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(54) **DEVIATED DRILLING SYSTEM UTILIZING FORCE OFFSET**

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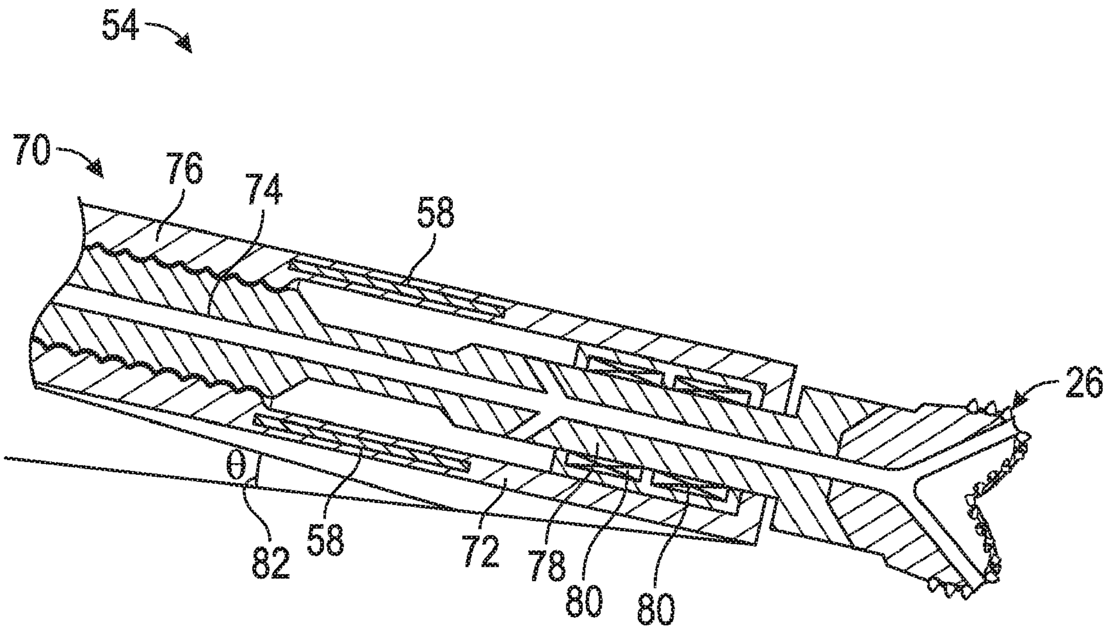
(57) **ABSTRACT**

A technique facilitates steering during, for example, a borehole drilling operation. A steering tool is employed to control an orientation of a drill bit or other component. The steering tool comprises a tool body and at least one actuator, e.g. piezo actuator. The at least one actuator, e.g. piezo actuator, is selectively displaced via application of appropriate inputs, e.g. electrical inputs. Controlled application of the inputs enables selective deformation of the actuators in a manner which changes the orientation of the drill bit or other component to a predetermined, desired orientation.



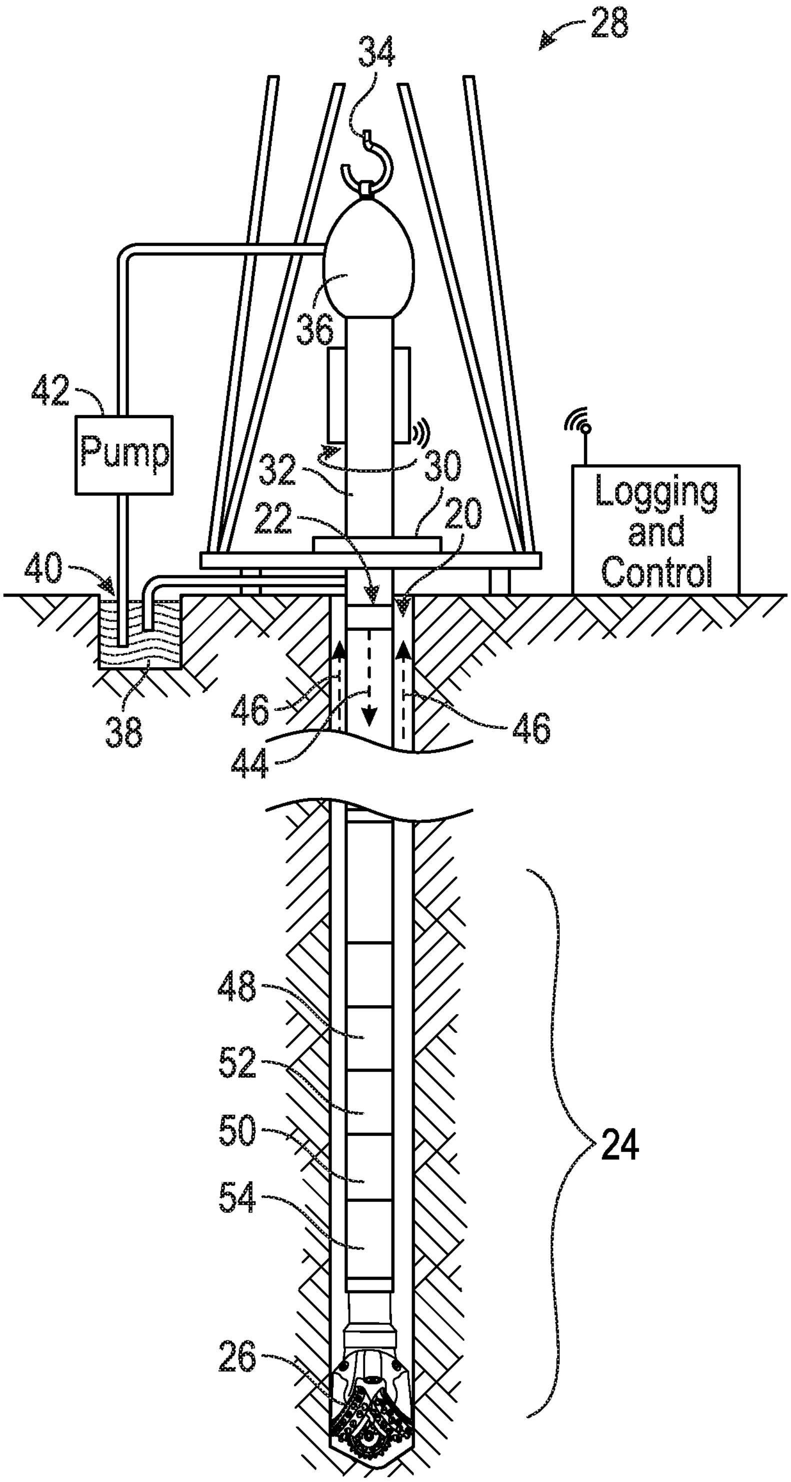

28
34
36
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FIG. 1

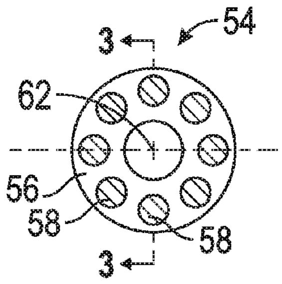

FIG. 2

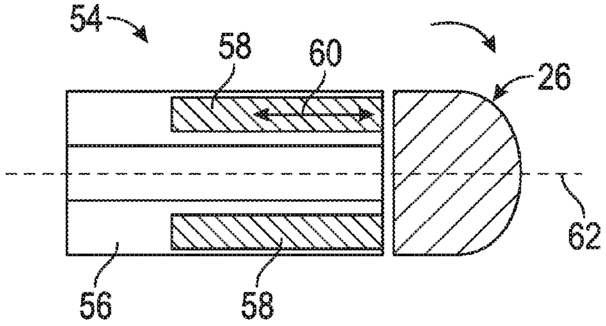

FIG. 3

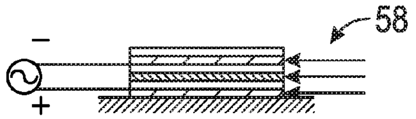

FIG. 4

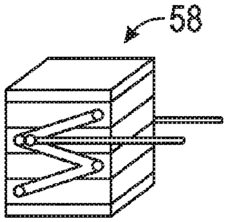

FIG. 5

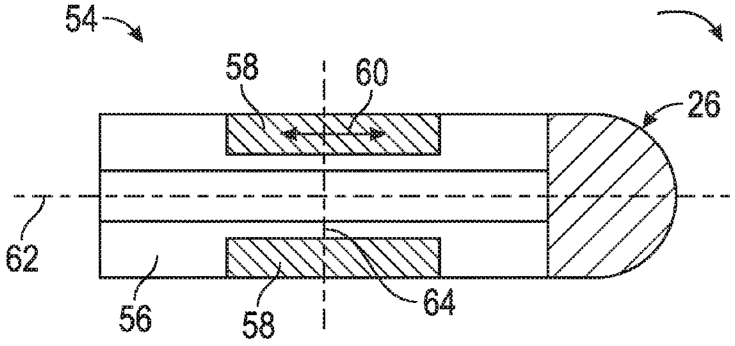

FIG. 6

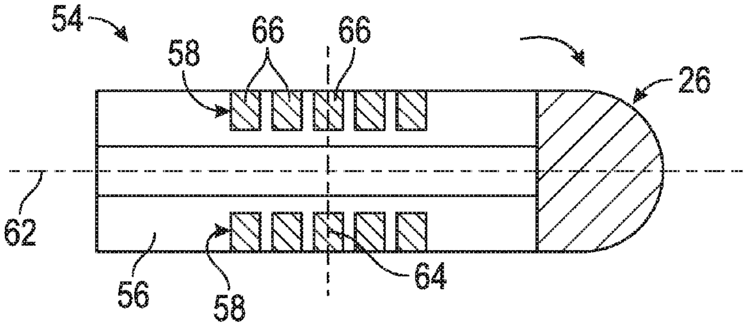

FIG. 7

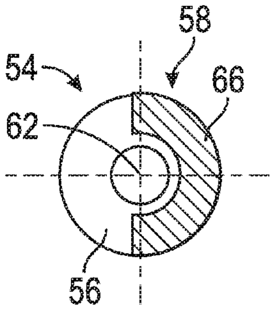

FIG. 8

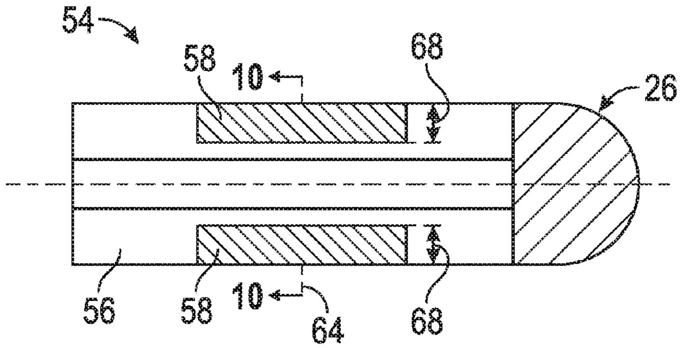

FIG. 9

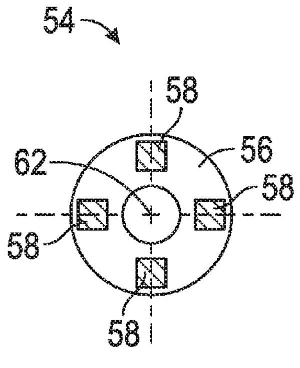

FIG. 10

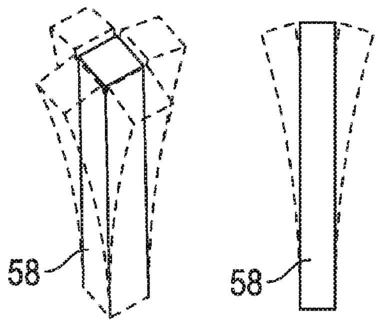

FIG. 11

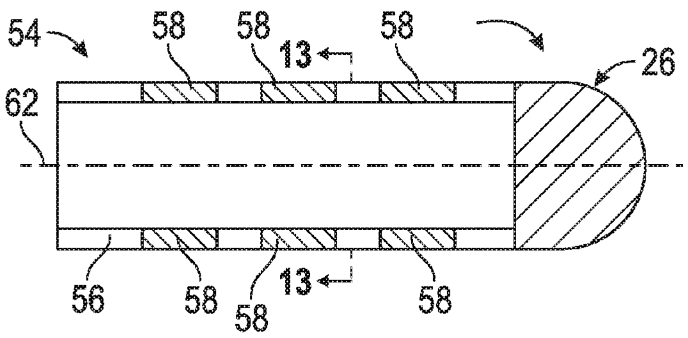

FIG. 12

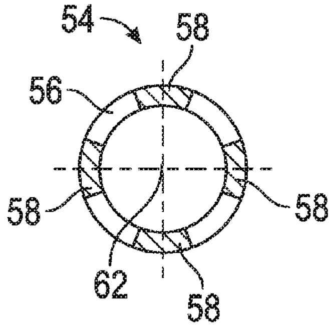

FIG. 13

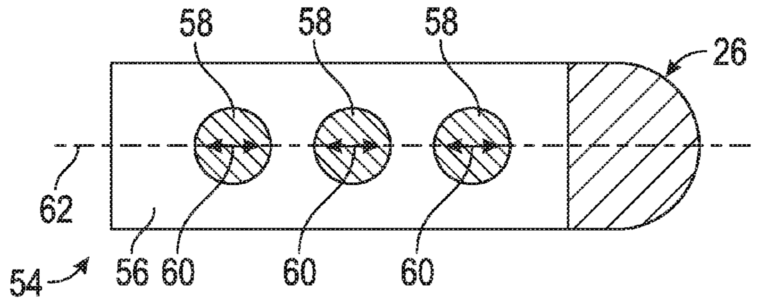

FIG. 14

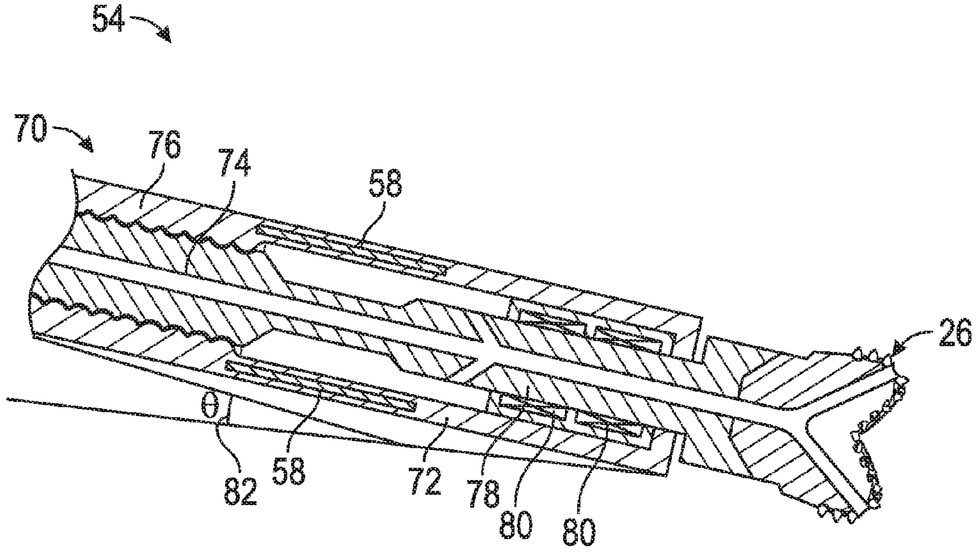

FIG. 15

DEVIATED DRILLING SYSTEM UTILIZING FORCE OFFSET

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims the benefit of and priority to U.S. Provisional Application Ser. No.: 62/116,534, filed Feb. 15, 2015, which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Drilling systems are employed for drilling a variety of wellbores. A drilling system may comprise a drill string and a drill bit which is rotated to drill a wellbore through a desired subterranean formation. In various drilling applications, a desired borehole trajectory is planned and calculated prior to drilling based on geological data. A number of steering techniques and equipment types may be employed to achieve a planned trajectory. For example, a bottom hole assembly may comprise a drill bit, stabilizers, drill collars, a mud motor, and a bent housing which cooperate to control a drilling direction. In other applications, a rotary steerable tool may be used to enable directional drilling while rotating a drill string. Rotary steerable drilling systems utilize various components including stabilizers, actuator pads, and other components to control the drilling direction. However, existing systems tend to be complex assemblies with multiple moving parts, and this complexity can lead to service quality issues and downtime.

SUMMARY

[0003] In general, a system and methodology are provided to facilitate steering during, for example, a borehole drilling operation. A steering tool is employed to control an orientation of a drill bit or other component. The steering tool provides a simple structure comprising a tool body and at least one actuator, e.g. a piezo actuator or other suitable actuator. The at least one actuator is selectively displaced via application of controlled inputs, e.g. electrical or hydraulic inputs. Appropriate application of the inputs enables selective deformation of the actuator(s) in a manner which changes the orientation of the drill bit or other component to a predetermined, desired orientation.

[0004] 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

[0005] 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:

[0006] FIG. **1** is a schematic illustration of an example of a drilling system deployed in a wellbore, according to an embodiment of the disclosure;

[0007] FIG. **2** is a cross-sectional schematic illustration of an example of a steering tool which may be positioned in a drilling system, e.g. the drilling system illustrated in FIG. **1**, according to an embodiment of the disclosure;

[0008] FIG. **3** is a cross-sectional schematic illustration taken generally along line **3-3** of FIG. **2**, according to an embodiment of the disclosure;

[0009] FIG. **4** is a schematic illustration of an example of a piezo actuator which can be used in the steering tool, according to an embodiment of the disclosure;

[0010] FIG. **5** is a schematic illustration of an example of another piezo actuator which can be used in the steering tool, according to an embodiment of the disclosure;

[0011] FIG. **6** is a cross-sectional schematic illustration of another example of a steering tool, according to an embodiment of the disclosure;

[0012] FIG. **7** is a cross-sectional schematic illustration of another example of a steering tool, according to an embodiment of the disclosure;

[0013] FIG. **8** is a cross-sectional schematic illustration similar to that of FIG. **2** but showing another example of a steering tool, according to an embodiment of the disclosure;

[0014] FIG. **9** is a cross-sectional schematic illustration of another example of a steering tool, according to an embodiment of the disclosure;

[0015] FIG. **10** is a cross-sectional schematic illustration taken generally along line **10-10** of FIG. **9**, according to an embodiment of the disclosure;

[0016] FIG. **11** is an illustration of another example of a piezo actuator which may be used in the steering tool, according to an embodiment of the disclosure;

[0017] FIG. **12** is a cross-sectional schematic illustration of another example of a steering tool, according to an embodiment of the disclosure;

[0018] FIG. **13** is a cross-sectional schematic illustration taken generally along line **13-13** of FIG. **12**, according to an embodiment of the disclosure;

[0019] FIG. **14** is a schematic side view of the steering tool illustrated in FIG. **12**, according to an embodiment of the disclosure; and

[0020] FIG. **15** is a schematic illustration of an example of a steering tool utilized in a steerable motor application, according to an embodiment of the disclosure.

DETAILED DESCRIPTION

[0021] 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.

[0022] The present disclosure generally relates to a system and methodology which facilitate steering during, for example, a borehole drilling operation. For example, the technique may be used for drilling deviated wellbores. According to embodiments described herein, a steering tool is employed to control an orientation of a drill bit or other component. By way of example, the steering tool may comprise a tool body and at least one actuator, e.g. a piezo actuator. In a specific embodiment, at least one piezo actuator is selectively displaced via application of electrical inputs. Appropriate application of electrical inputs enables selective deformation of the piezo actuator in a manner which changes the orientation of the drill bit or other component to a predetermined, desired orientation. In some applications, the piezo actuator may be replaced or supplemented with mechanical, e.g. hydraulic, actuators such as fluidic muscle actuators.

[0023] According to an embodiment, a new actuation scheme is defined for a steering tool, such as a rotary steerable drilling tool. In some applications, the new actuation scheme may be implemented in a steerable motor system with a downhole controlled bend section. In a specific embodiment, the actuation scheme comprises applying forces generally parallel to an axis of rotation. The forces may be applied to change the orientation of a drill bit or other component by applying a series of forces offset from the axis of rotation. In some applications, a series of actuators may be actuated in a specific combination/order such that a desired displacement is provided at the drill bit.

[0024] Embodiments of the steering tool described herein can be used to provide a simple, cost-effective, and reliable steering tool able to provide directional control during drilling operations. In some embodiments, the forces are generated by actuators such as actuators which are in the form of piezo-electric devices serving as piezo actuators. Depending on the parameters of a given application, many types of piezo actuators may be employed. However examples include a piezo electric stack (e.g. a ø56 mm×154 mm long stack) where displacements of 0.180 mm can be achieved with, for example, a 78 kN force and a response time of <1 ms up to 150° C.

[0025] It should be noted that other actuation methods also may be employed in some applications. For example, such other applications may utilize fluidic muscle (e.g. a fluidic muscle of nominal ø40 mm which provides 6 kN of contraction at 0.6 Mpa). The fluidic muscle system is a hydraulic/mechanical system which utilizes fluids in the actuators to achieve the desired actuation forces. The embodiments described herein also may be used to provide a device which can be locked into a state such that straight drilling is achieved without drilling an over-gauged hole (as is the case when using a bent angle such as in a positive displacement motor system).

[0026] FIG. **1** illustrates an example of a wellsite system in which embodiments described herein may be employed. The wellsite may be onshore or offshore. In a wellsite system, a borehole **20** is formed in a subsurface formation by drilling. The method of drilling to form the borehole **20** may include, but is not limited to, rotary and directional drilling. A drill string **22** is suspended within the borehole **20** and has a bottom hole assembly (BHA) **24** that includes a drill bit **26** at its lower end.

[0027] An embodiment of a surface system includes a platform and derrick assembly **28** positioned over the borehole **20**. An example of assembly **28** includes a rotary table **30**, a kelly **32**, a hook **34** and a rotary swivel **36**. The drill string **22** is rotated by the rotary table **30**, energized by a suitable system (not shown) which engages the kelly **32** at the upper end of the drill string **22**. The drill string **22** is suspended from the hook **34**, attached to a traveling block (not shown) through the kelly **32** and the rotary swivel **36** which permits rotation of the drill string **22** relative to the hook **34**. A top drive system can be used in other embodiments.

[0028] An embodiment of the surface system also includes a drilling fluid **38**, e.g., mud, stored in a pit **40** formed at the wellsite. A pump **42** delivers the drilling fluid **38** to the interior of the drill string **22** via one or more ports in the swivel **36**, causing the drilling fluid to flow downwardly through the drill string **22** as indicated by directional arrow **44**. The drilling fluid exits the drill string **22** via one or more ports in the drill bit **26**, and then circulates upwardly through the annulus region between the outside of the drill string **22** and the wall of the borehole, as indicated by directional arrows **46**. In this manner, the drilling fluid lubricates the drill bit **26** and carries formation cuttings and particulate matter up to the surface as it is returned to the pit **40** for recirculation.

[0029] The illustrated embodiment of bottom hole assembly **24** includes one or more logging-while-drilling (LWD) modules **48/50**, one or more measuring-while-drilling (MWD) modules **52**, one or more roto-steerable systems and motors (not shown), and the drill bit **26**. It will also be understood that more than one LWD module and/or more than one MWD module may be employed in various embodiments, e.g. as represented at **48** and **50**. It should also be noted that some applications may utilize the steering tool without MWD or LWD modules.

[0030] The LWD module **48/50** may be housed in a type of drill collar, and includes capabilities for measuring, processing, and storing information, as well as for communicating with the surface equipment. The LWD module **48/50** also may include a pressure measuring device and one or more logging tools.

[0031] The MWD module **52** also may be housed in a type of drill collar, and includes one or more devices for measuring characteristics of the drill string **22** and drill bit **26**. The MWD module **52** also may include one or more devices for generating electrical power for the downhole system. In an embodiment, the power generating devices include a mud turbine generator (also known as a "mud motor") powered by the flow of the drilling fluid. In other embodiments, other power and/or battery systems may be employed to generate power.

[0032] The MWD module **52** also may include one or more of the following types of measuring devices: a weight-on-bit measuring device, a torque measuring device, a vibration measuring device, a shock measuring device, a stick slip measuring device, a direction measuring device, and an inclination measuring device. These measuring devices may be used individually or in various combinations.

[0033] In an operational example, the wellsite system of FIG. **1** is used in conjunction with controlled steering or "directional drilling." Directional drilling is the intentional deviation of the wellbore from the path it would naturally take. In other words, directional drilling is the steering of the drill string **22** so that it travels in a desired direction. Directional drilling is, for example, useful in offshore drilling because it allows multiple wells to be drilled from a single platform. Directional drilling also enables horizontal drilling through a reservoir. Horizontal drilling, in turn, enables a longer length of the wellbore to traverse the reservoir, which increases the production rate from the well.

[0034] A directional drilling system also may be used in vertical drilling operations. Often the drill bit will veer off of a planned drilling trajectory because of the unpredictable nature of the formations being penetrated or the varying forces that the drill bit experiences. When such a deviation occurs, a directional drilling system may be used to put the drill bit back on course.

[0035] A method of directional drilling includes the use of a rotary steerable system ("RSS"). In an embodiment that employs the wellsite system of FIG. **1** for directional drilling, a steerable tool or subsystem **54** is provided. In an RSS, the drill string may be rotated from the surface, and downhole devices cause the drill bit to drill in the desired direction. Rotating the drill string greatly reduces the occurrences of the drill string getting hung up or stuck during drilling. Rotary steerable drilling systems for drilling deviated boreholes into the earth may be generally classified as either "point-the-bit" systems or "push-the-bit" systems.

[0036] In an example of a "point-the-bit" rotary steerable system, the axis of rotation of the drill bit is deviated from the local axis of the bottom hole assembly in the general direction of the new hole. The hole is propagated in accordance with the customary three-point geometry defined by upper and lower stabilizer touch points and the drill bit. The angle of deviation of the drill bit axis coupled with a finite distance between the drill bit and lower stabilizer results in the non-collinear condition for a curve to be generated. This may be achieved in a number of different ways, including a fixed bend at a point in the bottom hole assembly close to the lower stabilizer or a flexure of the drill bit drive shaft distributed between the upper and lower stabilizer. In its idealized form, the drill bit is not required to cut sideways because the bit axis is continually rotated in the direction of the curved hole. Examples of "point-the-bit" type rotary steerable systems and their operation are described in U.S. Pat. Nos. 6,394,193; 6,364,034; 6,244,361; 6,158,529; 6,092,610; and 5,113,953; and U.S. Patent Application Publication Nos. 2002/0011359 and 2001/0052428.

[0037] In an example of a "push-the-bit" rotary steerable system, there is no specially identified mechanism that deviates the bit axis from the local bottom hole assembly axis. Instead, the requisite non-collinear condition is achieved by causing either or both of the upper or lower stabilizers to apply an eccentric force or displacement in a direction that is orientated with respect to the direction of hole propagation. This may be achieved in a number of different ways, including non-rotating (with respect to the hole) eccentric stabilizers (displacement based approaches) and eccentric actuators that apply force to the drill bit in the desired steering direction. Steering is achieved by creating non co-linearity between the drill bit and at least two other touch points. In its idealized form, the drill bit is forced to cut sideways to generate a curved hole. Examples of "push-the-bit" type rotary steerable systems and their operation are described in U.S. Pat. Nos. 6,089,332; 5,971,085; 5,803,185; 5,778,992; 5,706,905; 5,695,015; 5,685,379; 5,673,763; 5,603,385; 5,582,259; 5,553,679; 5,553,678; 5,520,255; and 5,265,682.

[0038] Referring generally to FIGS. **2** and **3**, an example of steering tool **54** is illustrated as combined with drill bit **26**. In this example, the steering tool **54** comprises a tool body **56** which may be in the form of a collar. The steering tool **54** also comprises at least one actuator **58** which deforms in response to controlled inputs, e.g. electrical inputs. By way of example, the at least one actuator **58** may comprise a piezo-electric material and thus be in the form of a piezo actuator. In the illustrated example, a plurality of piezo actuators **58**, e.g. three, four or more actuators, is illustrated. During rotation of drill bit **26** via, for example, rotation of drill string **22** and/or a downhole motor, the steering tool **54** controls the trajectory of a borehole being drilled. Effectively, the steering tool **54** changes the angular orientation of the drill bit **26** by selectively displacing individual piezo actuators **58** in a longitudinal direction, as represented by arrow **60**. The longitudinal direction **60** is oriented along the length of tool body **56** and may be generally parallel with a longitudinal axis **62** of steering tool **54**.

[0039] In this example, the actuators **58** are selectively fired via application of electrical inputs so that the drill bit **26** and drilling direction can be deviated along a desired trajectory. At locations where the actuators **58** are not firing, the actuators **58** may be left unconstrained, or the actuators **58** may be attached and operated such that expansion, e.g. elongation, of one actuator **58** is matched by contraction of an opposing actuator **58** or another suitable actuator **58** to obtain the desired bending. In a variety of applications, the actuators **58** fire as the steering tool **54** rotates with a speed of rotation that matches the speed of tool body/collar rotation. In other applications, however, the speed of rotation may not be matched so as to obtain another desired wellbore trajectory. Regardless, the actuators **58** may be selectively expanded and contracted to provide the desired forces and the desired trajectory.

[0040] By forming actuators **58** as piezo actuators, the actuators are capable of precise movements which exert high force. Piezo actuators also are compact, have low energy consumption, quick response times, and no electromagnetic interference. The piezo actuators **58** can be actuated by applying a voltage as illustrated in FIG. **4**. This enables the actuator **58** to provide small displacements with a large amount of force. In some applications, a plurality of piezo actuators may be stacked together (and pre-wired/packaged) to form a single overall actuator **58**, as illustrated in FIG. **5**. This enables actuations with suitable displacements and large amounts of force which can be used, for example, at or inside the drill bit **26** or at other desired positions.

[0041] Instead of utilizing the actuators **58** directly against the drillbit **26**, however, the actuators **58**, e.g. piezo actuators, may be mounted along tool body **56** and selectively actuated to deform a weakened section **64** of the tool body/drill collar **56**, as illustrated in FIG. **6**. The weakened section **64** may have a variety of constructions including that of a separately installed component. For example, the weakened section **64** can be a joint, e.g. a universal joint or flex joint. In these embodiments, the weakened section **64** provides a section of the tool body/drill collar **56** which is more flexible than the rest of the tool body **56**. In the specific example illustrated, the piezo actuators **58** may be selectively elongated to cause bending of the tool body **56** and thus deviation of the drill bit **26** such that the drill bit **26** is oriented to drill in a new direction. In this and certain other embodiments, the piezo actuators **58** also may be controlled to provide a straight (non-bent) tool body **56** to enable straight drilling without drilling an over-gauged borehole.

[0042] In some applications, each actuator **58** may be constructed from a plurality of pieces **66**, e.g. piezo-electric actuator discs, positioned independently along the tool body **56**, as illustrated in FIG. **7**. The individual pieces or portions **66** of the actuator **58** may be selectively fired or actuated via electrical input to cause bending of the tool body **56** and thus deviation of the drill bit **26**. In some applications, the individual portions **66** may be constructed to extend circumferentially along at least a portion of the tool body **56**, as illustrated in FIG. **8**. By way of example, this type of embodiment can be used in a sliding (oriented) mode. It should also be noted that in this and other embodiments, a driveshaft may be positioned through a center of the tool body **56** to provide additional rotation to the drill bit **26** if desired.

[0043] In some embodiments, bending actuators **58** (e.g. three, four or more bending actuators) may be used, as illustrated in FIGS. **9-11**. In these types of embodiments, application of controlled inputs to the actuators **58**, e.g. application of electrical inputs to piezo actuators **58**, causes the actuators **58** to deform in a lateral direction as indicated by arrows **68**. The electrical inputs can be used to effectively bend the actuator **58** in a controlled manner, as illustrated in FIG. **11**. In some applications, the actuators **58** may again be used in combination with weakened area **64** such that bending of the actuators **58** causes bending of the tool body/drill collar **56** and thus deviation of drill bit **26**.

[0044] In another embodiment, a series of the actuators **58** may be placed into a tube, e.g. embedded into a tubular tool body **56**, as illustrated in FIGS. **12-14**. The actuators **58** may be in the form of discs or other suitable structures able to establish a stress field when inputs, e.g. electrical inputs, are selectively applied to the actuators. The stress field causes a controlled bending of the tube, e.g. tubular tool body **56**. This bending motion is again translated into deviation of the drill bit **26**.

[0045] In the embodiments discussed above, actuators **58** have been described as piezo actuators, however actuators **58** also may comprise other types of integral actuators able to control bending of the tool body/drill collar **56** and thus deviation of drill bit **26**. For example, actuators **58** may be in the form of hydraulic actuators, e.g. fluidic muscle actuators which utilize fluidic muscle to selectively cause the straightening or bending of the tool body/drill collar **56** to control drilling direction. The fluidic muscle system is a hydraulic/mechanical system which utilizes fluids in the actuators to achieve the desired actuation forces. In other words, fluid inputs are used rather than electrical inputs to control the bending and drilling direction. Additionally, other types of actuators also can be used to achieve the desired, control bending and consequent steering control.

[0046] Referring generally to FIG. **15**, an embodiment is illustrated in which a plurality of the actuators **58**, e.g. piezo actuators, is used with a downhole steerable motor **70** having a downhole adjustable bent angle section **72**. By way of example, the downhole steerable motor **70** may comprise a positive displacement motor having a rotor **74** which is rotatably driven within a stator **76**. The rotor **74** is coupled with a drill bit shaft **78** rotatably mounted within bearings **80**. The drill bit shaft also is coupled to the drill bit **26** to enable roatation of the drill bit **26** by motor **70**. The actuators **58** may be operated to adjust the bent angle section **72** and to thus adjust a bend angle **82**. This embodiment may be used to enable directional drilling without conventional tool face control. In some applications, the actuators **58** may be used to adjust the tool face and the bend angle at the same time through, for example, dynamic control of the actuators **58**. This latter type of embodiment enables drilling of a borehole while rotating 100% without sliding.

[0047] Depending on the parameters of a given application, the steering tool **54** may utilize a variety of structures and techniques to control the orientation of drill bit **26**. For example, various electro-mechanical, electro-magnetic, hydraulic, pneumatic, magneto-rheological, and/or other devices may be incorporated into the steering tool **54** to facilitate deviation of the drill bit **26** and to provide control over the direction of drilling. Additionally, a closed loop control system may be used to provide feedback with respect to the direction of drilling and/or other aspects of the drilling operation.

[0048] In some applications, the closed loop control system may enable vibration measurement so as to facilitate damping of vibrations to help optimize drilling parameters such as rate of penetration and/or drill bit life. In some embodiments, material, e.g. the material of tool body **56**, may be formed directly around the actuators **58** to provide protection from the drilling environment. For example, additive manufacturing can be used to embed the actuators **58** by building up material around them. However, the actuators **58** also can be fitted into pockets or otherwise affixed, mounted to, or attached to the tool body **56**.

[0049] 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. A system for use in a well, comprising:

a drill string comprising a drill bit and a steering tool for controlling the trajectory of a borehole formed by rotating the drill bit, the steering tool comprising a tool body and at least one piezo actuator which is selectively displaced via application of an electrical input to change a drilling orientation of the drill bit.

2. The system as recited in claim **1**, wherein the at least one piezo actuator is selectively displaced by controlling elongation of the at least one piezo actuator in a longitudinal direction generally parallel with a longitudinal axis of the steering tool.

3. The system as recited in claim **1**, wherein the at least one piezo actuator comprises a plurality of piezo actuators.

4. The system as recited in claim **1**, wherein the at least one piezo actuator comprises at least three piezo actuators.

5. The system as recited in claim **3**, wherein the piezo actuators of the plurality of piezo actuators act directly against the drill bit to change an angular orientation of the drill bit.

6. The system as recited in claim **3**, wherein the piezo actuators of the plurality of piezo actuators act to deform a weakened section of the tool body and to thus change an angular orientation of the drill bit.

7. The system as recited in claim **3**, wherein each piezo actuator comprises a plurality of portions separated from each other and disposed along a section of the tool body.

8. The system as recited in claim **3**, wherein the piezo actuators of the plurality of piezo actuators are generally arcuate and positioned to extend along at least a portion of the circumference of the tool body.

9. The system as recited in claim **3**, wherein the piezo actuators of the plurality of piezo actuators are constructed to bend laterally upon selected application of the electrical input.

10. The system as recited in claim **3**, wherein the piezo actuators of the plurality of piezo actuators are embedded in the tool body.

11. A method, comprising:

positioning a plurality of actuators in a tool body of a steering tool;

coupling the steering tool to a drill bit;

rotating the drill bit; and

controlling the drilling orientation of the drill bit by selectively displacing individual actuators of the plurality of actuators to bend the tool body.

12. The method as recited in claim **11**, wherein positioning comprises positioning a plurality of piezo actuators in the tool body of the steering tool and arranging the plurality of piezo actuators to act in a longitudinal direction generally parallel with a longitudinal axis of the steering tool.

13. The method as recited in claim **11**, wherein positioning comprises positioning a plurality of piezo actuators in the tool body of the steering tool and arranging the plurality of piezo actuators to act in a lateral direction with respect to a longitudinal axis of the steering tool.

14. The method as recited in claim **11**, wherein positioning comprises positioning a plurality of hydraulic actuators in the tool body of the steering tool.

15. The method as recited in claim **11**, further comprising connecting the drill bit and the steering tool into a drill string, wherein rotating the drill bit comprises rotating the drill bit by rotating the drill string.

16. The method as recited in claim **11**, further comprising connecting the drill bit and the steering tool into a drill string, wherein rotating the drill bit comprises rotating the drill bit by a motor.

17. The method as recited in claim **12**, wherein controlling the drilling orientation comprises using the plurality of piezo actuators in combination with a steerable motor to control a bent angle or to orient a toolface.

18. A system for use in a well, comprising:

a steering tool for controlling an orientation of a component, the steering tool comprising a tool body and a plurality of actuators, each actuator of the plurality of actuators being selectively displaced via application of controlled inputs to enable selective deformation of the actuators in a manner which bends the steering tool and changes the orientation of the component.

19. The system as recited in claim **18**, wherein the component comprises a drill bit.

20. The system as recited in claim **18**, wherein the plurality of actuators comprises a plurality of piezo actuators.

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