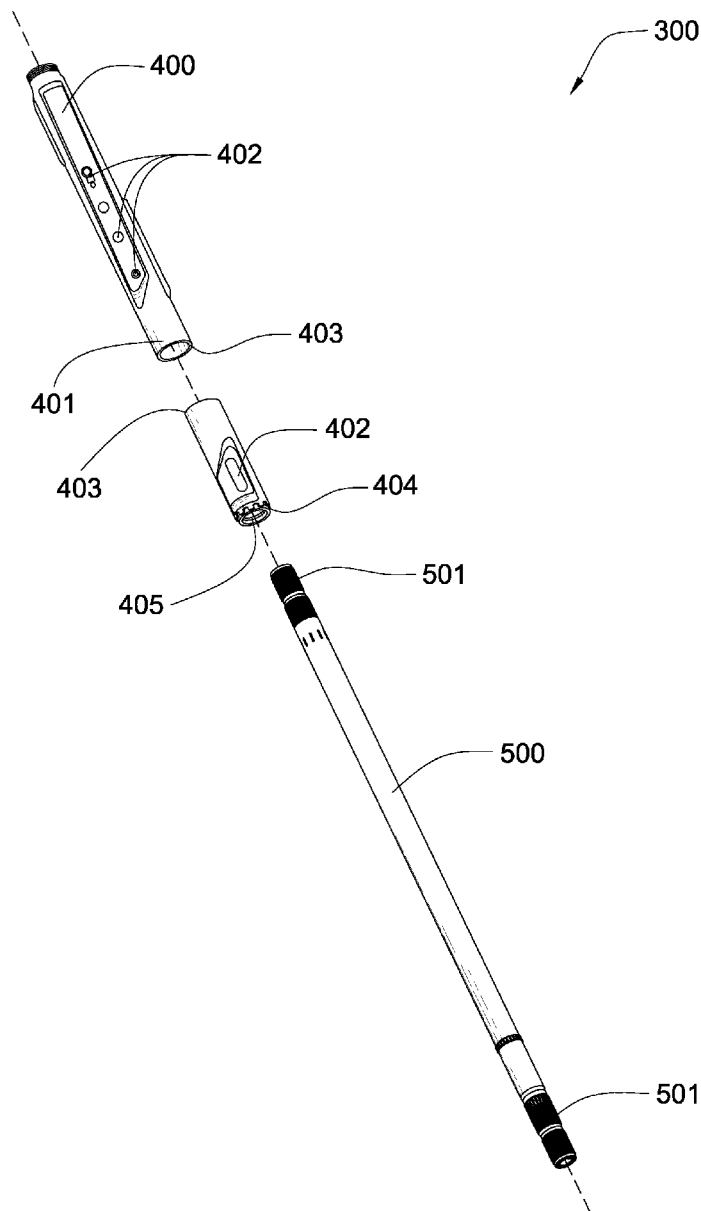


(43) **Pub. Date:** **Jan. 29, 2009**

(22) Filed: **Jul. 26, 2007**



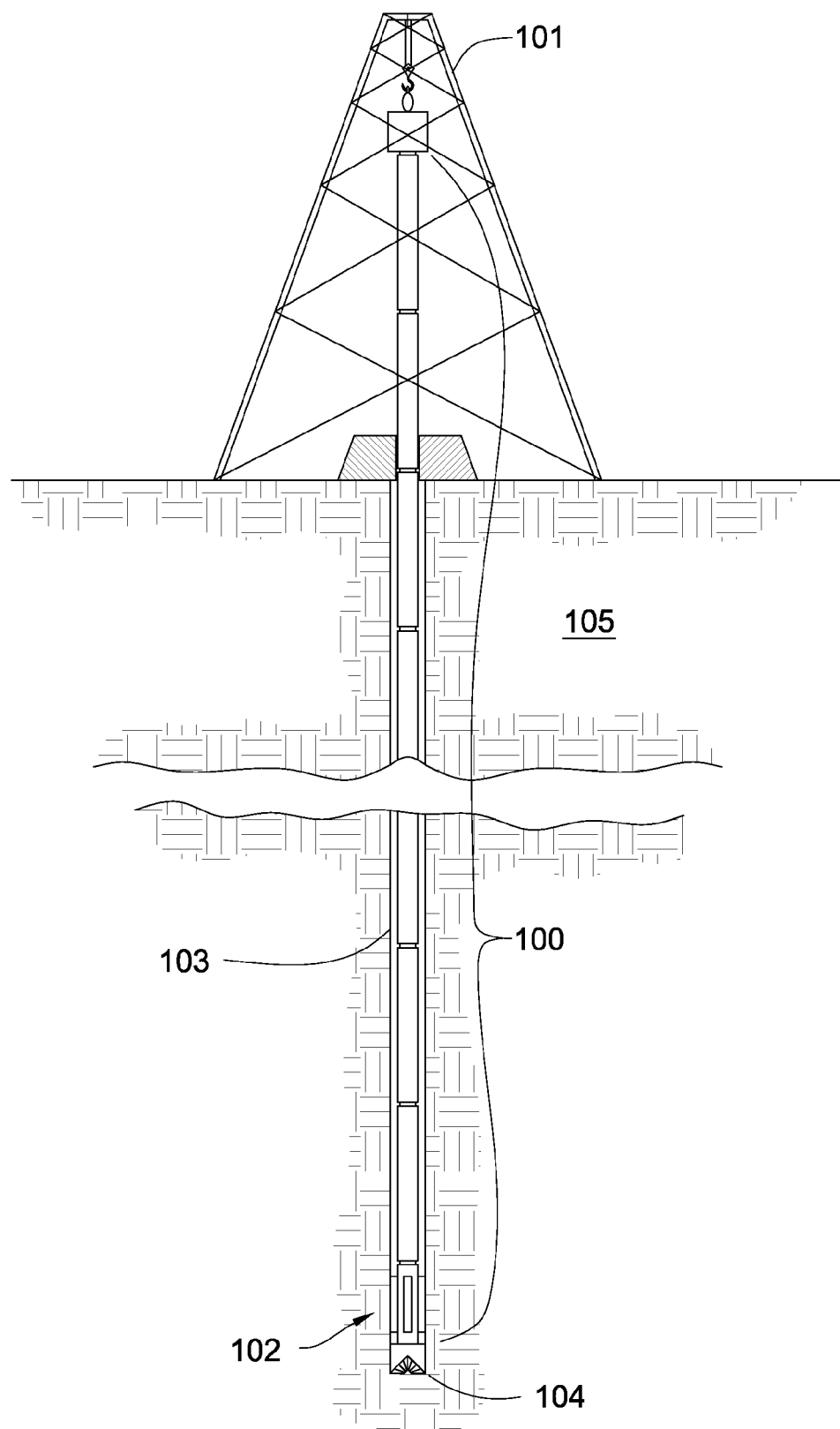
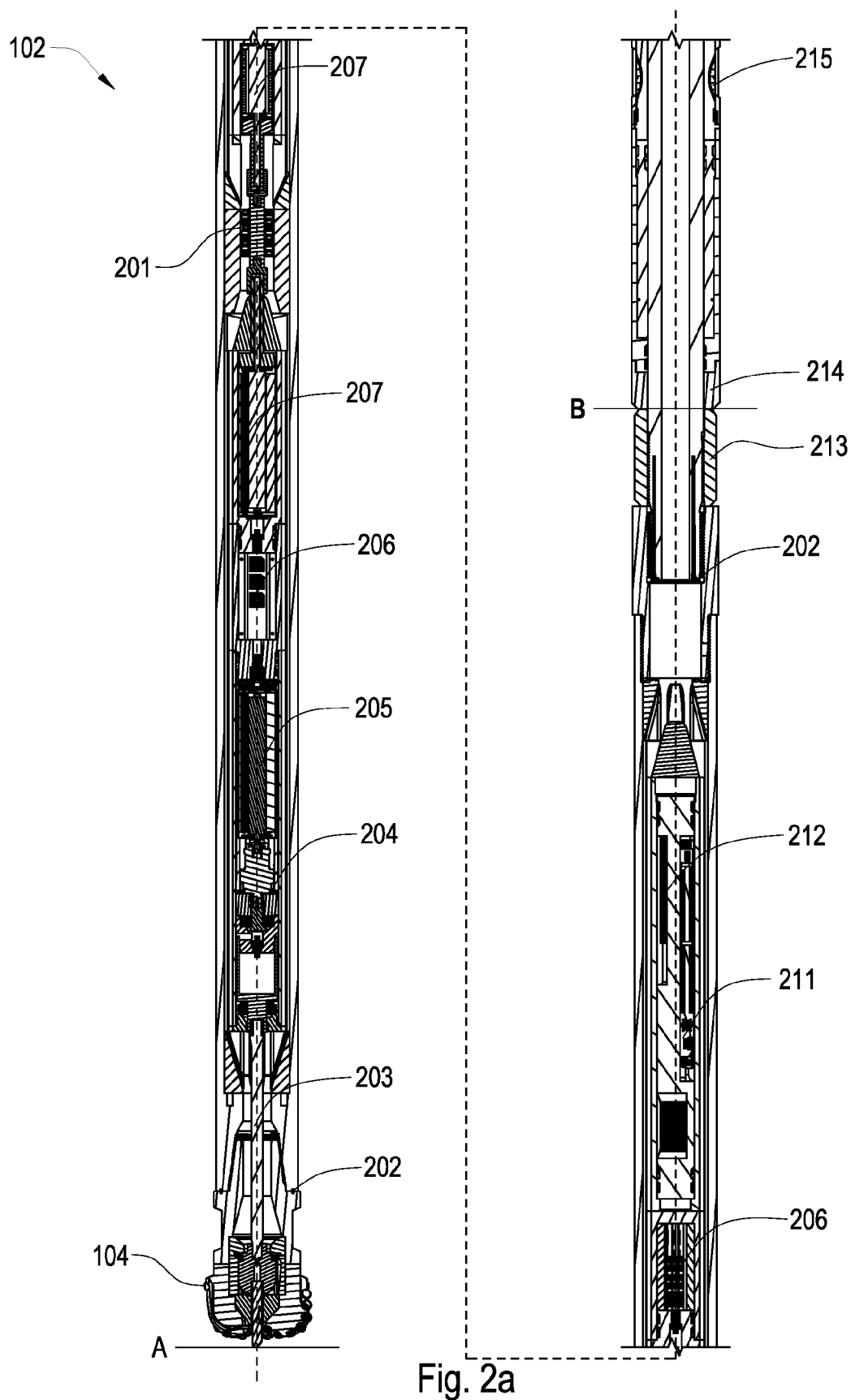
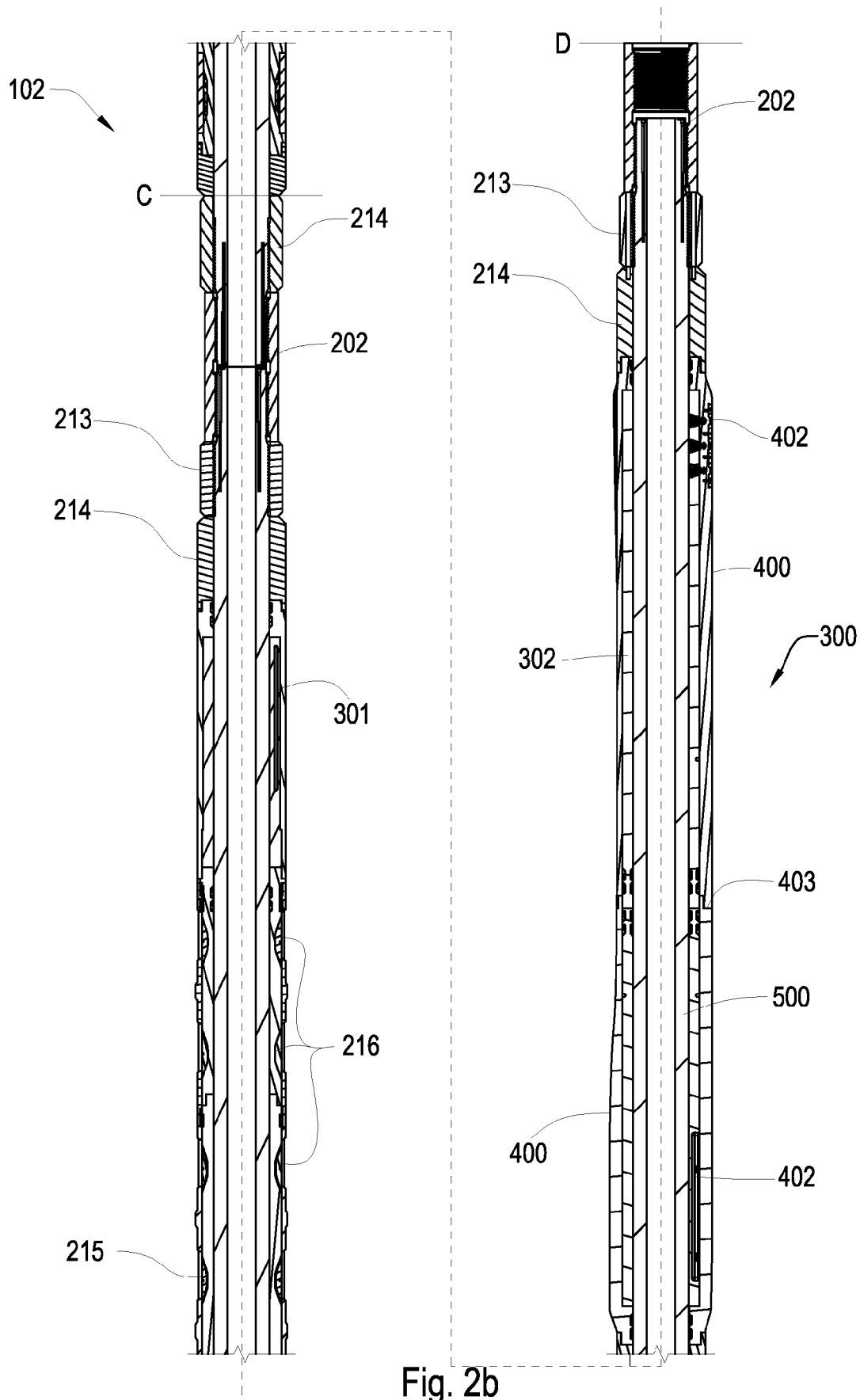
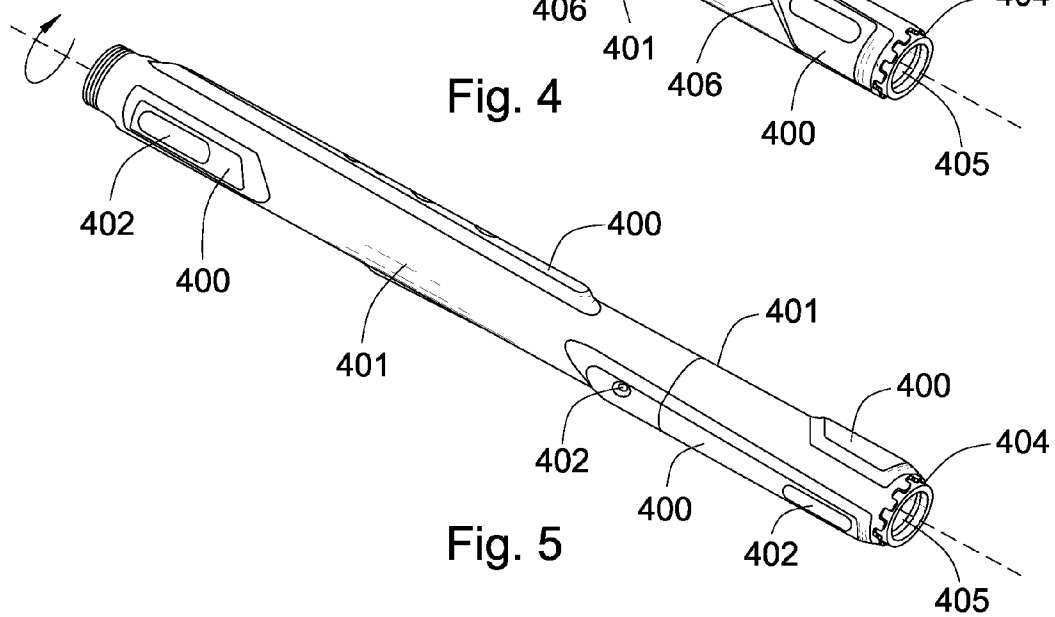
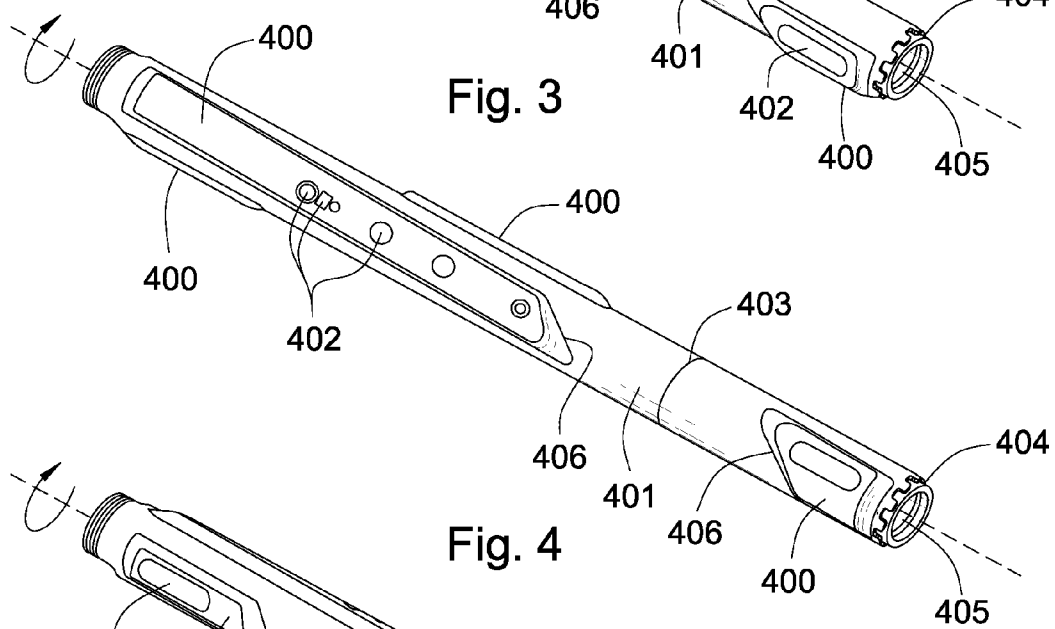
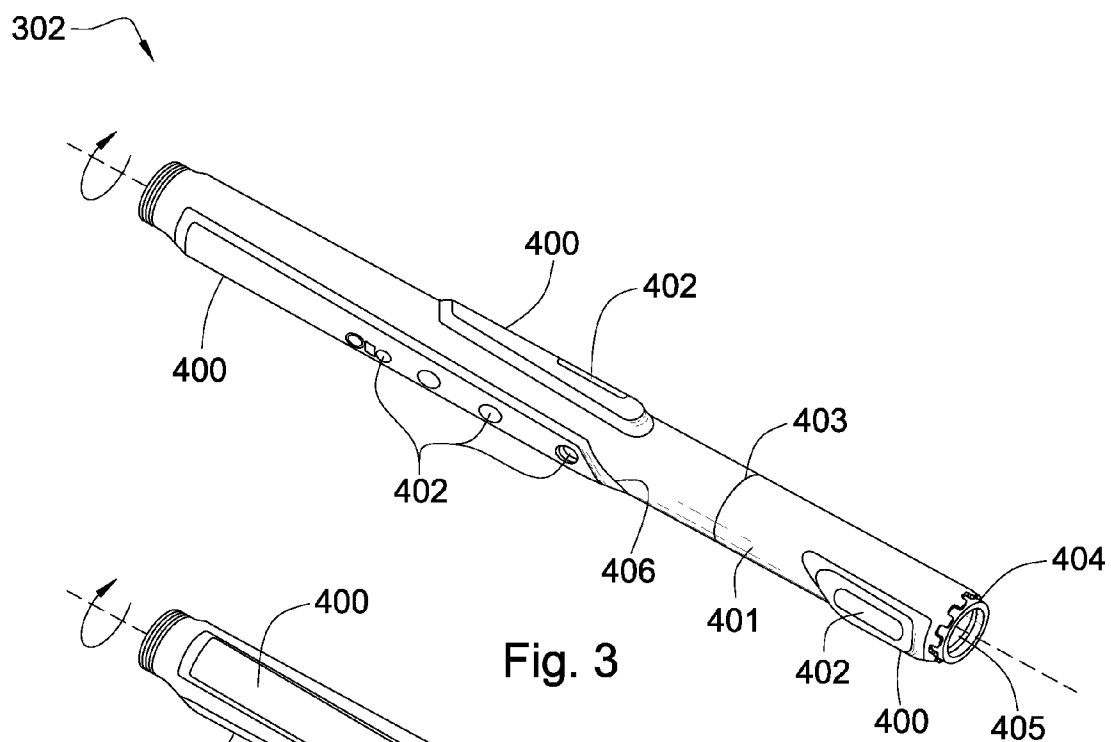


Fig. 1







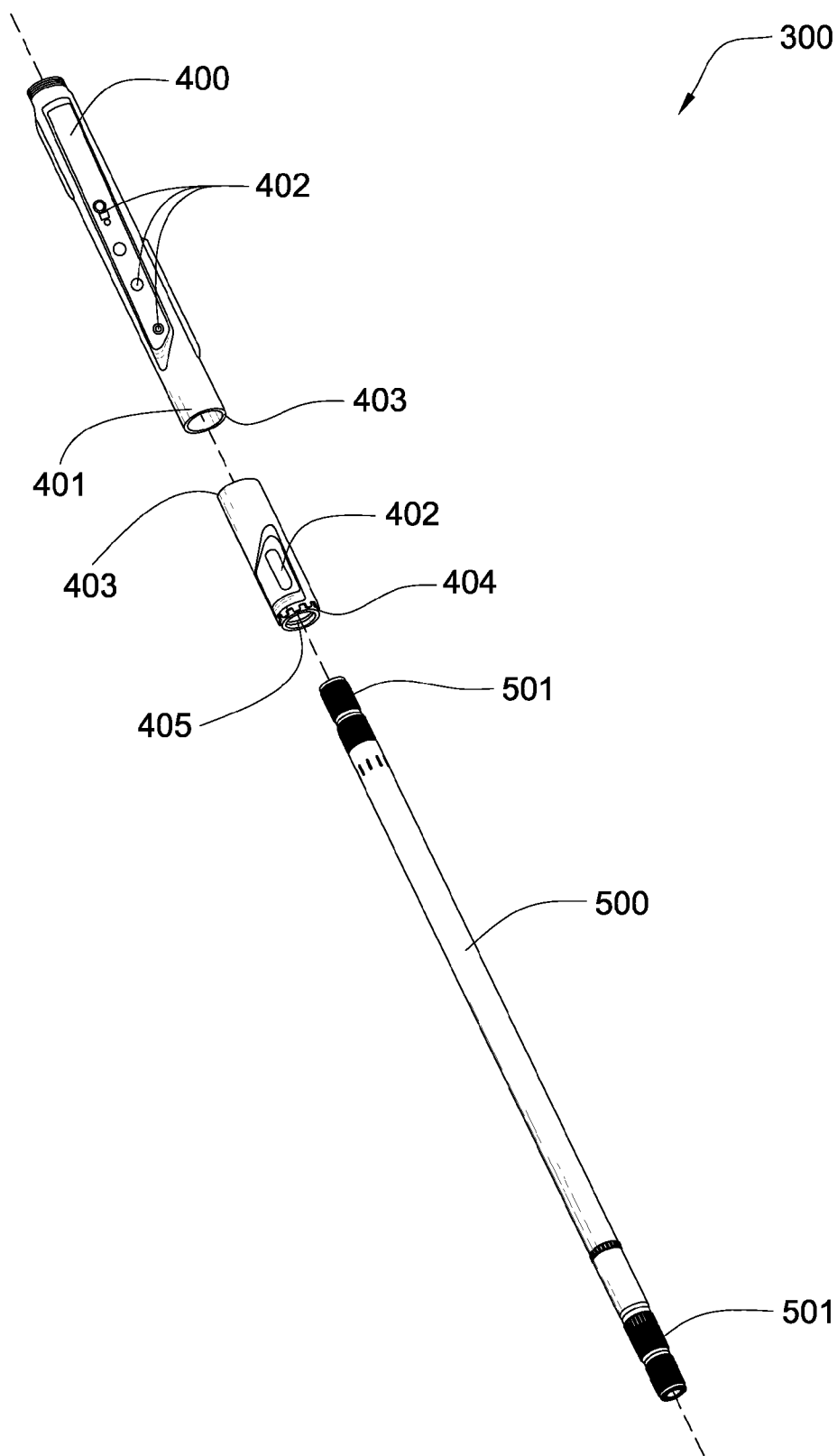


Fig. 6

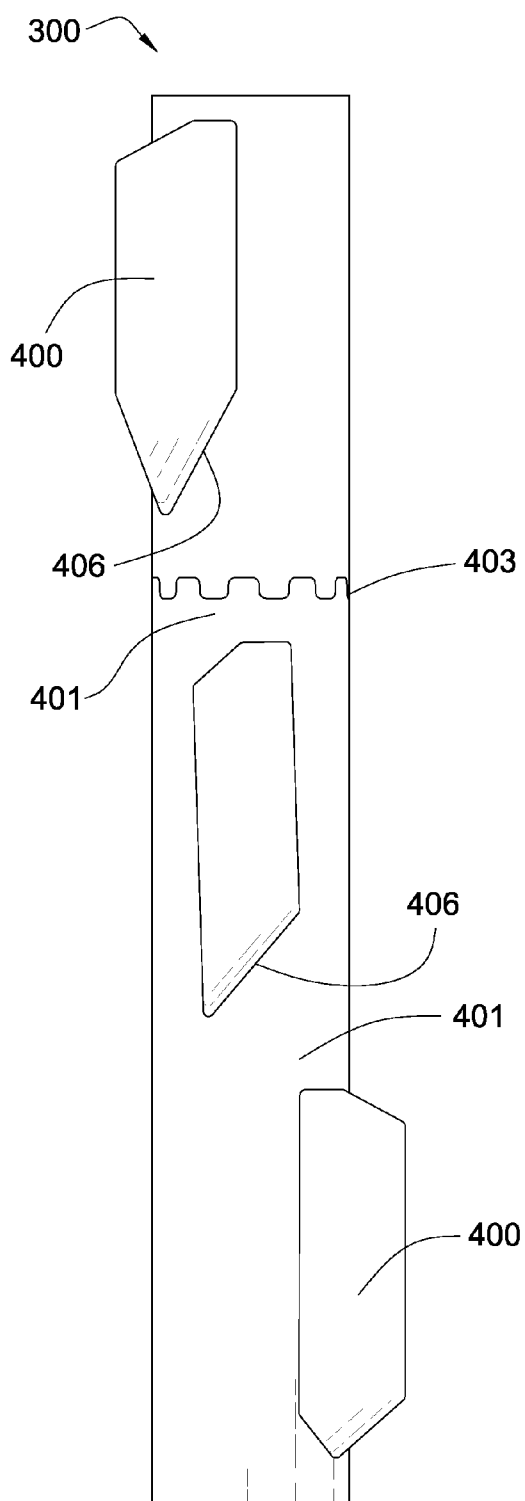


Fig. 7

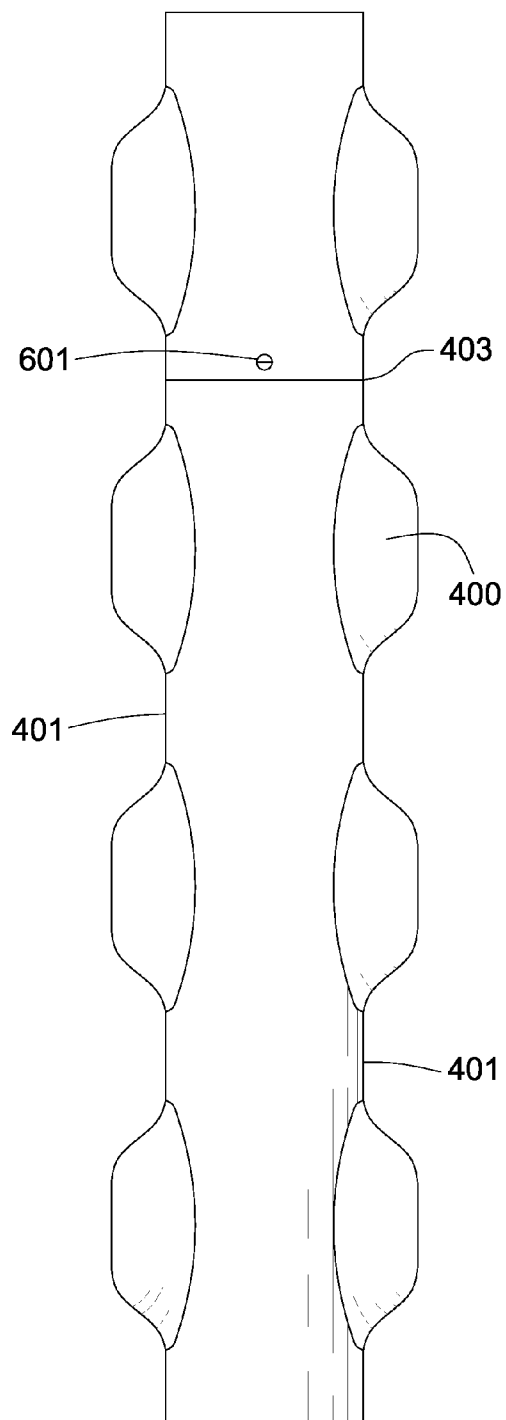


Fig. 8

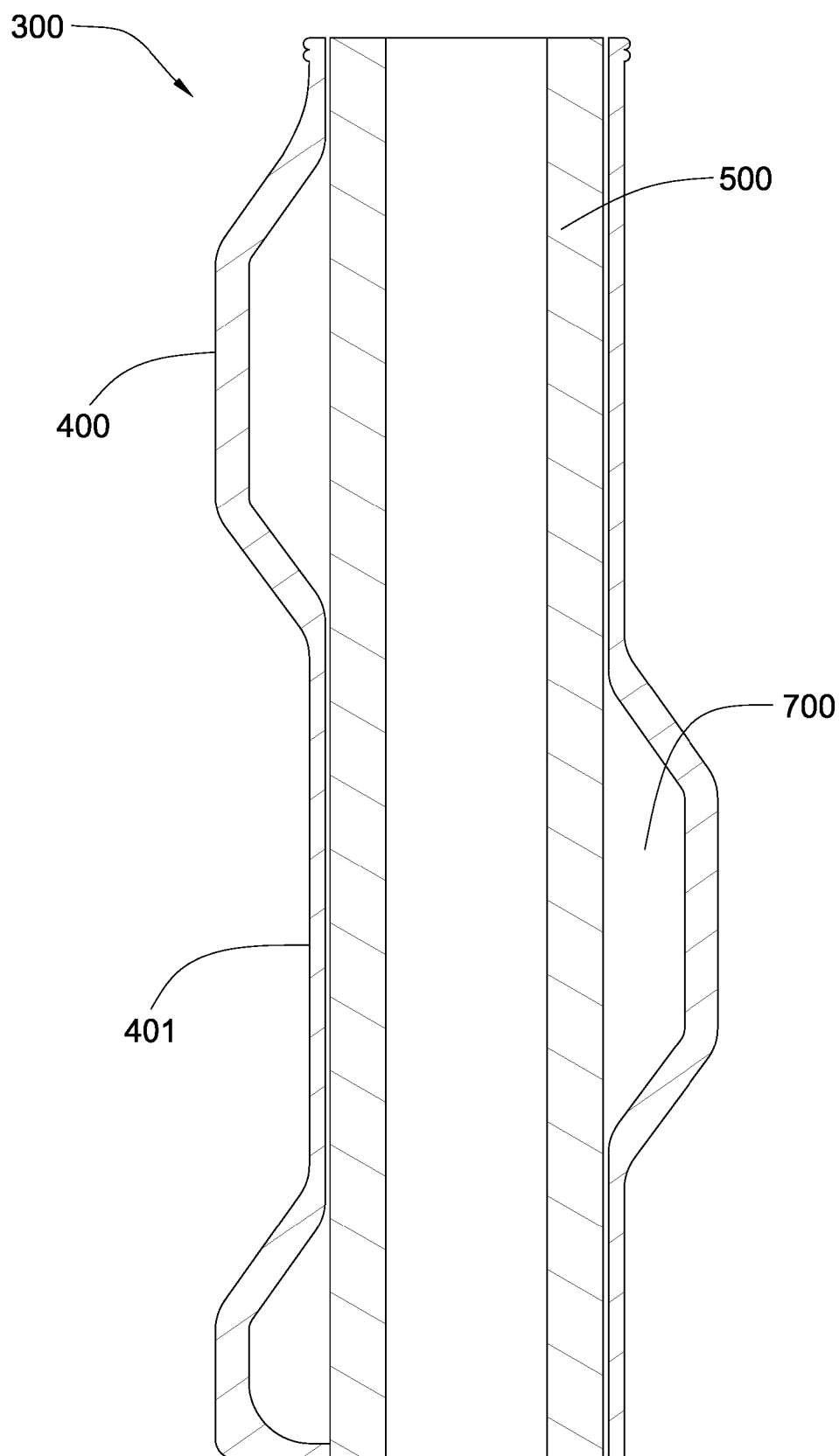


Fig. 9

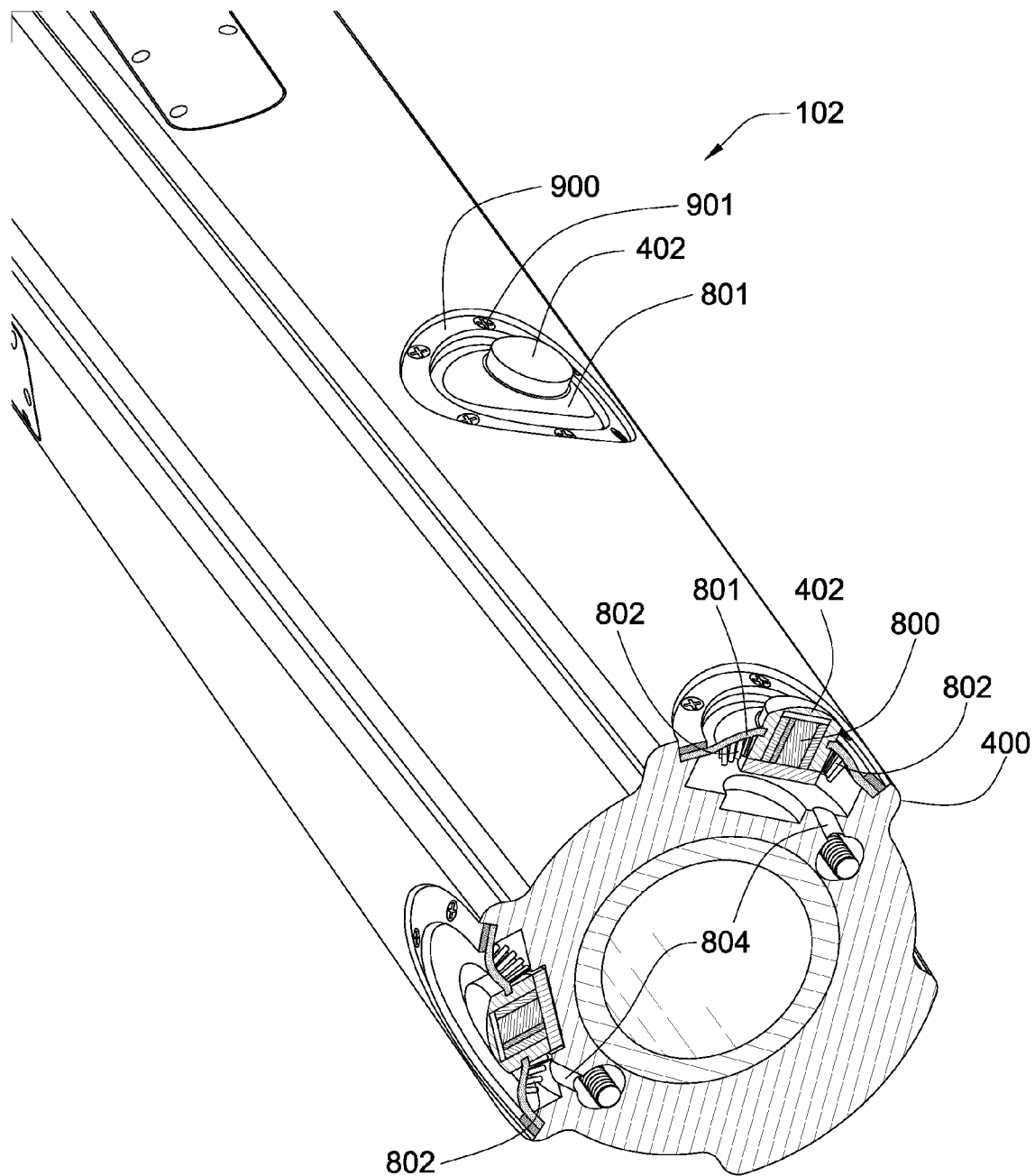


Fig. 10

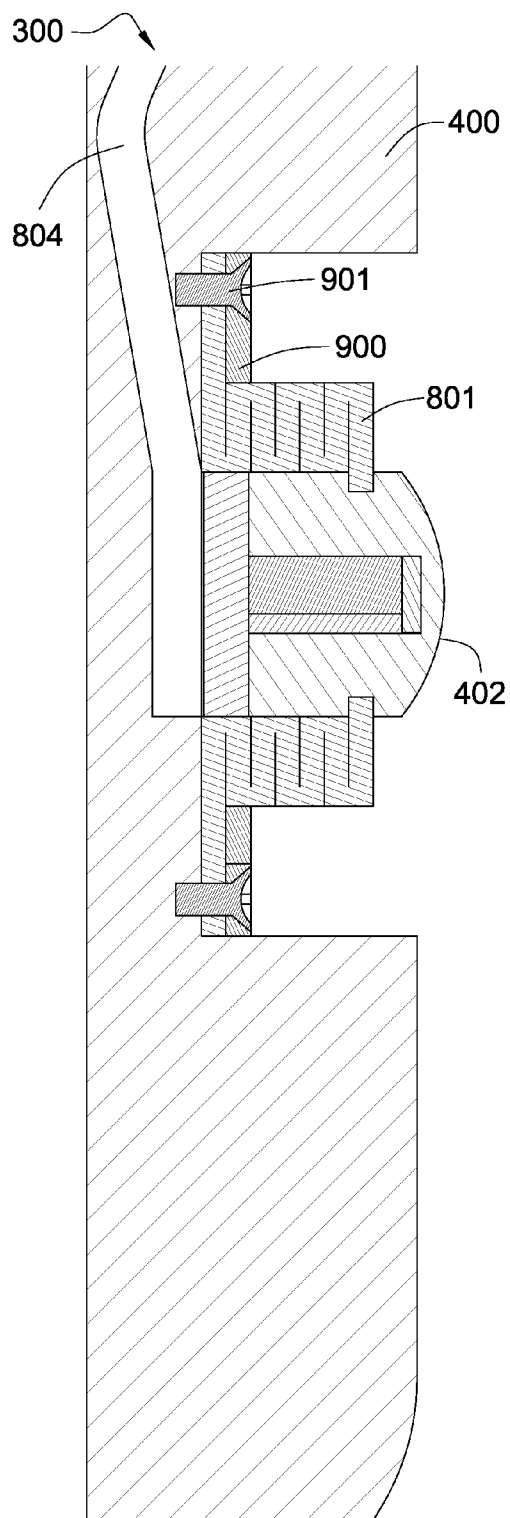


Fig. 11

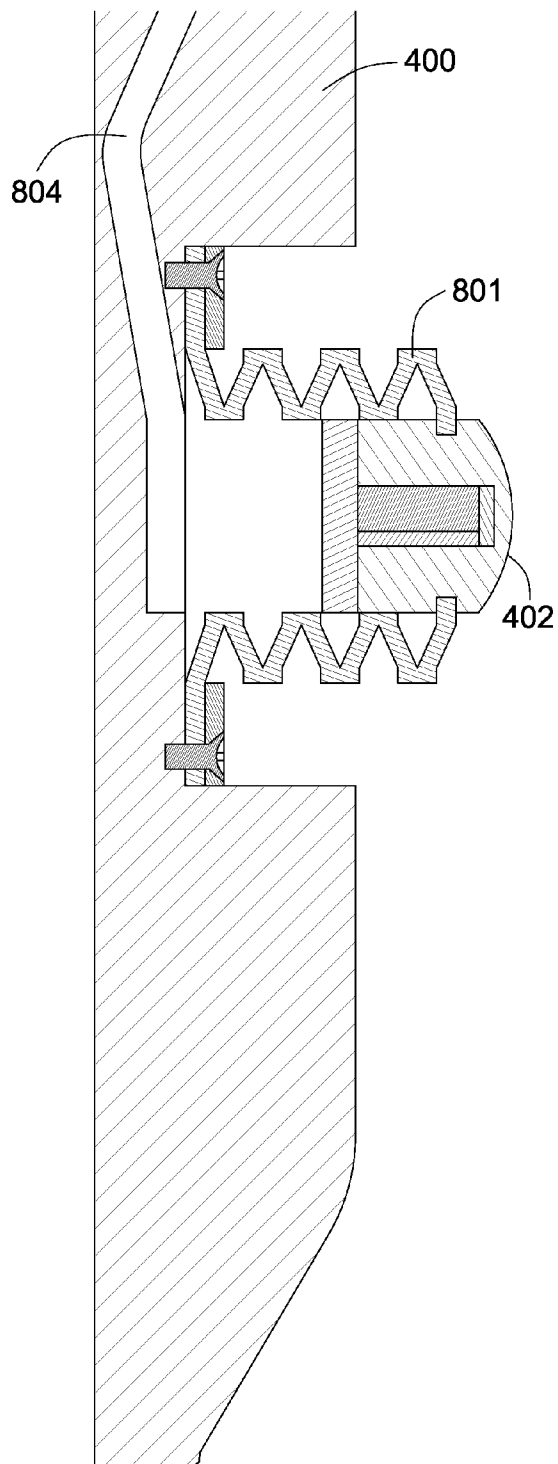


Fig. 12

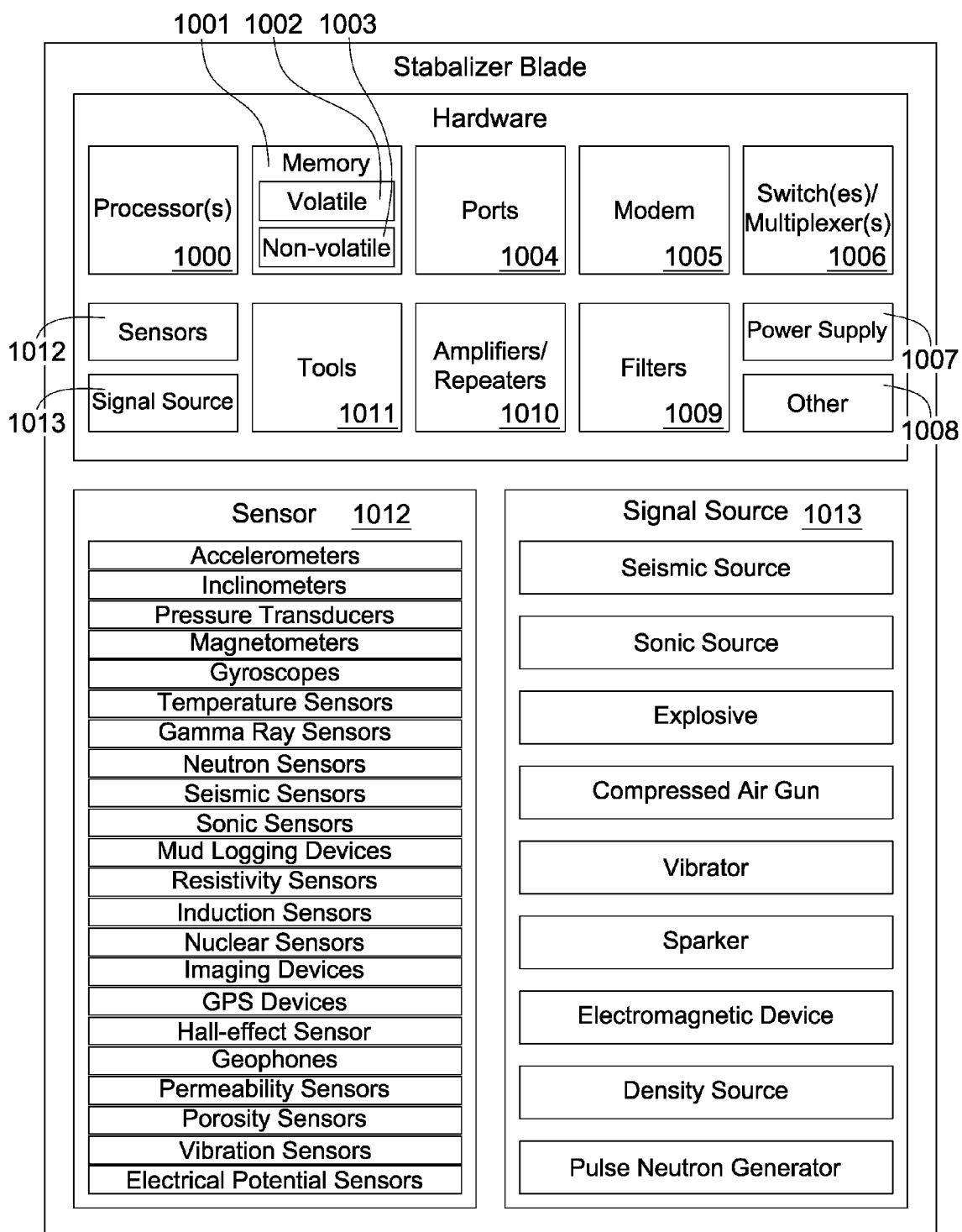


Fig. 13

STABILIZER ASSEMBLY

BACKGROUND OF THE INVENTION

[0001] The present invention relates to stabilizer assemblies, specifically stabilizer assemblies for use in oil, gas and geothermal drilling. Stabilizer assemblies are placed on a downhole tool string component to centralize the drill string in the bore hole.

[0002] U.S. Pat. No. 4,685,895 to Hatten which is herein incorporated by reference for all that it contains, discloses a stabilizer mechanism for guiding drill direction of a flexible drill string when drilling the straight portion of a deviated well bore. The stabilizing mechanism comprises a tubular mandrel adapted for connection between the flexible drill string and a drill bit. The mandrel has at least two, reduced diameter areas spaced apart and disposed axially along its length. A non-rotating type stabilizer sleeve is positioned on each of the reduced diameter areas. Bearing means is provided at each end of each of the sleeves to reduce wear. The mandrel is capable of traversing a short radius curve of a deviated well.

[0003] U.S. Pat. No. 6,564,883 to Fredericks et al. which is herein incorporated by reference for all that it contains, discloses a logging-while-drilling method and apparatus for obtaining information about a formation uses a plurality of rib sets with pad-mounted sensor on one or more selectively non-rotating sleeves attached to a rotating housing that is part of a drilling assembly. The sensors may be density, neutron, NMR, resistivity, sonic, dielectric or any number of other sensors. In an alternative arrangement, the sensors rotate with the drill string.

[0004] U.S. Pat. No. 5,250,806 to Rhein-Knudsen et al. which is herein incorporated by reference for all that it contains, discloses an apparatus and method for measuring density, porosity and other formation characteristics while drilling. The apparatus, preferably housed in a drill collar and placed within a drill string, includes a source of neutrons and a source of gamma rays placed within a tubular body which is adapted to provide for the flow drilling through it. Two sets of stabilizer blades are provided. One set, associated with the neutron source, includes secondary radiation detectors that are placed radially beyond the nominal outer radius of the body. Formation porosity measurement accuracy is substantially enhanced since the standoff of the detectors from the formation is substantially decreased. Another set, associated with the gamma ray source, includes one or more gamma ray detection assemblies in a single blade. Each of the gamma ray detector assemblies is also placed radially beyond the nominal outer radius of the tubular wall.

[0005] U.S. Pat. No. 6,622,803 to Harvey et al. which is herein incorporated by reference for all that it contains, discloses a stabilizer especially adapted for use with a drill string having an eccentric drilling element, such as a bi-center bit. The stabilizer has a pair of circumferentially displaced blades that lie in a common circumferential plane and extend from a rotatable sleeve supported on the stabilizer body, as well as a stationary blade. The rotating blades are aligned with the stationary blade when in a first circumferential orientation are disposed so that the mid-point between the rotating blades is located opposite the stationary blade, thereby providing full gauge stabilization, when the rotating blades are in a second circumferential orientation. A magnetic system senses the circumferential orientation of the rotating blades and transmits the information to the surface via mud pulse telemetry. A

piston actuated by the drilling mud locks the rotating blades into the active and inactive positions. A brake shoe located on the distal end of each rotating blade provides contact with the walls of the bore hole and serves as a support pad for a formation sensor.

BRIEF SUMMARY OF THE INVENTION

[0006] In one aspect of the present invention, a stabilizer assembly on a downhole tool string component, comprising a sleeve slideably attached to a mandrel of the tool string component. At least one stabilizer blade is formed in the sleeve and generally follows the length of the sleeve. A gap is formed in the at least one blade separating a first and second portion of the blade.

[0007] The gap may be 3.5 feet long and may be at least one foot long. The length of the gap may be at least twice the width of the blade. The first and second portion of the blade may be offset. The first or second portion may be less than 5 feet long. The gaps may add compliance to the stabilizer.

[0008] A plurality of gaps may be formed in the at least one blade. The plurality of gaps may be offset one from another. The plurality of gaps may be the same size. The plurality of gaps may be force or mass balanced with respect to the rotation of the downhole tool string. The stabilizer may be in gauge, near gauge, or under gauge with respect to the bit gauge. The stabilizer blades may be replaceable to change the gauge or the compliancy of the stabilizer depending on the application or replace it after significant wear.

[0009] At least one instrumentation device may be disposed in the at least one blade to gather subterranean data. The at least one instrumentation device may comprise at least one signal source. The signal source may be a seismic source, a sonic source, an explosive, a compressed air gun, a vibrator, a sparker, an electromagnetic device, a density source, a pulse neutron generator or combinations thereof.

[0010] The at least one instrumentation device may comprise at least one sensor. The at least one sensor may be selected from the group consisting of accelerometers, inclinometers, pressure transducers, magnetometers, gyroscopes, temperature sensors, gamma ray sensors, neutron sensors, seismic sensors, sonic sensors, mud logging devices, resistivity sensors, induction sensors, nuclear sensors, imaging devices, GPS devices, Hall-effect sensors, permeability sensors, porosity sensors, vibration sensors, electrical potential sensors, geophones or combinations thereof.

[0011] The at least one instrumentation device may be powered by a turbine, a battery, or a power transmission system from the surface or downhole. The at least one instrumentation device may be in communication with a downhole telemetry system. The at least one instrumentation device may be passively decoupled from the stabilizer assembly. The at least one instrumentation device may be actively decoupled from the stabilizer assembly.

[0012] At least one pocket may be formed on an inner diameter of the sleeve. The sleeve may be segmented. A contour of the blade at an end of the blade may have a biased curvature to accommodate mud flow. The segmented sleeve may be joined mechanically. The segmented sleeve may be joined through a castle connection. The segmented sleeve may allow for lengthening or shortening of the stabilizer assembly. In embodiments where the stabilizer assembly accommodates formation instrumentation, more or less instrumentation may be added or to modify the compliancy

of the stabilizer to either enhance or minimize drill bit deviation for accomplishing drilling trajectories.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a perspective diagram of an embodiment of a drill string suspended in a bore hole.

[0014] FIG. 2a is a cross-sectional diagram of an embodiment of a first portion of a bottom-hole assembly.

[0015] FIG. 2b is a cross-sectional diagram of an embodiment of a second portion of a bottom-hole assembly.

[0016] FIG. 3 is a side perspective diagram of an embodiment of a stabilizer assembly.

[0017] FIG. 4 is a side perspective diagram of an embodiment of the stabilizer assembly rotated on an axis.

[0018] FIG. 5 is a side perspective diagram of an embodiment of the stabilizer assembly rotated on an axis.

[0019] FIG. 6 is an exploded diagram of an embodiment of a stabilizer assembly.

[0020] FIG. 7 is a side perspective diagram of another embodiment of a stabilizer assembly.

[0021] FIG. 8 is a side perspective diagram of another embodiment of a stabilizer assembly.

[0022] FIG. 9 is a cross-sectional diagram of an embodiment of a stabilizer assembly.

[0023] FIG. 10 is a cross-sectional diagram of an embodiment of a hydraulic system used with an instrument device in accordance with a stabilizer assembly.

[0024] FIG. 11 is a cross-sectional diagram of another embodiment of a hydraulic system used with an instrumentation device in accordance with a stabilizer assembly.

[0025] FIG. 12 is a cross-sectional diagram of another embodiment of a hydraulic system used with an instrumentation device in accordance with a stabilizer assembly.

[0026] FIG. 13 is a schematic block diagram illustrating certain embodiments of hardware.

DETAILED DESCRIPTION OF THE INVENTION AND THE PREFERRED EMBODIMENT

[0027] Referring now to the figures, FIG. 1 is a cross-sectional diagram of an embodiment of a drill string 100 suspended by a derrick 101. A bottom-hole assembly 102 is located at the bottom of a bore hole 103 and comprises a bit 104 and a stabilizer assembly. As the drill bit 104 rotates down hole the drill string 100 advances farther into the earth. The drill string 100 may penetrate soft or hard subterranean formations 105.

[0028] FIGS. 2a through 2b disclose a cross-sectional diagram of the bottom-hole assembly 102. The portion intermediate point A and point B may comprise the steering assembly of the bottom hole assembly 102 that directionally guides the drill string 100 through the formation 105. An embodiment of the steering assembly that may be compatible with the present invention is disclosed in the patent application Ser. No. 11/611,310 to Hall, which is herein incorporated by reference for all it contains.

[0029] The steering assembly may comprise a mud turbine 201 or battery used to power electronic instrumentation devices and tools disposed in the bottom-hole assembly 102. The turbine 201 may be in communication with power generators 207 creating a power supply for the bottom-hole assembly 102 and drill string 100. The steering assembly may also comprise power converters 206 to adapt the electrical output of the power source 201 to an AC power source. The

steering assembly may also comprise a steering motor 205, a steering motor control 206, and a steering hammer 203 to steer the bottom-hole assembly 102 and drill string 100 through the formation 105. The steering assembly may also comprise a gear box 204 to control the rpm of the steering hammer 203. Inclination and direction sensors 211 may also be disposed within the steering assembly to detect the location of the bottom-hole assembly 102 downhole. A telemetry network link 212 is also disposed within the steering assembly.

[0030] The bottom-hole assembly 102 may also comprise a resistivity tool disposed intermediate point B and point C adapted to obtain evaluation data of a formation 105. Transmitters 215 communicate a signal into the formation 105 and sensors 216 detect the signal as it travels through the formation 105 determining the resistivity of the formation 105. A preferred embodiment of the resistivity tool is disclosed in the patent application Ser. No. 11/776,447 to Snyder, which is herein incorporated by reference for all it contains.

[0031] The embodiments of the bottom-hole assembly 102 in FIGS. 2a through 2b disclose a stabilizer assembly 300 intermediate point C and point D. The stabilizer assembly 300 may comprise a sleeve slideably attached to a mandrel 500. The sleeve 300 may have at least one stabilizer blade that generally follows the length of the sleeve 300 and extends outward from the center axis of the bore hole 103 to engage the formation 105 maintaining the bottom-hole assembly 102 approximately centered in the bore hole 103.

[0032] The stabilizer of the present invention is adapted to maximize the stabilizer blade contact with the borehole thereby improving the coupling of formation instrumentation in the stabilizer with the formation, improve signal strength, and reduce noise. The stabilizer blades may be shaped in a spiral to reduce shocks and vibrations.

[0033] The stabilizer assembly 300 may have a gap formed in the at least one blade 400 and separating the blade 400 into a first and second portion. Often in oil, gas, or geothermal drilling applications subterranean formations 105 may dictate drilling along deviated paths to avoid hazards or to improve hydrocarbon or geothermal production. It is believed that the gap will reduce the stiffness of the stabilizer assembly 300 allowing the bottom hole assembly to more easily follow a deviated or radial path through the formation 105. A mechanical joint 403 may also be formed in the sleeve 302, segmenting the sleeve 302 to further reduce the stiffness of the stabilizer assembly 300.

[0034] The stabilizer assembly 300 may also comprise at least one instrumentation device 402 disposed in the blades 400. The at least one instrumentation device 402 may be powered by the turbine 201, a battery, or a power transmission system from the surface or down hole.

[0035] The at least one instrumentation device 402 may also transmit data through a downhole telemetry system. A preferred method of downhole data transmission using inductive couplers 202 disposed in tool joints is disclosed in the U.S. Pat. No. 6,670,880 to Hall, et al, which is herein incorporated by reference for all it discloses. An alternate data transmission path may comprise direct electrical contacts in tool joints such as in the system disclosed in U.S. Pat. No. 6,688,396 to Floerke, et al., which is herein incorporated by reference for all that it discloses. Another data transmission system that may also be adapted for use with the present invention is disclosed in U.S. Pat. No. 6,641,434 to Boyle, et al., which is also herein incorporated by reference for all that

it discloses. In some embodiments of the present invention alternative forms of telemetry may be used to communicate with the bottom-hole assembly 102, such as telemetry systems that communicate through the drilling mud or through the earth. Such telemetry systems may use electromagnetic or acoustic waves. The alternative forms of telemetry may be the primary telemetry system for communication with the tool string 100 or they may be back-up systems designed to maintain some communication if the primary telemetry system fails.

[0036] FIGS. 3 through 5 disclose an embodiment of the sleeve 302 rotated about a central axis. The sleeve may have three blades 400, and a gap 401 may be formed in two of the three blades 400. A contour 406 of the blades 400 at an end of the blades 400 may have a biased curvature to enhance mud and/or cutting flow. Often in oil, gas, or geothermal drilling an unbalanced drill string 100 may cause a drill bit 104 to rotate in an irregular, undesirable manner that could damage the drill string 100 and the bore hole 103. The gaps 401 may be sized so as to be mass and/or force balanced with respect to the rotation of the downhole tool string 100 preventing the drill string from rotating irregularly. In some embodiments, the gaps may be 1 foot to 3.5 feet long depending on the desired flexibility of the stabilizer assembly. In some embodiments, the gaps 401 may be at least twice the width of the blade 400. The gaps 401 may also vary in length one from the other so as to possibly make one side of the stabilizer assembly 300 more flexible than the other, or they may have the same length so as to create a uniform flexibility throughout the stabilizer assembly 300. FIG. 6 discloses an exploded diagram of the sleeve 302 and the mandrel 500 that fits within the sleeve 302. The ends 501 of the mandrel 500 are adapted to axially connect the stabilizer assembly 300 to the drill string 100.

[0037] Now referring to FIG. 7, the stabilizer assembly 300 may have a blade 400 that spirals gradually around the circumference of the sleeve 302. A plurality of gaps 401 may divide at least one blade 400 into three portions. It is believed that a plurality of gaps 401 may further increase the flexibility of the stabilizer assembly 300. As a result of the spiral geometry of the blade 400, the first, second and third portion of the blade 400 may be offset and the multiple gaps 401 in the plurality of gaps 401 offset. The sleeve 302 may be segmented and a castle connection may be used as the mechanical joint 403. A pin 601 may also be adapted to function as a mechanical joint 403 in the segmented sleeve 302 as disclosed in FIG. 8. The plurality of gaps 401 may also divide the blades 400 into more than three portions as in FIG. 8.

[0038] FIG. 9 discloses a stabilizer assembly 300 with at least one pocket 700 formed on an inner diameter of the sleeve. The at least one pocket 700 may also be formed within the blades 400. The at least one pocket may be adapted to house the at least one instrumentation device 402.

[0039] Referring to FIG. 10, the instrumentation devices 402 may be actively or inactively decoupled to the blade 400 by way of damping elements 801 which in the actively decoupled case may allow the instrumentation devices 402 to extend toward the borehole 103 wall. The damping elements 801 may serve to substantially isolate the instrumentation devices 402 from vibrations or other waves propagating through the stabilizer assembly 300. Furthermore, the damping elements 801 may seal openings between the instrumentation devices 402 and the stabilizer assembly 300, not only to prevent the passage of materials or contaminants there-

through, but to also to enable hydraulics or other sealed actuating mechanisms 804 to press the instrumentation devices 402 against the borehole 103 wall, actively decoupling the instrumentation devices 402 from the stabilizer blade 400. Such actuators 804 are described in more detail in the patent application Ser. No. 11/162,505 to Cox et. al, which is herein incorporated by reference for all it contains. In certain contemplated embodiments, the diaphragms 801 may be secured to the blade 400 by way of a ring 900 or other coupling element 900, which may be attached to the blade 400 with screws 901 or other attachment means known to those skilled in the art.

[0040] In the illustrated embodiment of FIG. 10, the damping element 801 is configured as a diaphragm 801 which may be deformed in response to an applied pressure differential. In certain embodiments, the diaphragm 801 may be constructed of a flexible elastomeric material capable of withstanding the rigors of a downhole environment. Furthermore, the diaphragm 801 may also provide a safety mechanism to prevent the receiver from becoming stuck in the borehole. For example, if the instrumentation devices 402 become stuck against the borehole 103 wall, the diaphragms 801 may be designed to rupture when the drill string 100 is rotated. If the instrumentation devices 402 are actuated by a hydraulic or other fluid-actuated system 804, the rupture may cause the hydraulic or other fluid to release, thereby freeing the instrumentation devices 402. Although this may impair the function of the instrumentation devices 402 until the diaphragms 801 are repaired, it provides some assurance that the drill string 100 will not become stuck in the borehole. In selected embodiments, the inside of the diaphragm 801 may be filled with an open-cell foam made up of an elastomeric material filled with microscopic particles of tungsten. In other embodiments, the diaphragm 801 itself may be filled with similar particles. Such composite materials are known to strongly dampen sound. Since foam is difficult to render, an array of polymer rods 802 has been substituted for the foam in the drawing. The diaphragm 801 may be actuated by a lossy fluid, such as a low-viscosity silicone oil filled with dense particles, such as barite or tungsten. The dense particles may be synthesized at nanometer size or may be milled to that size, so as to remain permanently in suspension in the fluid. Such fluids are also known to have strong sound-damping characteristics.

[0041] Now Referring to FIGS. 11 and 12, in another embodiment, the damping element 801 may be embodied as a bellows 801, such as a metal bellows 801. When inflated with a fluid, such as a gas or liquid, the bellows 801 may expand to extend the instrumentation device 402 against the borehole 103 wall. A shoe 900 comprising various attachment elements 901, such as screws, rivets, welds, or the like, may secure the outer edges of the bellows 801 to the blade 400. FIGS. 11 and 12 show the bellows 801 in an inwardly relaxed and outwardly extended state, respectively, to show the contemplated movement of the bellows 801 and instrumentation devices 402.

[0042] Referring to FIG. 13, the stabilizer assembly 300 may include hardware 1050 to increase the functionality of the stabilizer assembly 300. The hardware 1050 may include one or several processors 1000 capable of processing or executing instructions or other data. Processors 1000 may include hardware such as busses, clocks, cache, or other supporting hardware.

[0043] Likewise, hardware 1050 may include volatile 1002 and nonvolatile memory 1003 providing data storage and

staging areas for data transmitted between hardware components **1050**. Volatile memory **1002** may include random access memory (RAM) or equivalents thereof, providing high-speed memory storage. Memory **1001** may also include selected types of nonvolatile memory **1003** such as read-only-memory (ROM), or other long term storage devices, such as hard drives and the like. Ports **1004** such as serial, parallel, or other ports **1004** may be used to input and output signals uphole or downhole from the stabilizer assembly **300**, provide interfaces with the instrumentation devices **402** located in the stabilizer assembly **300**, or interface with other tools or sensors located in a drilling environment.

[0044] A modem **1005** may be used to modulate digital data onto a carrier signal for transmission uphole or downhole. Likewise, the modem **1005** may demodulate digital data from signals transmitted uphole or downhole. A modem **1005** may provide various built in features including but not limited to error checking, data compression, or the like. In addition, the modem **1005** may use any suitable modulation type such as QPSK, OOK, PCM, FSK, QAM, or the like. The choice of a modulation type may depend on a desired data transmission speed, as well as unique operating conditions that may exist in a downhole environment. Likewise, the modem **1005** may be configured to operate in full duplex, half duplex, or other mode. The modem **1005** may also use any of numerous networking protocols currently available, such as collision-based protocols, such as Ethernet, or token based protocols such as are used in token ring networks.

[0045] A stabilizer assembly **300** may also include one or several switches **1006** or multiplexers **1006** to filter and forward packets or combine several signals for transmission over a single medium. Likewise, a demultiplexer may be included with the multiplexer **1006** to separate multiplexed signals received from uphole or downhole.

[0046] A stabilizer assembly may include various sensors **1012** located within the stabilizer assembly **300**. Sensors **1012** may include data gathering devices such as pressure sensors, accelerometers, hydrophones, piezoelectric devices, inclinometers, pressure transducers, magnetometers, gyroscopes, temperature sensors, gamma ray sensors, neutron sensors, seismic sensors, sonic sensors, mud logging devices, resistivity sensors, induction sensors, nuclear sensors, imaging devices, GPS devices, Hall-effect sensors, permeability sensors, porosity sensors, vibration sensors, electrical potential sensors, geophones or the like. Sensors **1012** may be configured to gather data for transmission up the network to the grounds surface, or may also receive control signals from the surface to control selected parameters of the sensors **1012**. For example, an operator at the surface may actually instruct a sensor **1012** to take a particular measurement.

[0047] A stabilizer assembly may also include various signal sources **1013** located within the stabilizer assembly **300**. Signal sources **1013** may include a seismic source, a sonic source, an explosive, a compressed air gun, a vibrator, a sparker, an electromagnetic device, a density source, a pulse neutron generator or combinations thereof.

[0048] Collectively the signal sources **1013** and the sensors **1012** are adapted to measure the properties and conditions of the formation down-hole. Likewise, other instrumentation devices **402** located downhole may interface with the stabilizer assembly **300** to gather data for transmission uphole, or follow instructions received from the surface.

[0049] Since a drill string may extend into the earth 20,000 feet or more, signal loss or signal attenuation that occurs

when transmitting data uphole or downhole, may be an important or critical issue. Various hardware or other devices of the downhole network may be responsible for causing different amounts of signal attenuation. To reduce data loss due to signal attenuation, amplifiers **1010**, or repeaters **1010**, may be placed within the stabilizer assembly **300**. The amplifiers **1010** may receive a data signal, amplify it, and transmit it uphole or downhole. Like an amplifier **1010**, a repeater **1010** may be used to receive a data signal and retransmit it at a higher power. However, unlike an amplifier **1010**, a repeater **1010** may remove noise from the data signal.

[0050] Likewise, a stabilizer assembly may include various filters **1009**. Filters **1009** may be used to filter out undesired noise, frequencies, and the like that may be present or introduced into a data signal traveling uphole or downhole. Likewise, the stabilizer assembly **300** may include a power supply **1007** to supply power to any or all of the hardware **1050**. The stabilizer assembly **300** may also include other hardware **1008**, as needed, to provide desired functionality to the stabilizer assembly **300**.

[0051] Whereas the present invention has been described in particular relation to the drawings attached hereto, it should be understood that other and further modifications apart from those shown or suggested herein, may be made within the scope and spirit of the present invention.

What is claimed is:

1. A stabilizer assembly on a downhole tool string component, comprising:
 - a sleeve slideably attached to a mandrel of the tool string component;
 - at least one stabilizer blade is formed in the sleeve and generally follows the length of the sleeve; and
 - a gap formed in the at least one blade and separating a first and second portion of the blade.
2. The stabilizer assembly of claim 1, wherein at least one instrumentation device is disposed in the at least one blade to gather subterranean data.
3. The stabilizer assembly of claim 2, wherein the at least one instrumentation device comprises at least one signal source.
4. The stabilizer assembly of claim 3, wherein the signal source is a seismic source, a sonic source, an explosive, a compressed air gun, a vibrator, a sparker, an electromagnetic device, a density source, a pulse neutron generator or combinations thereof.
5. The stabilizer assembly of claim 2, wherein the at least one instrumentation device comprises at least one sensor.
6. The stabilizer assembly of claim 5, wherein the at least one sensor is selected from the group consisting of accelerometers, inclinometers, pressure transducers, magnetometers, gyroscopes, temperature sensors, gamma ray sensors, neutron sensors, seismic sensors, sonic sensors, mud logging devices, resistivity sensors, induction sensors, nuclear sensors, imaging devices, GPS devices, Hall-effect sensors, permeability sensors, porosity sensors, vibration sensors, electrical potential sensors, geophones or combinations thereof.
7. The stabilizer assembly of claim 2, wherein the at least one instrumentation device is in communication with a downhole telemetry system.
8. The stabilizer assembly of claim 2, wherein the at least one instrumentation device is passively decoupled from the stabilizer assembly.

9. The stabilizer assembly of claim 2, wherein the at least one instrumentation device is actively decoupled from the stabilizer assembly.

10. The stabilizer assembly of claim 1, wherein at least one pocket is formed on an inner diameter of the sleeve.

11. The stabilizer assembly of claim 1, wherein a contour of the blade at an end of the blade has a biased curvature to accommodate mud flow.

12. The stabilizer assembly of claim 1, wherein a plurality of gaps are formed in the at least one blade.

13. The stabilizer assembly of claim 12, wherein the plurality of gaps are offset one from another.

14. The stabilizer assembly of claim 12, wherein the plurality of gaps is force balanced with respect to the rotation of the downhole tool string.

15. The stabilizer assembly of claim 1, wherein the sleeve is segmented.

16. The stabilizer assembly of claim 15, wherein the segmented sleeve is joined through a castle connection.

17. The stabilizer assembly of claim 1, wherein the gap is at least one foot long.

18. The stabilizer assembly of claim 1, wherein the length of the gap is at least twice the width of the blade.

19. The stabilizer assembly of claim 1, wherein the first and second portions are offset.

20. The stabilizer assembly of claim 1, wherein the first or second portion is less than 5 feet long.

* * * * *