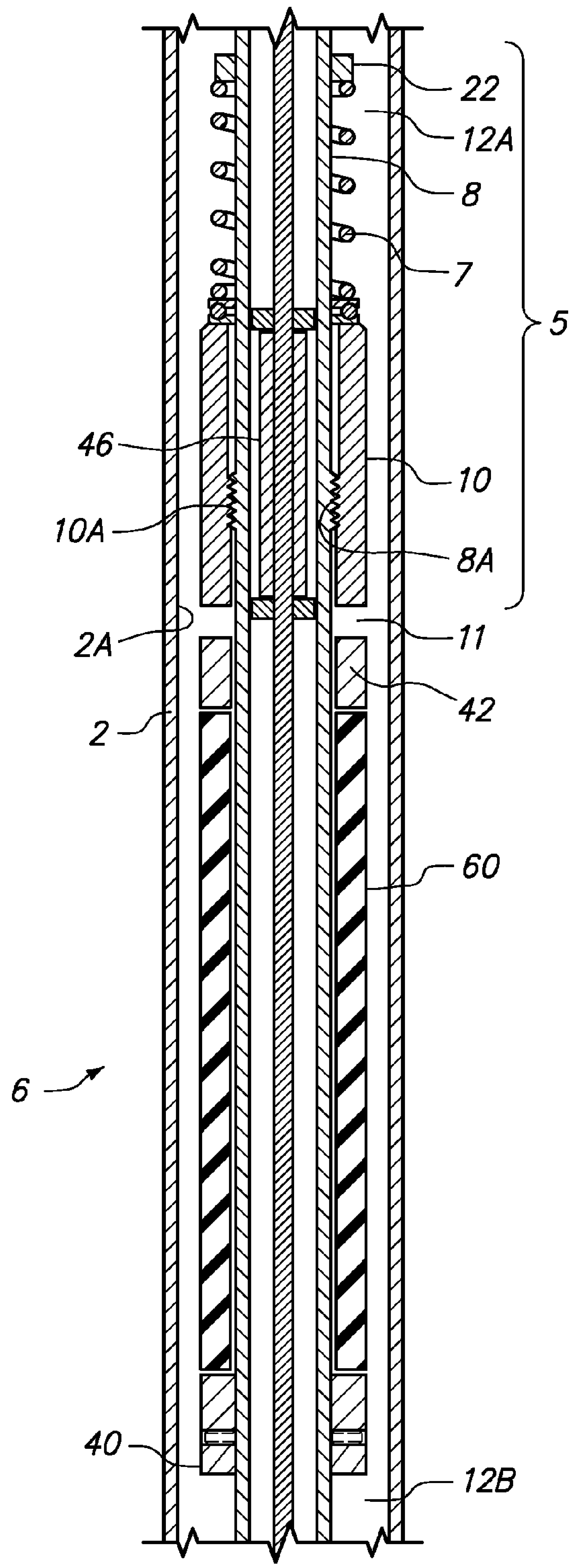

22
12A
8
7
5
46
10
10A
8A
2A
11
42
2
60
6
40
12B

FIG. 4B

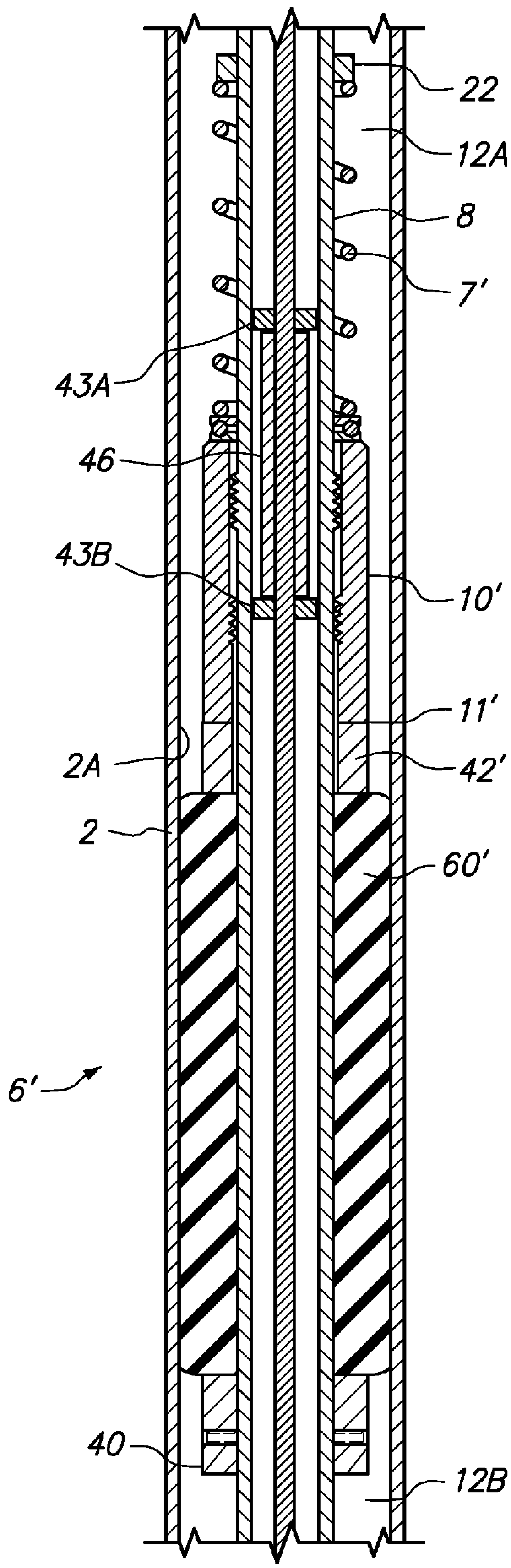

22
12A
8
7'
43A
46
43B
10'
11'
2A
42'
2
60'
6'
40
12B

FIG. 5A

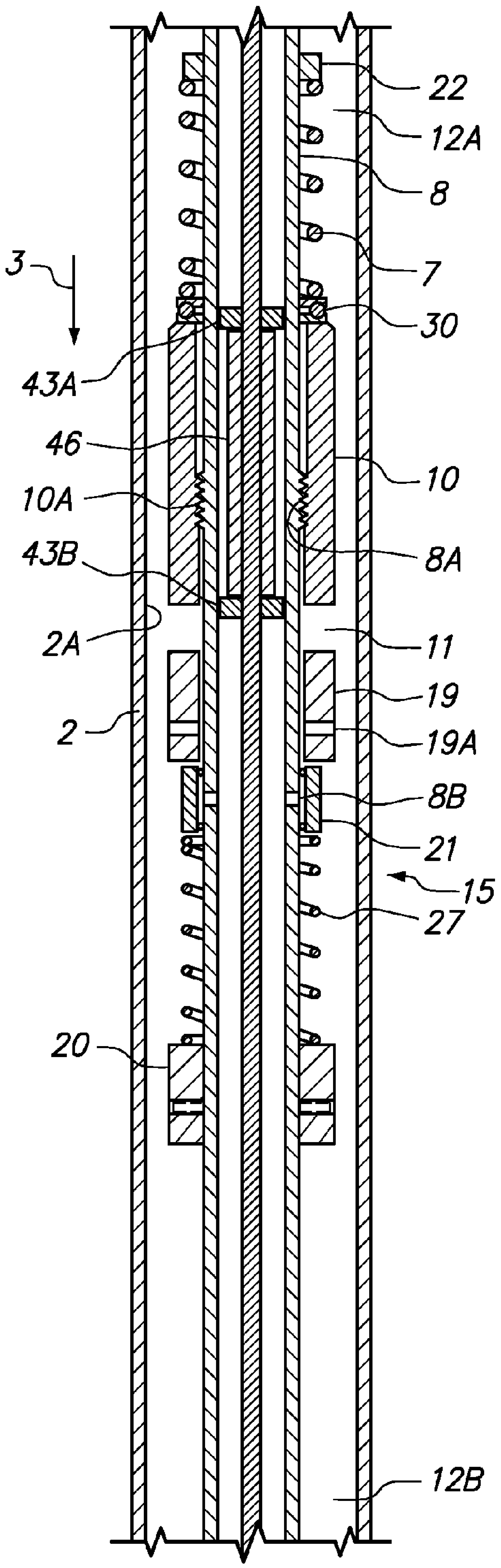
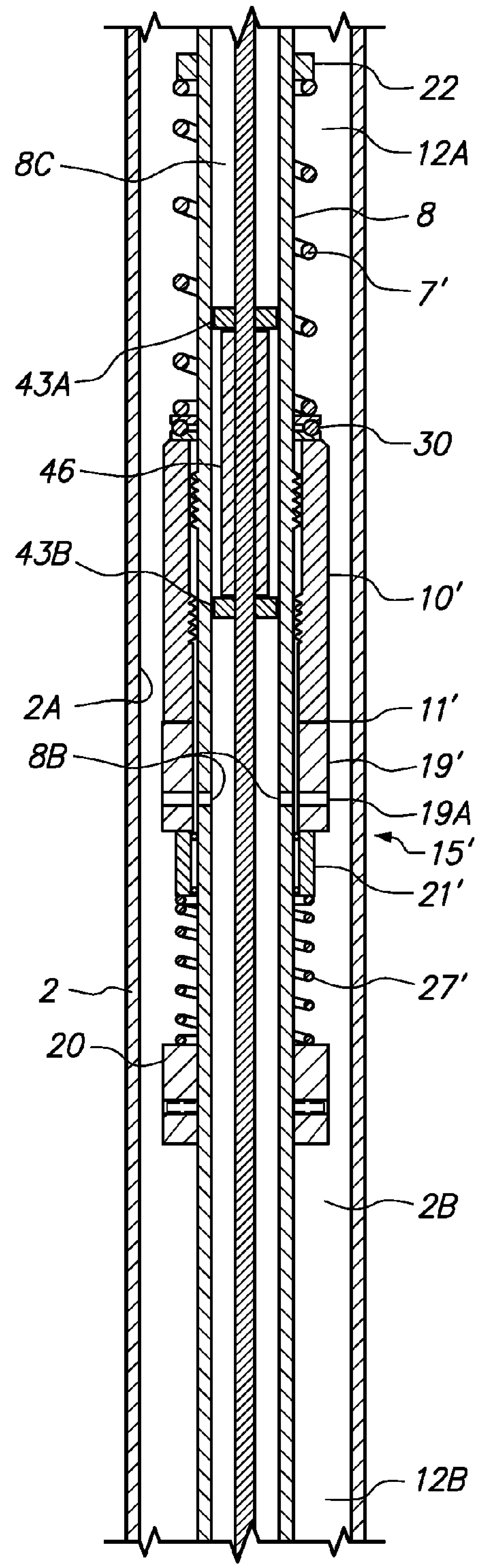

22
12A
8
7
3
30
43A
46
10
10A
8A
43B
2A
11
19
2
19A
8B
21
15
27
20
12B

FIG. 5B


22
12A
8C
8
7'
43A
30
46
10'
43B
2A
11'
8B
19'
19A
15'
21'
27'
2
20
2B
12B

DOWNHOLE DEVICE ACTUATOR AND METHOD

STATEMENT OF RELATED APPLICATIONS

[0001] This application is a continuation-in-part application depending from and claiming benefit of priority to U.S. patent application Ser. No. 12/542,494 filed on Aug. 17, 2009, which is a non-provisional application depending from and claiming benefit of priority to U.S. Provisional Application No. 61/089,461 filed on Aug. 15, 2008.

FIELD OF THE INVENTION

[0002] This application relates to methods and devices for downhole operations in earthen boreholes. More specifically, this application relates to actuating a device coupled to a tubular string and run into an earthen borehole.

BACKGROUND

[0003] It is conventional practice to drill a borehole into the earth using a tubular string, typically called a drill string, extending from a rig at the earth's surface, and to cement a tubular string, typically called a casing string, in the borehole to prevent collapse and stabilize the borehole. Some boreholes may be extended in a step-wise manner, and additional strings of casing are cemented in the borehole as part of each step. In some completed boreholes, a tubular string may be installed within the bore of the cemented casing string to facilitate, for example, the recovery of oil and/or gas from penetrated geologic formations.

[0004] Various devices may be coupled to a tubular string and actuated downhole to facilitate their installation. These devices are typically actuated after being run into and positioned within a borehole, e.g., in a desired location therein.

[0005] For example, but not by way of limitation, bow spring centralizers may be used to position a casing string within a borehole for a subsequent cementing step. Bow spring centralizers may be disposed on a casing string at spaced intervals to provide an annulus between the casing string and the borehole. Cement slurry may be displaced through the bore of the casing string and into the annulus to form a protective cement liner therein. In boreholes having a horizontal or highly deviated portion, more robust bow springs may be needed to provide sufficient stand-off, but more robust bow springs will increase frictional resistance to movement of the casing string through the borehole.

[0006] One solution is to run centralizers, e.g., bow spring centralizers, on the casing string in a retracted (e.g., collapsed) mode to reduce the frictional resistance to movement of the casing string through the borehole. The retracted centralizers may then be deployed at a targeted interval, e.g., to provide the desired stand-off between the casing string and the borehole. Because the centralizers are installed on the exterior of the casing string, a challenge is presented in actuating the stand-off portion (e.g., bow spring) of the centralizers from the retracted or collapsed mode to a deployed mode without compromising the integrity of the casing string. The centralizers are substantially inaccessible because they are disposed within a narrow annulus between the casing string and the borehole. One attempted solution provides a method of restraining a centralizer installed on a casing string in a collapsed mode using one or more dissolvable restraining bands, and then dissolving the bands downhole using a strong acid, such as fluoric acid, circulated into the annulus. This solution is disfavored because the acid is dangerous to handle at the surface and can damage critical components in the borehole.

[0007] Another example of a device to be actuated after it is positioned in a borehole is a packer. A packer may be used to seal off an annulus between two tubular strings such as, for example, an annulus between an installed casing string and a production string disposed within the bore of the casing string. The pressure in the annulus may be monitored so that a leak in the casing string and/or production string can be readily detected, e.g., for diagnoses and/or repair. A packer may be coupled to a tubular string and run into a borehole in a retracted mode and then expanded, e.g., to an isolating mode downhole. As above, a challenge is presented in actuating the packer from the retracted mode to the isolating mode without compromising the integrity of the pipe string.

[0008] What is needed is an actuator that can be disposed onto a tubular string, adjacent to a device, run into a borehole and then reliably activated to actuate the device without compromising the integrity of the tubular string to which it is coupled.

SUMMARY

[0009] Embodiments of the invention disclosed herein satisfy the above-stated needs. For purposes of the disclosure that follows, the terms "tubular", "tubular string" and "tubular segment" include, but are not limited to, a casing segment and/or a casing string.

[0010] One embodiment of an actuation system comprises an outer sleeve threadedly received on a threaded portion of a tubular segment between an energy storage member, such as, but not limited to, a spring, e.g., a compression spring, which may be in a charged (or compressed) mode to store energy therein, and an actuatable device. A transfer device may be run into the bore of the tubular segment and rotated to activate, or "trigger," the actuator. Upon activation, the outer sleeve of the actuator engages and manipulates the adjacent device using the energy provided from the energy storage member, e.g., an expanding compression spring.

[0011] In one embodiment of the system, a transfer device may be used to enable a magnetic clutch to activate the actuator. For example, an actuator may be received on a tubular segment adjacent to an actuatable device. The actuator may comprise an energy storage member, such as, a compression spring, having a bore received onto the tubular segment and restrained in a charged (or compressed) mode by an outer sleeve threadedly received on an adjacent threaded and non-magnetic portion of the tubular segment. A magnet is coupled to the outer sleeve, and a second magnet is coupled to an inner pipe string and run into the bore of the tubular segment and into the bore of the outer sleeve to form a magnetic clutch. Rotation of the inner pipe string transfers torque to the outer sleeve through the magnetic clutch. The outer sleeve may be rotated from threaded engagement with the tubular segment to release the energy storage member (e.g., the compression spring) to a discharged (e.g., an expanded) mode. The energy storage member displaces the outer sleeve to engage and actuate the adjacent device. Energy storage members that can be used in this application may include, without limitation, a spring (e.g., compression spring or a coil spring) and/or a fluidic cylinder or other chamber and/or other members to convert potential energy to kinetic energy, e.g., including the use of gravitational force.

[0012] In one embodiment, the inner pipe string may serve dual purposes, activating the actuator and pumping fluid to the borehole, such as, an acid to stimulate a formation face, a pressurized fluid to a portion of the borehole to test the seal of a packer or cement slurry. More information relating to an inner pipe string of the kind that can facilitate certain embodiments of the system, method and actuator disclosed herein is available from Davis-Lynch, Inc. of Pearland, Tex., USA.

[0013] In one embodiment, an actuator and/or the actuatable device may be protected from unwanted engagement with the borehole by a centralizer (or centralizers) coupled to the tubular segment adjacent to the actuator and/or the device. For example, in one embodiment, an actuator and an adjacent actuatable device are protected from unwanted contact with the borehole by straddling both with a pair of centralizers to provide stand-off between the tubular string and the borehole. It should be understood that the actuator may be more exposed to engagement with the borehole in curved or irregular sections of the borehole.

[0014] An embodiment of a method of using an actuator to actuate a downhole device disposed on a tubular string and run into a borehole includes the steps of: receiving a device on a non-magnetic tubular segment having an adjacent externally threaded portion; threadedly receiving an outer sleeve comprising a magnet on the threaded portion of the tubular segment; receiving a compression spring restrained in a compressed mode on the tubular segment by engagement with the outer sleeve; making-up the tubular segment into a tubular string; running the tubular string into a borehole to form an annulus between the outer sleeve and the borehole; rotating the outer sleeve from threaded engagement with the tubular string using a magnetic clutch; releasing the compression spring from the compressed position to expand and displace the outer sleeve to actuate the adjacent device.

[0015] Another embodiment of the method to actuate a device on a tubular string run into a borehole comprises the steps of: receiving an actuatable device on a tubular segment; threadedly receiving an outer sleeve having a magnet on an adjacent threaded portion of a non-magnetic portion of the tubular segment; receiving a compression spring in a compressed mode onto the tubular segment adjacent the outer sleeve; making-up the tubular segment into a tubular string with a tag-in receptacle aligned with the bore of the tubular string; running the tubular string into a borehole; coupling a portion of a torque transfer device having a second magnet to an inner pipe string; running the inner pipe string into the bores of the tubular segment and the outer sleeve; sealably engaging the inner pipe string with the tag-in receptacle to position the torque transfer device within the outer sleeve to form a magnetic clutch; rotating the inner pipe string to rotate the outer sleeve from threaded engagement with the tubular string; releasing the compression spring from the compressed mode to expand and actuate the adjacent device. In one embodiment, a magnetic clutch is formed by positioning the second magnet on the inner pipe string proximal the magnet on the outer sleeve to form a magnetic clutch. The interaction of the magnets enables transfer of torque from the inner pipe string to the outer sleeve to rotate the outer sleeve and thereby threadedly disengage the outer sleeve from the externally threaded portion of the tubular string. A plurality of second magnets may be coupled to the inner pipe string in a first pattern to interact with a plurality of magnets coupled to the outer sleeve in a coincident pattern.

[0016] It should be noted that an outer sleeve having a magnet and an inner pipe string having a second magnet may be used to form a magnetic clutch and to actuate, operate or otherwise magnetically engage mechanisms other than the threadedly engaged outer sleeve described herein. For example, but not by way of limitation, the inner string may be manipulated along an axis (e.g., longitudinally manipulated) of the tubular string to move a tab (e.g., within the inner sleeve) into or from a slot (e.g., on the exterior of the tubular string) to couple or decouple one component to or from the other. The tab and the slot may be juxtaposed so that the tab is on the tubular string and the slot is within the outer sleeve. Such axial manipulation may be used independently of or in conjunction with other uses of the magnetic clutch disclosed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The foregoing and other features and aspects will be best understood with reference to the following detailed description of embodiments of the invention, when read in conjunction with the accompanying drawings, wherein:

[0018] FIG. **1** is an elevation view of an embodiment of the actuator in a run-in mode and disposed on a tubular segment adjacent to a centralizer having flexible ribs.

[0019] FIG. **2** is an elevation view of the actuator of FIG. **1** in an activated mode to actuate the centralizer.

[0020] FIG. **3** is an elevation view of the apparatus of FIG. **1** with an inner pipe string and torque transfer device superimposed thereon to illustrate a magnetic clutch.

[0021] FIG. **3**A is an elevation view of an embodiment of a transfer device on an inner pipe string and a plurality of magnets coupled to the torque transfer device to interact with the plurality of magnets coupled to the outer sleeve of FIG. **3**.

[0022] FIG. **4**A is an elevation section view of an actuatable packer having a packing member received between a first collar and a second collar adjacent the outer sleeve of the actuator.

[0023] FIG. **4**B is the packer of FIG. **4**A after the outer sleeve of the actuator displaces the second collar towards the first collar to radially expand the packing member.

[0024] FIG. **5**A is an elevation section view of a valve having a closure sleeve movably received between the outer sleeve of the actuator and a back-up spring and in a closed position to cover fluid ports in the tubular string.

[0025] FIG. **5**B is the view of FIG. **5**A after the outer sleeve of the actuator displaces the closure sleeve from the closed position to an open position to permit fluid flow through the fluid ports.

DETAILED DESCRIPTION

[0026] The following detailed description refers to the above-listed drawings wherein depicted elements are not necessarily shown to scale and wherein like or similar elements are designated by the same reference numeral through the several views.

[0027] FIG. **1** is an elevation view of an embodiment of an actuator **5** in a run-in mode and disposed on a non-magnetic tubular segment **8** adjacent to an actuatable centralizer **9** having flexible ribs **16**, e.g., ribs in a collapsed position. The illustrated actuator **5** comprises a compression spring **7** and an adjacent outer sleeve **10** comprising a plurality of magnets **48**B and an internally threaded portion **10**A (shown in FIG. **1** in dotted lines) threadedly received on an externally threaded portion **8**A (also shown in dotted lines) of the tubular segment **8**. Energy storage member is depicted as a compression spring **7** which is also illustrated in a charged or compressed (run-in) mode to store energy therein, and the compression spring **7** is restrained in the compressed mode between a collar **22**, e.g., a stop collar as known to one of ordinary skill in the art, and the outer sleeve **10**. A thrust bearing **30** may be disposed intermediate the compressed spring **7** and the outer sleeve **10** to limit friction resistance to rotation of the outer sleeve **10** relative to the compressed spring **7**.

[0028] The actuator **5** is shown received on a tubular segment **8** adjacent to a centralizer **9** for purposes of illustration only. It should be understood that the actuator **5** may be used in conjunction with a variety of actuatable devices. The centralizer **9** disposed adjacent to the outer sleeve **10** in FIG. **1** comprises a plurality of ribs **16** coupled between a first collar **12** and a second, e.g., moving, collar **14** that is adjacent to, but spaced from, the outer sleeve **10** of the actuator **5**. The ribs **16** of the centralizer **9** are shown in FIG. **1** in a substantially flattened configuration. Optionally, a gap **11** may separate the second collar **14** of the centralizer **9** from engagement with the outer sleeve **10** of the actuator **5**. While FIG. **1** illustrates the first collar **12** of the centralizer **9** disposed adjacent to a stop collar **20**, it should be understood that the stop collar **20** may be integrally formed with or coupled to the first collar **12** to, for example, maintain a gap **11** between the outer sleeve **10** of the actuator **5** and the centralizer **9**. Optionally, a stop collar **13** may be positioned between the first collar **12** and the second collar **14** to limit expansion of the centralizer **9** as described below in connection with FIG. **2**.

[0029] FIG. **2** is an elevation view of the actuator **5'** of FIG. **1** in an activated or released mode to actuate the adjacent centralizer **9'** to a deployed mode. The outer sleeve **10'** is shown axially displaced after being rotated from threaded engagement with the non-magnetic tubular segment **8**. Upon threaded disengagement, the outer sleeve **10** of FIG. **1** is released to move along the tubular segment **8** in response to force applied by the compression spring **7** to the position shown in FIG. **2**. The outer sleeve **10'** is shown in FIG. **2** after engaging the second collar **14'** at sleeve end **10**B and displacing the second collar **14** toward the first collar **12** to a position corresponding to a deployed mode of the centralizer **9'**. The first collar **12** of the centralizer **9'** is restrained against movement by stop collar **20**. The ribs **16'** are shown in FIG. **2** in a deployed mode, e.g., extended, to provide stand-off between the tubular segment **8** and the wall **4**A of the borehole **4**. The displacement of the outer sleeve **10'** from its position in FIG. **1** corresponds to the separation between the interior threads **10**A of the outer sleeve **10'** from the externally threaded portion **8**A of the non-magnetic tubular portion **8** illustrated in FIG. **2**.

[0030] FIG. **3** is an elevation view of the actuator of FIG. **1** with the position of an inner pipe string superimposed thereon to illustrate a magnetic clutch. The magnetic clutch illustrated in FIGS. **3** and **3**A comprises a plurality of magnets **48**B coupled to the outer sleeve **10** (see FIG. **3**) and a transfer device **34** comprising a plurality of magnets **48**A coupled to the inner pipe string **36** (e.g., a magnet retainer **46** in FIG. **3**A). The transfer device **34** illustrated in FIG. **3**A (and shown in dotted lines in an engaged position within the outer sleeve **10** in FIG. **3**) magnetically couples the outer sleeve **10** to the inner pipe string **36** to provide a magnetic clutch. Rotation of the inner pipe string **36** transfers torque to the outer sleeve **10** through the magnetic clutch, and the magnetic interaction is enabled by a non-magnetic tubular segment **8** through which the magnetic interaction occurs. The threaded interface between the externally threaded portion **8**A of the tubular segment **8** and the internally threaded portion **10**A of the outer sleeve **10** is exaggerated in the illustration of FIGS. **1-3**. These threads may be fine threads having a small pitch and a large thread count (threads per inch or cm) to minimize the torque required to threadedly disengage the outer sleeve **10** from the tubular segment **8**.

[0031] The magnets **48**B of the outer sleeve **10** in the embodiment illustrated in FIG. **3** are arranged in a generally columnar pattern. A variety of arrangements of the magnets **48**B may be used, and the arrangement illustrated in FIG. **3** is but an example of how the magnet(s) **48**B might be arranged on the outer sleeve **10**. For example, three separate columnar arrangements of magnets may be angularly distributed, e.g., at 120 degree intervals. The magnets **48**A on the inner pipe string **36** may be coupled to the magnet carrier **46** of FIG. **3**A in an arrangement generally coinciding with the arrangement of the magnets **48**B on the outer sleeve **10** of FIG. **3**. In some embodiments, the inner pipe string **36** may comprise a bore (not shown in FIG. **3**A) through which a fluid, for example, a cement slurry, an acid or a pressurized fluid, may be provided to an end (not shown in FIG. **3**A) of a tubular string into which the tubular segment **8** is included.

[0032] The transfer device **34** of FIG. **3**A may include a first spacer **43**A and/or a second spacer **43**B straddling the magnet carrier **46** to radially position the magnets **48**A within the bore of the non-magnetic tubular segment **8** (see FIG. **3**) when the inner pipe string **36** is run into the tubular segment **8**. The first and/or second spacers **43**A, **43**B are shown in FIG. **3**A as generally triangular in shape, but may comprise a variety of shapes without loss of function.

[0033] The actuator **5** described above in connection with FIGS. **1** through **3**A may be used to actuate a variety of devices used in downhole operations. The energy stored in the compression spring **7** of the actuator **5** and released upon activation to displace the outer sleeve **10** as disclosed above may be used to actuate, for example, a centralizer **9**, as shown in FIGS. **1** and **2**, a packer **6** (as discussed in more detail in relation to FIGS. **4**A and **4**B below), a cement basket, a casing hanger, an openable fluid port (as discussed in more detail in relation to FIGS. **5**A and **5**B below), and many other actuatable devices.

[0034] The device to be actuated may be positioned to minimize or prevent frictional resistance to rotation of the outer sleeve. For example, FIGS. **1** and **3** illustrate a gap **11** that may be disposed between the moving collar **14** of the centralizer **9** and the outer sleeve **10** of the actuator **5**. In one embodiment of the method of using the actuator **5**, the centralizer **9** may be restrained from sliding on the non-magnetic tubular segment **8** to maintain a gap **11** and prevent the device which is, in the illustrations in FIGS. **1** and **3**, a centralizer **9**, from frictionally engaging the outer sleeve **10** as it rotates toward threaded disengagement from the tubular segment **8**. FIGS. **1** and **3** illustrate a slightly bowed configuration of the ribs **16** of the centralizer **9** in the collapsed or retracted mode to ensure that the ribs **16**, upon actuation by the actuator (see element **5** in FIGS. **1** and **3**), deploy to the bowed mode illustrated in FIG. **2**. It should be understood that straight ribs could load upon engagement by the outer sleeve **10** in a compressive mode, like a column, and thereby prevent full expansion of the compression spring **7** (see FIG. **2**).

[0035] FIG. **4**A is a sectional elevation view of a packer **6** having a generally sleeve-shaped packing member **60** received onto the tubular segment **8** between a first collar **40** and a moving collar **42** adjacent the outer sleeve **10**. The packing member **60** may be, for example, but without limitation, an elastic polymer, rubber, or some other resilient, solid material. The tubular segment **8** of FIG. **4**A is illustrated as threadedly included within a tubular string disposed within a larger tubular string **2** having an interior bore **2**A. The packing member **60** of the packer **6** is illustrated in FIG. **4**A in its retracted mode to allow fluid communication between an uphole portion **12**A of the borehole **12** above the packer **6** to a downhole portion **12**B below the packer **6**. A gap **11** may be disposed between the moving collar **42** of the packer **6** and the outer sleeve **10** of the actuator **5** to prevent the moving collar **42** from frictional engagement with the outer sleeve **10** when the outer sleeve **10** is rotated to threadedly disengage the interior threads **10**A from the threaded portion **8**A of the non-magnetic tubular segment **8** to release the compression spring **7** to move the outer sleeve **10**.

[0036] FIG. **4**B is the packer of FIG. **4**A after the outer sleeve **10'** threadedly disengages the tubular segment **8** and displaces the second collar **42'** against the packing member **60'** to close the gap **11'** and axially compress the packing member **60'** between the first collar **40** and the second, e.g., moving collar **42'** to actuate the packer **6'** to an expanded mode. The packing member **60'** may thus be radially expanded to seal against the interior bore **2**A of the larger tubular string **2** to isolate the uphole annular portion **12**A from the downhole annular portion **12**B. The magnet retainer **46** generally remains in its position relative to the larger tubular string and the non-magnetic tubular portion **8** as the outer sleeve **10'** moves along the tubular segment **8** under the force of the compression spring **7'** a distance corresponding to the separation between the interior threads **10**A of the outer sleeve **10'** from the threaded portion **8**A of the non-magnetic tubular segment **8**.

[0037] FIG. **5**A is an elevation view of a valve **15** having a closure sleeve **21** movably received between the outer sleeve **10** and a back-up spring **27** and in a closed position to cover fluid ports **8**B in the tubular segment **8**. In the embodiment shown in FIGS. **5**A and **5**B, a pusher sleeve **19** having flow passages **19**A is disposed intermediate the closure sleeve **21** and the outer sleeve **10**. Optionally, a gap **11** may be disposed between the pusher sleeve **19** and the outer sleeve **10**.

[0038] FIG. **5**B is the elevation view of FIG. **5**A after the outer sleeve **10'** is released to displace the closure sleeve **21'** along the tubular segment **8** from the closed position to an open position to permit fluid flow through the fluid ports **8**B. The back-up spring **27'** is shown in a compressed mode as acted upon by the larger compression spring **7'** through the outer sleeve **10'**, pusher sleeve **19'**, and closure sleeve **21'**. The flow passages **19**A of the pusher sleeve **19'** are aligned with the fluid ports **8**B in the tubular segment **8** to establish fluid communication between the bore **8**C of the tubular segment **8** and the annulus **2**B between the tubular segment **8** and the wall **2**A of the larger tubular **2**.

[0039] It should be understood that embodiments of the system, actuator and the method of using the actuator may be used in an open borehole, as illustrated in FIGS. **1** and **2**, or in a cased hole, as illustrated in FIGS. **4**A through **5**B, to simultaneously or separately actuate a plurality of actuatable devices of the same or different kinds that may be coupled to a tubular string and run into a borehole. For example, by manipulating the thread pitch or thread count of one actuator as compared to another, the number of rotations of the inner pipe string, after the magnetic clutch is formed by positioning of the inner pipe string, can be used to vary the sequence or timing of actuation of a plurality of devices coupled to the tubular string. For example, an inner pipe string could be rotated to actuate a first actuatable device, then operations could commence, followed by further rotation to actuate a second actuatable device.

[0040] The magnets used in embodiments of the invention may or may not comprise rare earth magnets or electromagnets. A non-magnetic tubular segment **8** is provided to enable the magnetic interaction between the magnets **48**A on the inner pipe string **36** and the magnets **48**B on the outer sleeve **10**, and the non-magnetic tubular segment **8** may be, for example, stainless steel. It should be understood that embodiments of the invention using multiple outer sleeves driven, using magnetic couplings between the inner pipe string and the outer sleeves, may continue to effectively function notwithstanding disablement of one or more outer sleeves due to, for example, contact with the borehole. For example, should an outer sleeve engage the borehole, for example, at a borehole irregularity or deviation, the inner string is not disabled from continued rotation within the bore of the tubular string, and other outer sleeves may continue to rotate to threaded disengagement in response to rotation of the inner pipe string without damage to or substantial impairment of the intended benefit provided by the invention.

[0041] The terms "comprising," "including," and "having," as used in the claims and specification herein, shall be considered as indicating an open group that may include other elements not specified. The terms "a," "an," and the singular forms of words shall be taken to include the plural form of the same words, such that the terms mean that one or more of something is provided. The term "one" or "single" may be used to indicate that one and only one of something is intended. Similarly, other specific integer values, such as "two," may be used when a specific number of things is intended. The terms "preferably," "preferred," "prefer," "optionally," "may," and similar terms are used to indicate that an item, condition or step being referred to is an optional (not required) feature of the invention. "Non-magnetic," as that term is used herein, refers to a substance that is substantially unaffected by, or does not substantially interfere with, a magnetic field. Non-limiting examples of non-magnetic substances include polymers, stainless steel, copper (e.g., nickel-copper alloy), aluminum and combinations thereof. However, the use of the term "non-magnetic" does not necessarily require the absolute absence of any substance that may be affected by or interfere with a magnetic field. For example, it is within the scope of the invention for a non-magnetic tubular segment to have articles disposed thereon or included therein that are sufficiently small so as not to substantially affect or interfere with a magnetic field.

[0042] From the foregoing detailed description of specific embodiments of the invention, it should be apparent that a system for enhancing the quality of cementing operations that is novel has been disclosed. Although specific embodiments of the system are disclosed herein, this is done solely for the purpose of describing various features and aspects of the invention, and is not intended to be limiting with respect to the scope of the invention. It is contemplated that various substitutions, alterations, and/or modifications, including but not limited to those implementation variations which may have been suggested herein, may be made to the disclosed embodiments without departing from the spirit and scope of the invention as defined by the appended claims which follow.

[0043] While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.

We claim:

1. A method of actuating a device comprising the steps of:

threadably receiving an outer sleeve, comprising a magnet, on an externally threaded portion of a non-magnetic tubular segment made up into a tubular string, the outer sleeve positioned intermediate the device and an adjacent energy storage member in a charged mode;

running the tubular string into an earthen borehole;

running a second magnet disposed on an inner pipe string into a bore of the non-magnetic tubular segment to position the second magnet proximal the magnet of the outer sleeve to form a magnetic clutch;

rotating the inner pipe string to rotate the outer sleeve from threaded engagement with the non-magnetic tubular segment using the magnetic clutch;

releasing energy stored in the energy storage member to displace the outer sleeve to actuate the device.

2. The method of claim **1** further comprising the steps of:

disposing a centralizer having a first collar, a second collar and a plurality of flexible ribs therebetween adjacent the outer sleeve;

securing at least one of the first and second collars of the bow spring centralizer to the tubular string; and

displacing the other of the first and second collars of the bow spring centralizer toward the one of the first and second collars to radially deploy the bow springs.

3. The method of claim **1** further comprising the steps of:

disposing a packing member intermediate a first collar and a second collar adjacent the outer sleeve;

securing the first collar to the tubular string; and

displacing the second collar toward the first collar to radially deploy the packing member.

4. The method of claim **1** further comprising the steps of:

disposing a cement basket having a first collar and a second collar adjacent the outer sleeve;

securing at least one of the first and second collars of the cement basket to the tubular string; and

displacing the other of the first and second collars of the cement basket toward one of the one of the first and second collars to radially expand the cement basket.

5. The method of claim **1** further comprising the steps of:

displacing a sleeve relative to a fluid port;

wherein the device is a valve.

6. The method of claim **1** wherein the energy storage member comprises a spring.

7. An actuator to actuate a device disposed on a tubular string run into a borehole, comprising:

an energy storage member intermediate a first collar and an outer sleeve threadedly received on a threaded portion of a non-magnetic tubular segment adjacent the device, the outer sleeve comprising a magnet; and

an inner pipe string to position a second magnet within the bores of the non-magnetic tubular segment and the outer sleeve to magnetically couple the inner pipe string to the outer sleeve;

wherein rotation of the inner pipe string in a first direction rotates the outer sleeve from threaded engagement with the non-magnetic tubular segment to release the energy storage member from a charged mode to displace at least one component of an actuatable device.

8. The apparatus of claim **7** further comprising a thrust bearing rotatably disposed intermediate the energy storage member and the outer sleeve.

9. The apparatus of claim **7** further comprising:

a second stop collar coupled to the non-magnetic tubular segment in a spaced-apart relationship from the first stop collar to together straddle the energy storage member, the outer sleeve and the device.

10. The apparatus of claim **7** wherein the non-magnetic tubular segment comprises stainless steel.

11. The apparatus of claim **7** wherein the non-magnetic tubular segment is removably attachable to a tubular string.

12. The apparatus of claim **7** wherein the energy storage member comprises a spring.

13. A deployable centralizer comprising:

an energy storage member intermediate a first stop collar and an outer sleeve threadedly coupled to a non-magnetic tubular segment adjacent the downhole device, the outer sleeve comprising a magnet;

an inner pipe string to position a second magnet within the bores of the non-magnetic tubular segment and the outer sleeve to magnetically couple the inner pipe string to the outer sleeve;

a centralizer having a plurality of flexible ribs coupled between a first end collar and a second end collar, the centralizer intermediate a second stop collar and the outer sleeve;

wherein threaded disengagement of the outer sleeve from the tubular segment releases energy from the energy storage member to displace the second end collar toward the first end collar to bow the ribs.

14. The deployable centralizer of claim **13** wherein the second stop collar is integral with the first end collar of the centralizer.

15. The deployable centralizer of claim **13** comprising a stop collar disposed intermediate the first end collar and the second end collar.

16. The deployable centralizer of claim **13** further comprising a thrust bearing disposed between the outer sleeve and the energy storage member.

17. The deployable centralizer of claim **13** wherein the non-magnetic tubular segment comprises stainless steel.

18. A deployable packer to engage a bore comprising:

an energy storage member intermediate a first stop collar and an outer sleeve threadedly coupled to a non-magnetic tubular segment, the outer sleeve comprising a magnet; and

an inner pipe string to position a second magnet within the bores of the non-magnetic tubular segment and the outer sleeve to magnetically couple the inner pipe string to the outer sleeve;

a second stop collar coupled to the tubular segment in a spaced-apart relationship with the first stop collar to together straddle the energy storage member and outer sleeve; and a packing member received on the tubular segment intermediate the second stop collar and the outer sleeve;

wherein upon rotation of the inner pipe string, the outer sleeve threadedly disengages the outer sleeve from the non-magnetic tubular segment to allow the energy storage member to displace the outer sleeve against the packing member;

wherein the packing member is radially expanded by engagement with the outer sleeve to engage a bore.

19. The deployable packer of claim **18** wherein the non-magnetic tubular segment comprises stainless steel.

20. The deployable packer of claim **18** further comprising a thrust bearing disposed between the outer sleeve and the energy storage member.

21. The deployable packer of claim **18** wherein the energy storage member comprises a spring.

22. A method of deploying a centralizer to an expanded mode within a bore comprising the steps of:

threadably receiving an outer sleeve having a magnet on an externally threaded portion of a non-magnetic tubular segment made up into a tubular string, the outer sleeve positioned intermediate a centralizer and an energy storage member;

running the tubular string into an earthen borehole;

running a second magnet on an inner pipe string into a bore of the non-magnetic tubular segment to position the second magnet proximal the magnet of the outer sleeve to form a magnetic clutch;

rotating the inner pipe string to rotate the outer sleeve from threaded engagement with the non-magnetic tubular segment; and

releasing energy from the energy storage member to displace the outer sleeve against an end collar of the centralizer to deploy the centralizer to an expanded mode.

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