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(19) **United States**(12) **Patent Application Publication**
Biddick et al.(10) **Pub. No.: US 2013/0341034 A1**(43) **Pub. Date: Dec. 26, 2013**(54) **FLAPPER RETENTION DEVICES AND METHODS**(52) **U.S. Cl.**

USPC 166/373; 166/323

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(57)

ABSTRACT(73) Assignee: **SCHLUMBERGER TECHNOLOGY CORPORATION**, Sugar Land, TX (US)(21) Appl. No.: **13/531,730**(22) Filed: **Jun. 25, 2012****Publication Classification**(51) **Int. Cl.**
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A flow control device comprising a flapper retention device electrically activated to a hold position to retain the flapper in an open position in response to the operator being in a first position and the retention device electrically deactivated to a released position permitting movement of the flapper in response to the operator being in a second position. When the operator is in the first position, an end of the operator is located in the closure path of the flapper and in the second position the end of the operator is located out of the closure path.

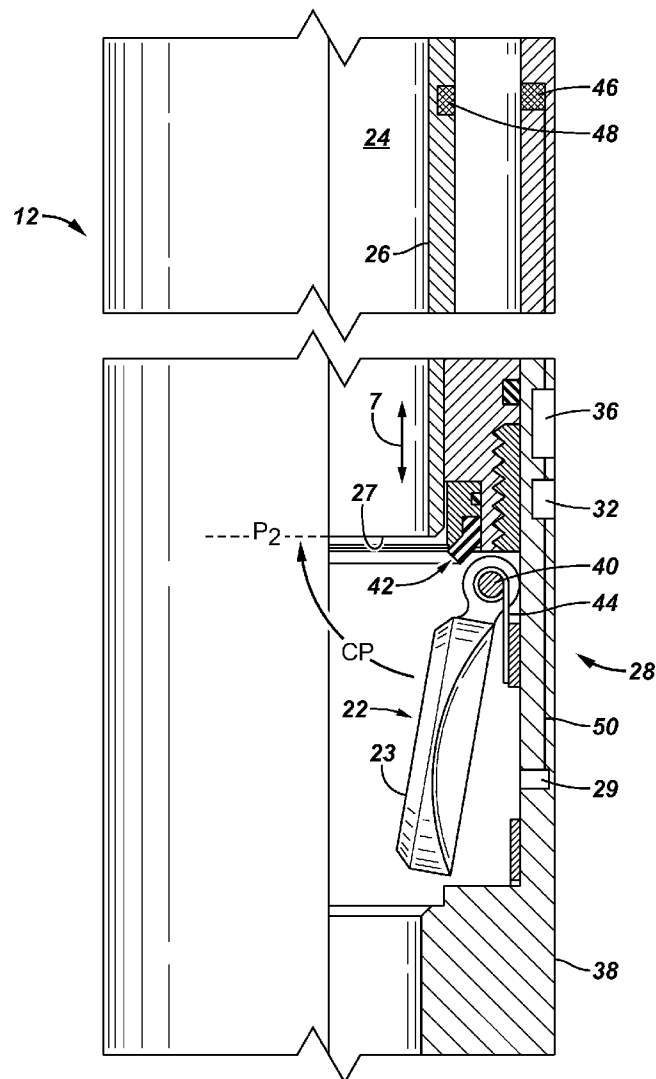


FIG. 1

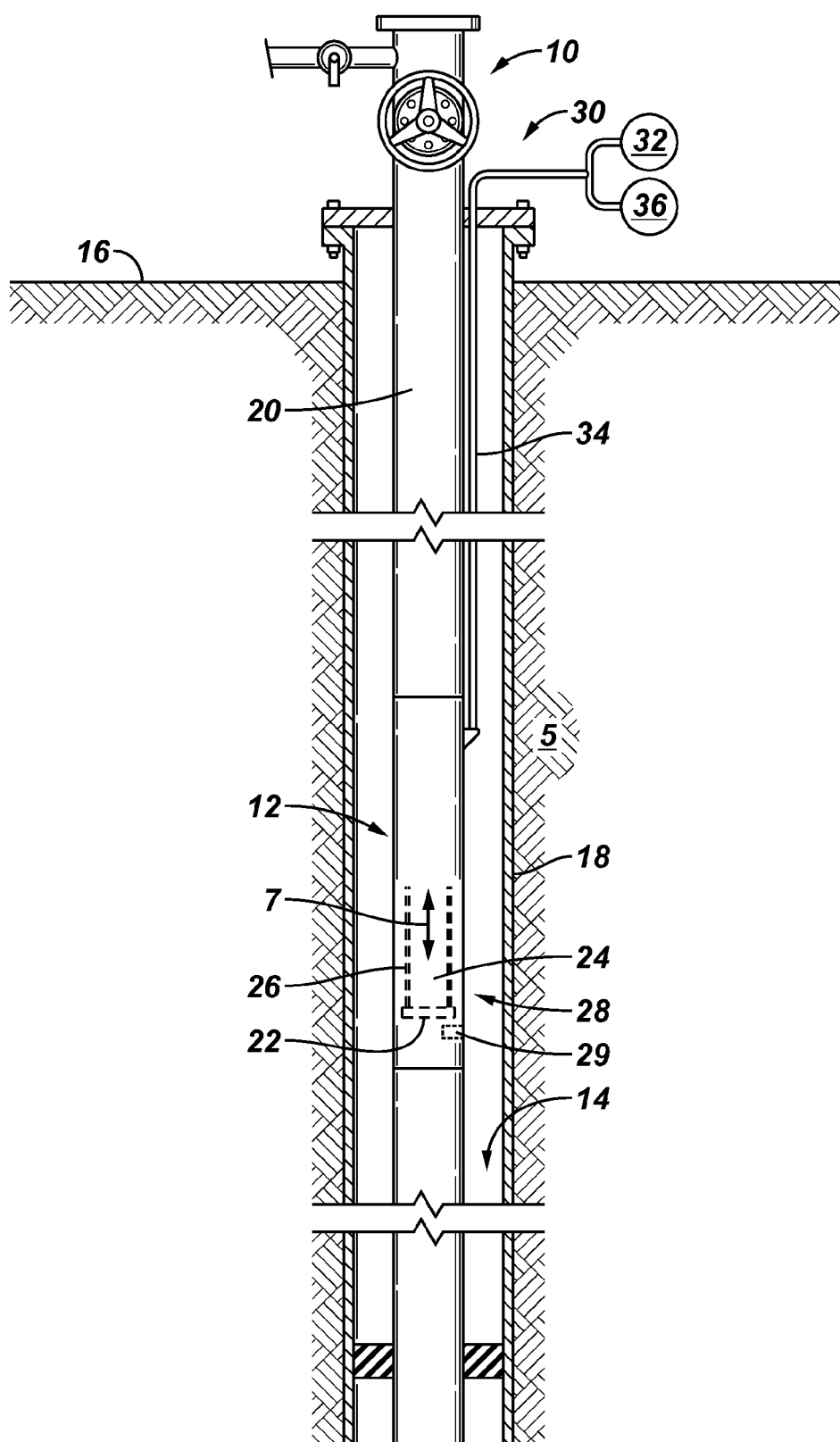


FIG. 2

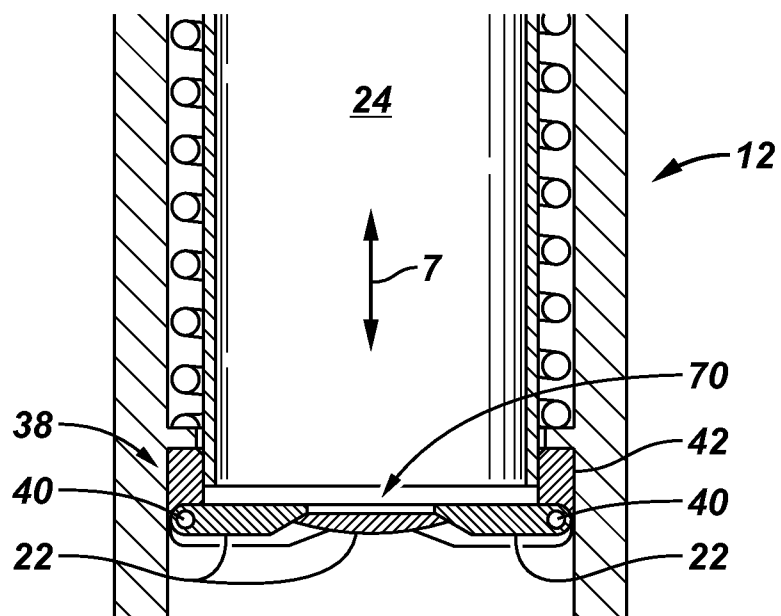


FIG. 3

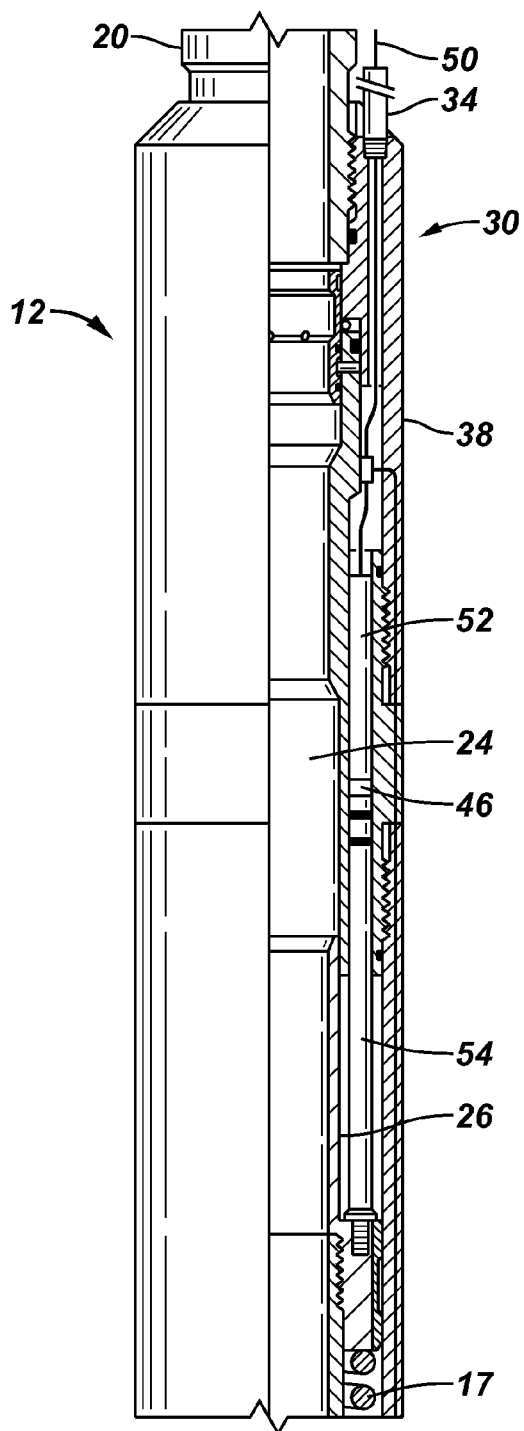


FIG. 4

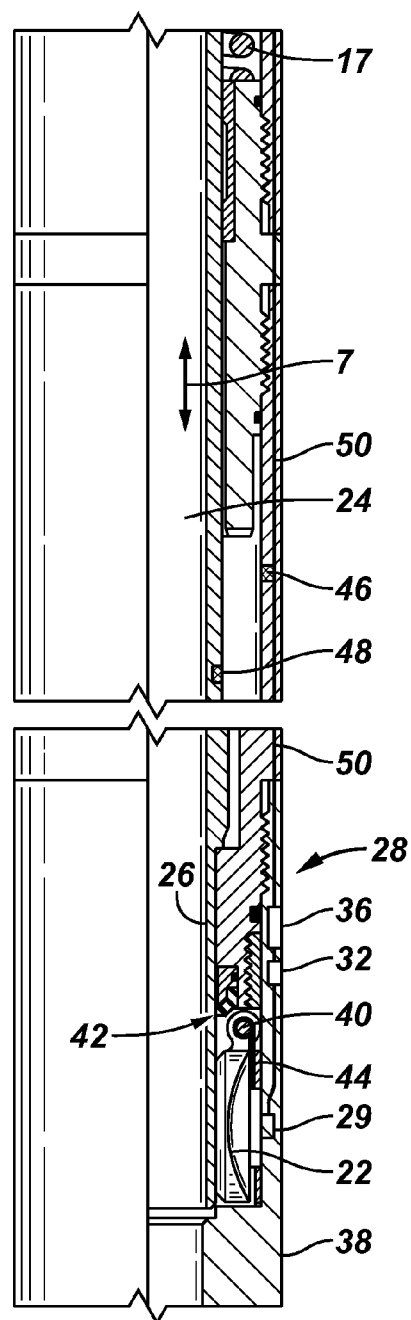


FIG. 5

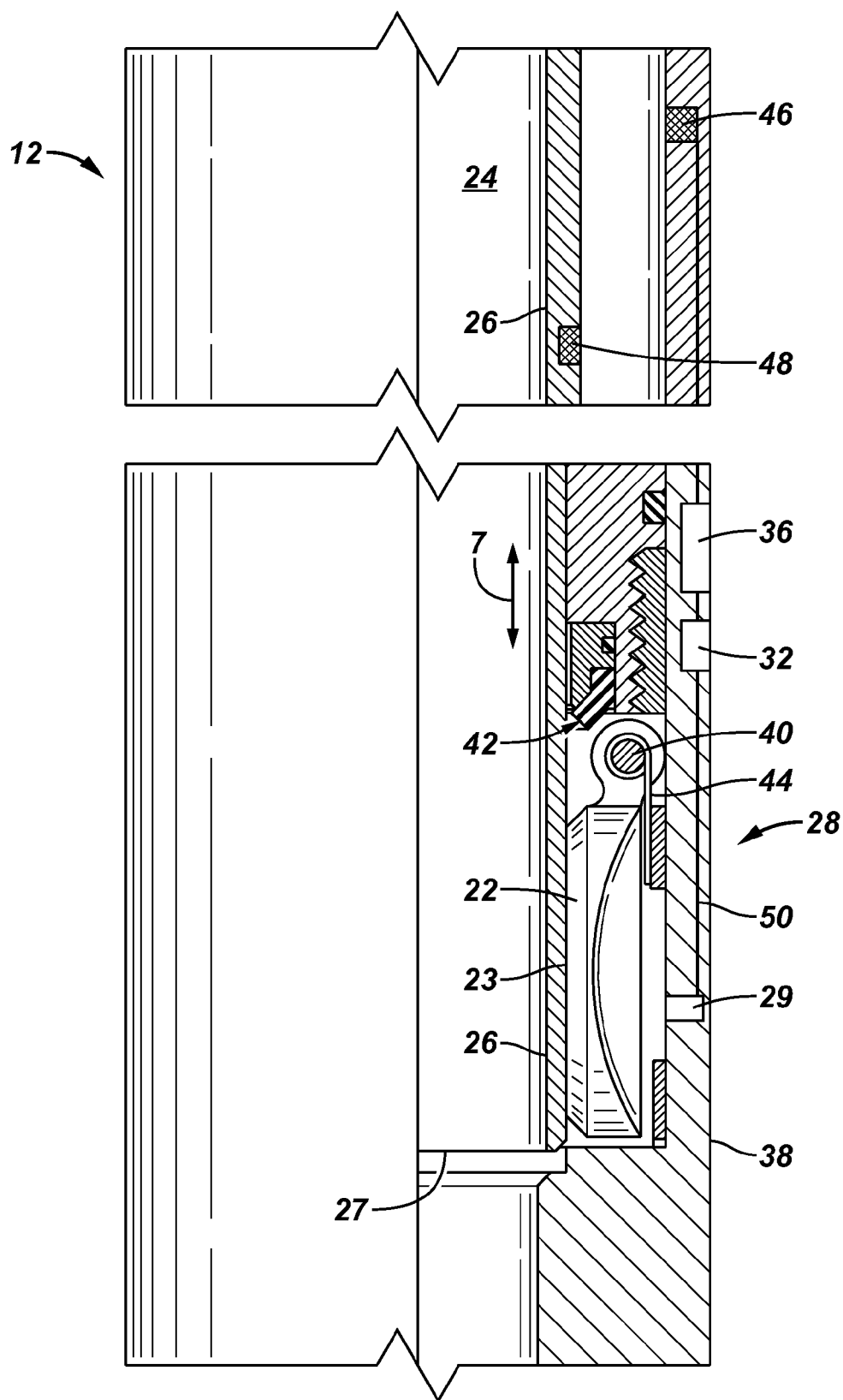


FIG. 6

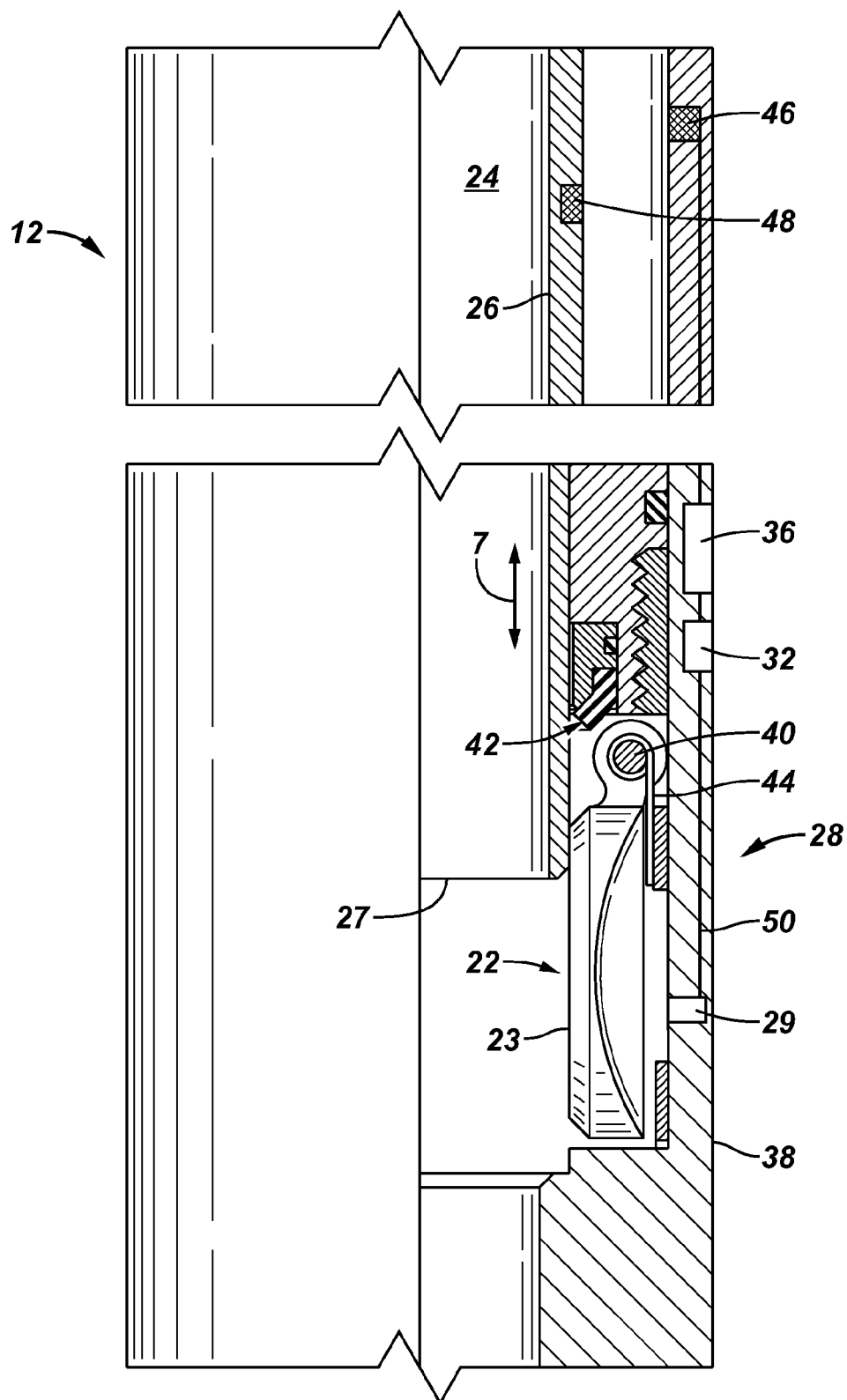
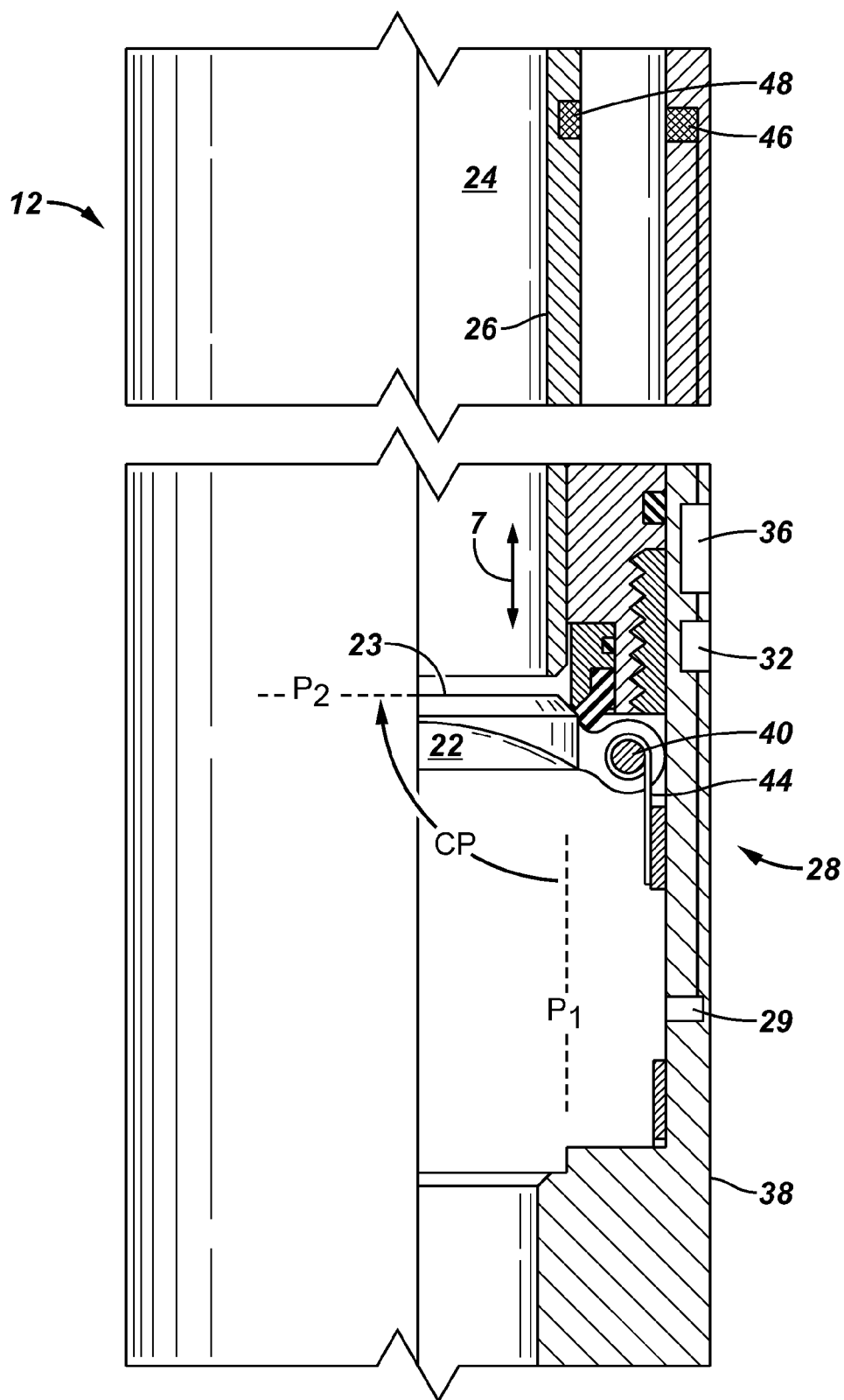


FIG. 8



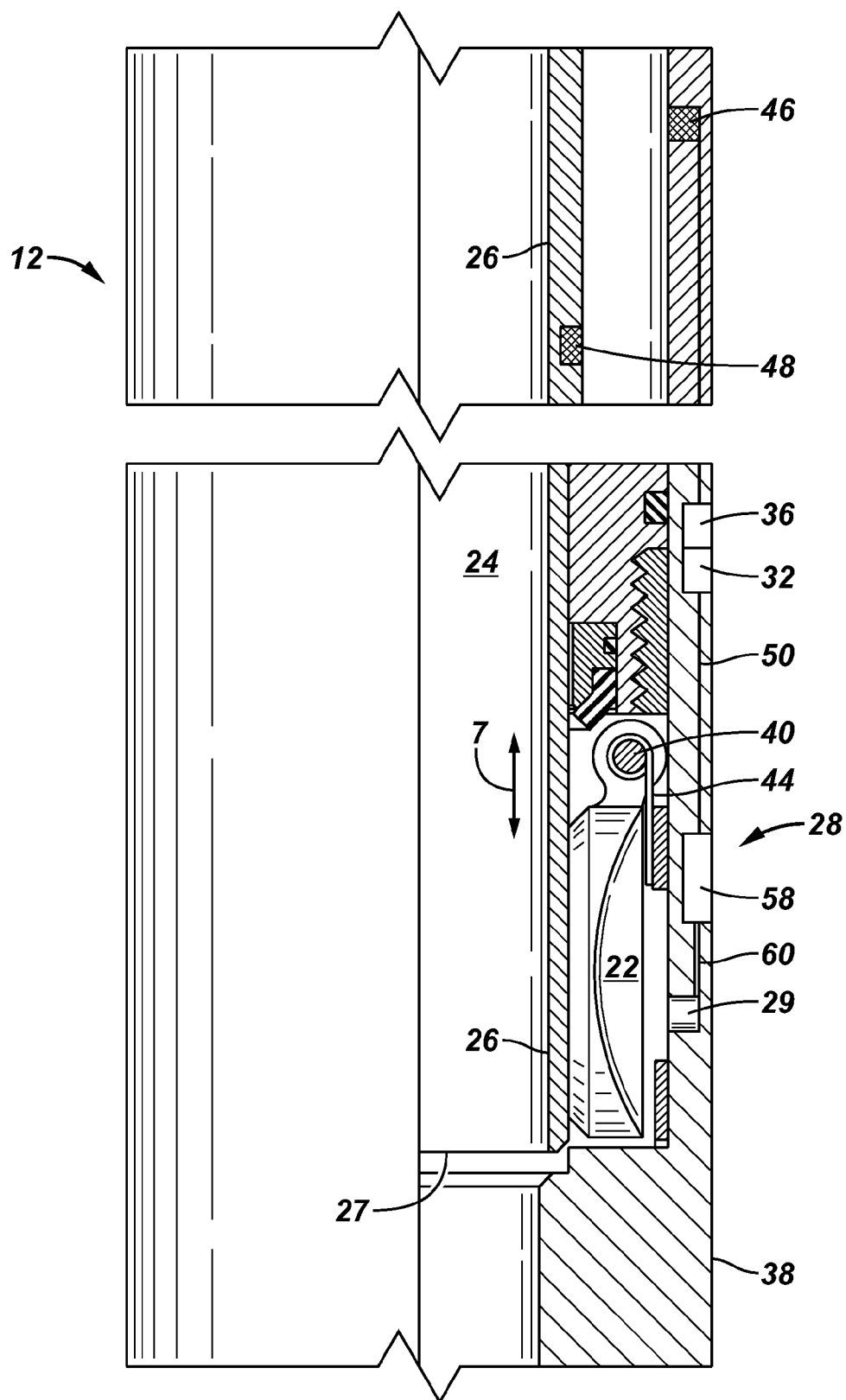


FIG. 10

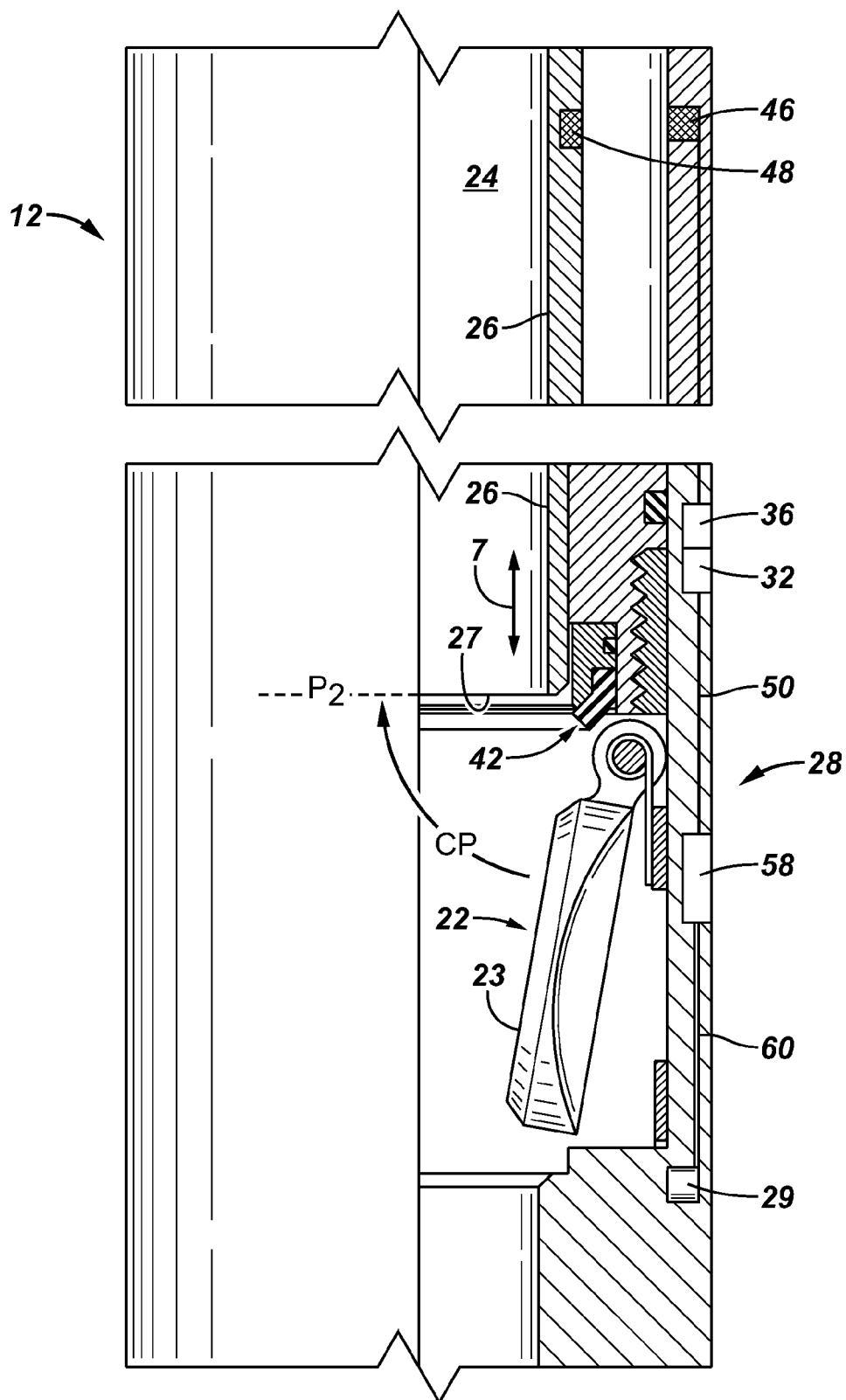


FIG. 11

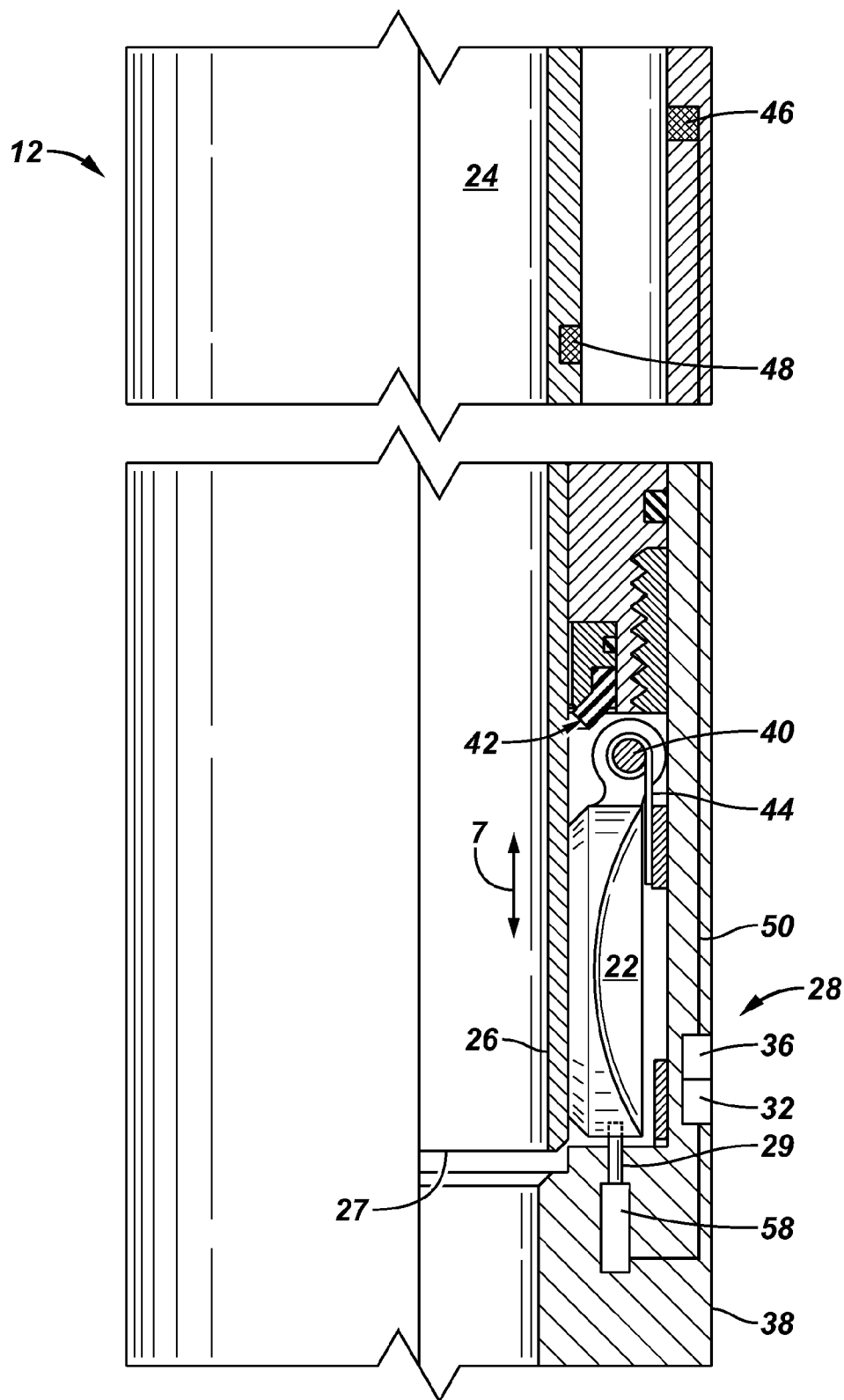


FIG. 12

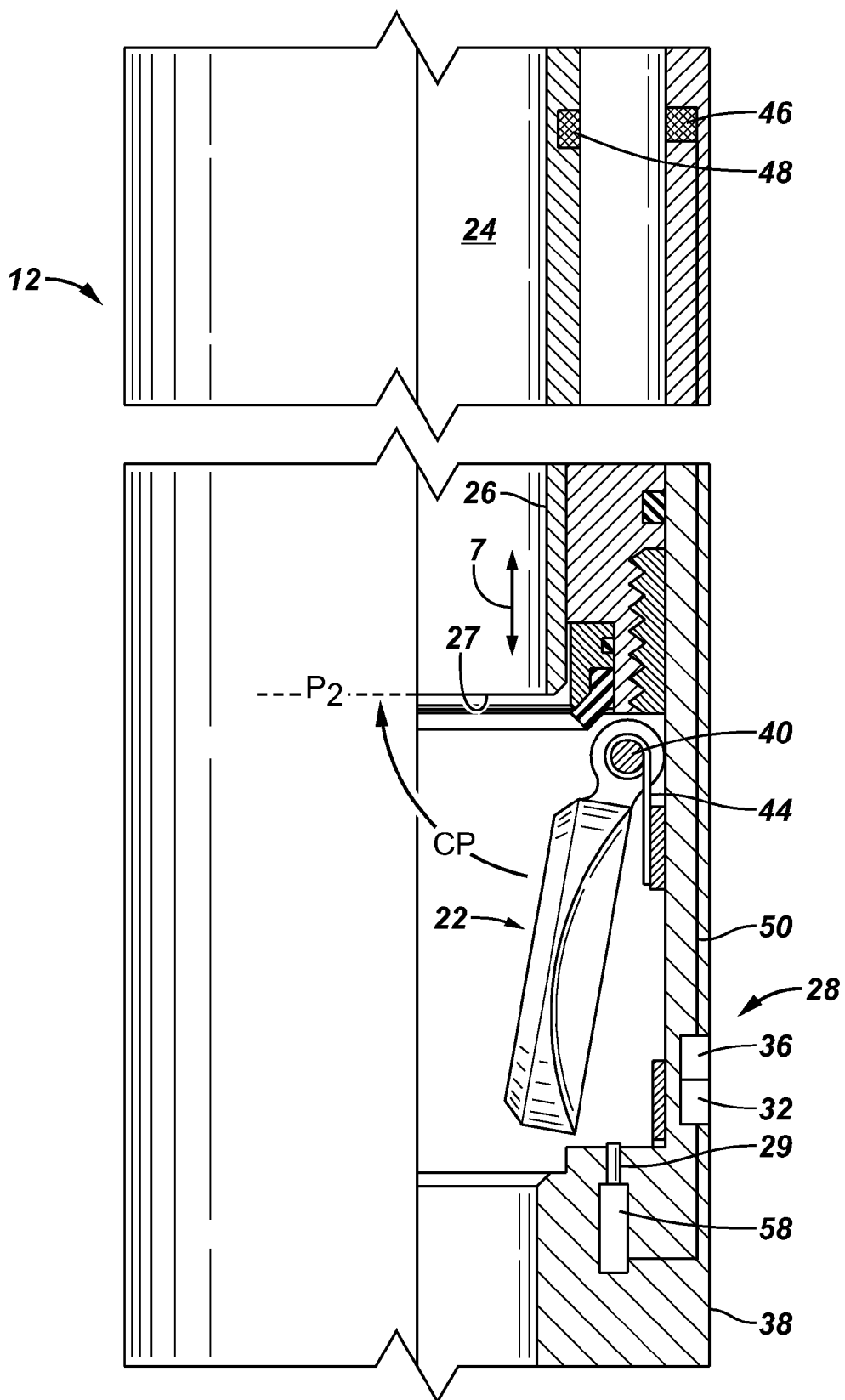


FIG. 13

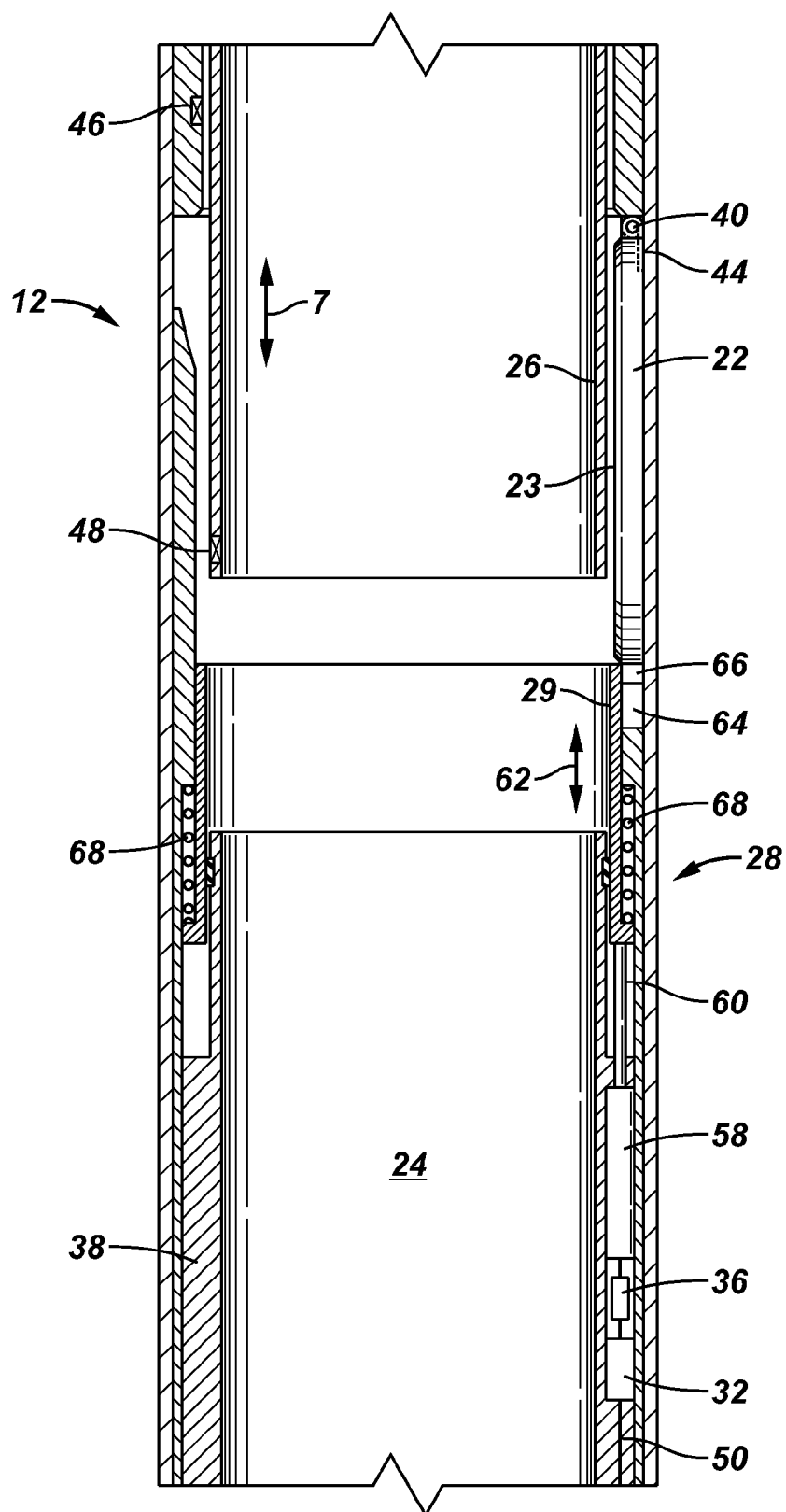
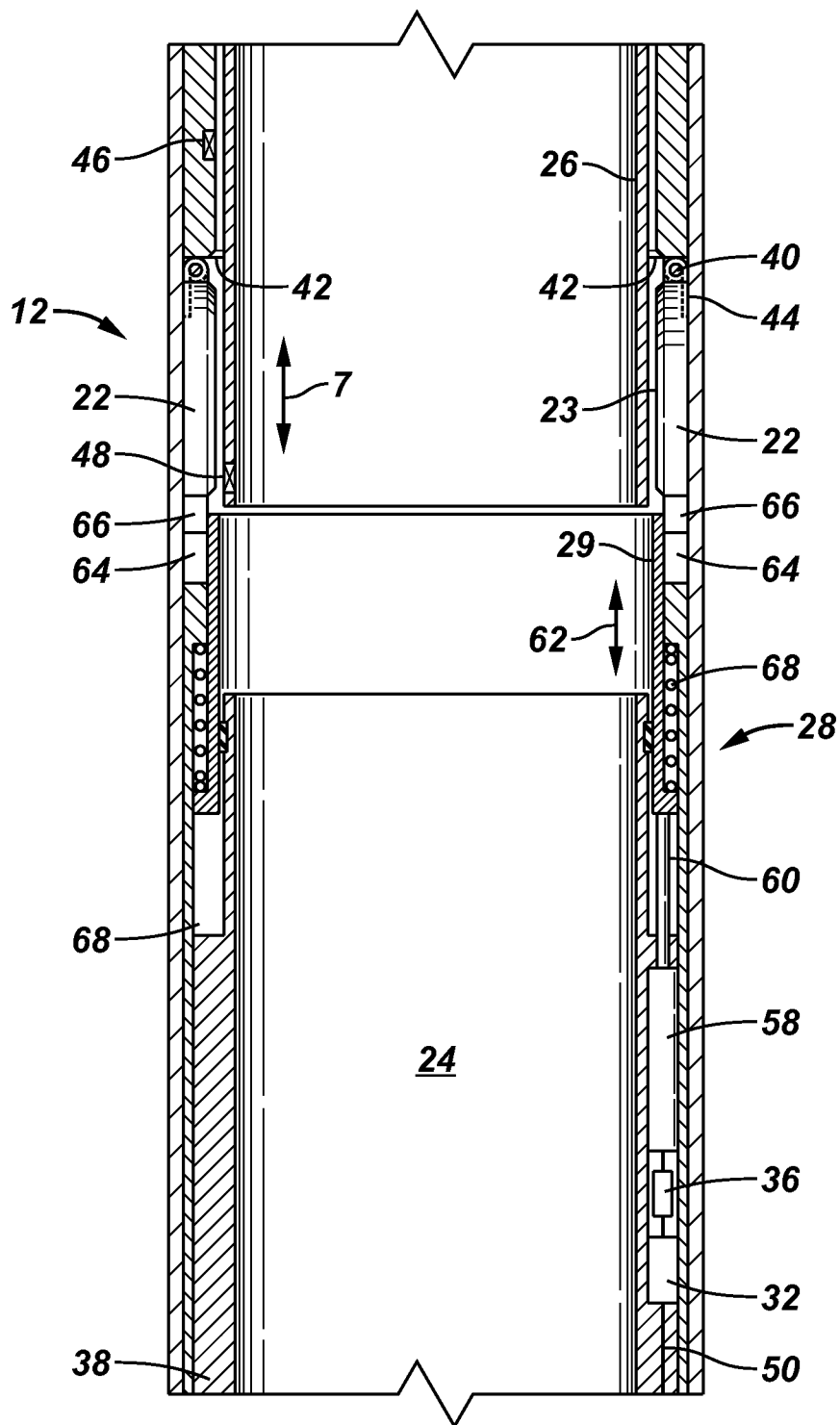


FIG. 14



FLAPPER RETENTION DEVICES AND METHODS

BACKGROUND

[0001] This section provides background information to facilitate a better understanding of the various aspects of the disclosure. It should be understood that the statements in this section of this document are to be read in this light, and not as admissions of prior art.

[0002] Equipment is utilized in wells (e.g., wellbore, bore hole) to facilitate the flow of fluids in the well relative to the subterranean formation surrounding the well. Valves are utilized in the well (e.g., subsurface) to inhibit or otherwise control the fluid flow through the well equipment. For example, flapper valves are often utilized to enable flow of fluid in a first direction while blocking uncontrolled fluid flow in a second direction. Flapper valves can also be used to restrict or limit the rate of fluid flow.

[0003] For example, many valves utilize a flapper as a closure mechanism fitted within a body or housing to enable control over fluid flow through a primary longitudinal bore upon an appropriate applied signal (e.g., pressure, flow, electrical or other means) from a control system. The applied signal is commonly a rapid reduction of the hydraulic operating pressure that holds the valve open, thereby facilitating shut-in of the production or injection fluid flow by closure of the valve. The closure mechanism may be moved between the open and closed position by movement of a tubular device, often called a flow tube. The flow tube can be moved to the open position or operated by the valve actuator which is motivated by hydraulics, pressure, electronic, or other applied signals and power sources. The shifting of the flow tube to a closed position can be performed for example by a mechanical power spring and/or a pressurized accumulator that applies a required load to move the flow tube to the closed position upon interruption of the opening signal.

SUMMARY

[0004] An example of a flow control device in accordance with an embodiment of the disclosure includes a housing comprising a valve seat having a bore therethrough and a flapper moveable through a closure path between a closed position contacting the valve seat and an open position. An operator is axially moveable within the housing between a first position and a second position. In the first position an end of the operator is located in the closure path of the flapper and in the second position the end of the operator is located out of the closure path. The flow control device includes a flapper retention device that is electrically activated to a hold position to retain the flapper in the open position in response to the operator being in the first position and the flapper retention device is electrically deactivated to a released position permitting movement of the flapper in response to the operator being in the second position. An example of a well system in accordance to an embodiment includes a tubular string disposed in a wellbore and carrying a housing comprising a valve seat having a bore and a flapper moveable through a closure path between a closed position contacting the valve seat and an open position. A flapper retention device is electrically activated to a hold position to retain the flapper in the open position in response to an end of an operator being in the closure path of the flapper.

[0005] An example of a wellbore method in accordance with an embodiment of the disclosure comprises utilizing a flow control device disposed in a wellbore on a tubular string. The flow control device including a valve seat having a bore therethrough and a flapper moveable through a closure path between a closed position contacting the valve seat and an open position. The method includes moving the flapper to the open position in response to axially moving an operator to a first position with an end of the operator in the closure path and electrically activating a flapper retention device to a hold position retaining the flapper in the open position in response to detecting the operator in the first position.

[0006] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Embodiments of flapper retention devices and methods are described with reference to the following figures. The same numbers are used throughout the figures to reference like features and components. It is emphasized that, in accordance with standard practice in the industry, various features are not necessarily drawn to scale. In fact, the dimensions of various features may be arbitrarily increased or reduced for clarity of discussion.

[0008] FIG. 1 illustrates an example well system in which embodiments of a flow control device and a flapper retention device can be implemented.

[0009] FIG. 2 illustrates an example of a flow control device utilizing more than one closure member.

[0010] FIGS. 3 and 4 illustrate complimentary views of upper and lower portions of a flow control device incorporating a flapper retention device according to one or more embodiments.

[0011] FIG. 5 illustrates an example flow control device and flapper retention device in an open position according to one or more embodiments.

[0012] FIG. 6 illustrates an example flow control device and flapper retention device as the operator is being moved out of the closure path of the flapper.

[0013] FIG. 7 illustrates an example flow control device and flapper retention device after the flapper retention device has released the flapper and the operator has cleared the closure path of the flapper.

[0014] FIG. 8 illustrates an example flow control device and flapper retention device with the flapper depicted in the closed position.

[0015] FIGS. 9 and 10 illustrate an example flow control device and flapper retention device incorporating a permanent magnet latch depicted in a hold open position and a released position respectively.

[0016] FIGS. 11 and 12 illustrate an example flow control device and flapper retention device incorporating a piston latch depicted in a hold open position and a released position respectively.

[0017] FIG. 13 illustrates an example flow control device and flapper retention device incorporating a sleeve latch depicted in a hold open position.

[0018] FIG. 14 illustrates an example flow control device and flapper retention device incorporating a sleeve latch depicted in a hold position retaining more than one flapper in an open position.

DETAILED DESCRIPTION

[0019] It is to be understood that the following disclosure provides many different embodiments, or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the disclosure. These are, of course, merely examples and are not intended to be limiting. In addition, the disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed. Moreover, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed interposing the first and second features, such that the first and second features may not be in direct contact.

[0020] As used herein, the terms “up” and “down”; “upper” and “lower”; “top” and “bottom”; and other like terms indicating relative positions to a given point or element are utilized to more clearly describe some elements. Commonly, these terms relate to a reference point as the surface from which drilling operations are initiated as being the top point and the total depth of the well being the lowest point, wherein the well (e.g., wellbore, borehole) is vertical, horizontal or slanted relative to the surface.

[0021] FIG. 1 is a schematic of a well 10 incorporating an embodiment of a flow control device, generally denoted by the numeral 12, according to one or more embodiments of the disclosure. Well 10 includes a wellbore 14 extending from a surface 16 into an earthen formation 5. Wellbore 14 may be lined in whole or in part with casing 18. Surface 16 is illustrated in FIG. 1 as the surface of the ground, or seafloor, however, surface 16 may be located at a platform, located for example at the sea surface, from which drilling and/or production operations are performed. Flow control device 12 is disposed in wellbore 14 on a tubular string 20 (e.g., tubing). Flow control device 12 comprises one or more closure members, referred to herein as flappers 22, operable between a closed position restricting fluid flow, depicted by arrow 7, through bore 24 and an open position permitting relatively greater fluid flow through bore 24. As will be understood by those skilled in the art with benefit of this disclosure, in the closed position the one or more flappers 22 may block fluid flow 7 (e.g., safety valve) or reduce the fluid flow rate across flow control device 12 relative to when the one or more closure members 22 are in the open position. For example, FIG. 1 illustrates an example of a flow control device 12 comprising one or more flappers 22 in the closed position forming a barrier blocking fluid flow 7. FIG. 2 illustrates a flow control device 12 comprising two or more flappers 22 cooperative to form a restricted flow path 70 when flappers 22 are in the closed position.

[0022] According to one or more embodiments of the disclosure, flow control device 12 includes an operator 26 (e.g., flow tube, sleeve) axially moveable within bore 24 to operate flapper 22 to the open position and a flapper retention device 28 to hold flapper 22 in the open position (FIGS. 1 and 3).

[0023] Flow control device 12 is operated to the open position by an actuating system, generally denoted by the numeral 30, operationally connected to operator 26. Actuating system 30 may comprise one or more power sources 32, for example an electrical source and/or a hydraulic pressure source, located at surface 16 and/or in wellbore 14. In the embodiment of FIG. 1, a control line 34 is illustrated extending from power source 32 located at surface 16 and flow control device 12. As will be understood by those skilled in the art with benefit of this disclosure, control line 34 may include a flow path for hydraulic fluid and/or electrical conductors to transmit electrical power and control signals.

[0024] According to one or more embodiments, actuating system 30 may be a hydraulic system. Hydraulic pressure is provided for example by power source 32 (e.g., pumps, hydraulic fluid reservoir) through control line 34 and applied to operator 26 to move flapper 22 to the open position allowing full fluid flow across flow control device 12 within tubular string 20. Hydraulic pressure may be maintained above a certain level to hold flapper 22 in the open position. Upon release of the hydraulic pressure, operator 26 retracts permitting flapper 22 to move to the closed position wherein fluid flow is blocked or restricted relative to the open position. In the depicted embodiments, flapper retention device 28 may be actuated to selectively hold flapper 22 in the open position. Flapper retention device 28 may operate to release flapper 22 in response to a release control signal and/or upon the occurrence of a well event indicating closure of flow control device 12. As will be further described below, flapper retention device 28 may be electrically powered without regard to whether flapper 22 is operated to the open position by a hydraulic or electrical actuating system 30. In some embodiments, flapper retention device 28 will hold flapper 22 in the open position until a hold signal is interrupted and/or a release signal is received. Flapper retention device 28 may be adapted to delay the release of flapper 22 until operator 26 has retracted to a desired position.

[0025] According to one or more embodiments, actuating system 30 may be an electrical system, as depicted for example in FIGS. 3 and 4. An electrical signal may be transmitted, for example from a controller 36 located at surface 16 to activate electrical motor 52 (see FIG. 3) to operate flapper 22 from the closed position to the open position. Activation of electrical motor 52 acts to provide an applied force to operator 26 to axially move operator 26 into contact with flapper 22. Electrically actuated flow control devices 12 may be of particular benefit in high pressure wells or when the flow control device 12 is located in deep wells. For example, the time required for the receipt of a hydraulic signal to release the closure member may be undesirable for operation of a flow control device. High pressure installations may reduce the reliability of hydraulic actuation. Electrical control signals may be transmitted, or conducted, from surface 16 located power sources 32 and/or subsurface located power sources 32 and/or controllers 36 (e.g., processors). For example, electrical power and/or control signals may be transmitted wirelessly, via electrical conductors 50, and via wired pipe. “Wired drill pipe” or “WDP” is utilized herein to mean one or more tubular members, including drill pipe, drill collars, casing, tubing and other conduit, that are adapted for use in a drill string, with each tubular member comprising a wired link. “Wired link” means a pathway that is at least partially wired along or through a WPD joint for conducting signals.

[0026] Referring now to FIGS. 3 and 4 illustrating upper and lower portions respectively of an embodiment of a flow control device 12 and flapper retention device 28 in accordance to one or more embodiments. Flow control device 12 generally includes a tubular body or housing 38 adapted to be connected to tubular string 20 to form a part thereof. Housing 38 carries a valve seat 42 defining a fluid passageway or bore 24 through which hydrocarbon or other downhole fluid flow 7 can be controlled. For this purpose, flow control device 12 is equipped with one or more closure members, illustrated and referred to as flapper 22, carried by housing 38 and moveable through a closure path CP, illustrated in FIGS. 7 and 8, between positions opening and closing bore 24. Flapper 22 is pivotally connected to housing 38, for example via valve seat 42, by a pivot pin 40 and cooperates with valve seat 42 for effecting a seal along a contacting portion of flapper 22. When flapper 22 is in the closed position and seated on valve seat 42 (see FIG. 8), flow control device 12 is in the closed position in which fluid flow 7, for example upward toward surface 16 (see FIG. 1), through bore 24 and tubular string 20 is restricted or blocked. According to one or more embodiments, flow control device 12 is adapted to close or be closed to block or restrict fluid flow 7 through flow control device 12 in response to abnormal or undesired well conditions.

[0027] Operator 26 is axially moveable (e.g., slidable) through housing 38 and valve seat 42 between a first, or open, position (see FIGS. 4, 5) preventing biasing device 44 from urging flapper 22 to its closed position, and a second, or closed, position (see FIG. 7) permitting flapper 22 to be moved, for example by biasing device 44 and/or fluid flow 7, to its closed position. The end 27 of operator 26 is in the closure path CP of flapper 22 when operator 26 is in the first, or open, position; and when operator 26 is in the second position, the end 27 of operator 26 is located above valve seat 42 and out of closure path CP of flapper 22. Biasing device 44 is depicted as a torsion spring in the illustrated embodiment; however, biasing device 44 may include other devices including gas springs and actuators.

[0028] Operator 26 is axially moved by operation of actuating system 30, which is depicted in FIGS. 3 and 4 as an electrical actuating system. Depicted actuating system 30 includes an electrical actuator, or motor 52, operationally connected to operator 26 by a piston 54. In this embodiment, electrical motor 52 is operationally connected to surface 16 located controller 36 (see FIG. 1) by conductor 50.

[0029] Flapper retention device 28 is provided for preventing movement of flapper 22 from its open position (see FIGS. 4, 5) to its closed position (see FIG. 7) until operator 26 has been urged clear of the closure path CP (see FIGS. 7, 8) of flapper 22 defined by the full open position P1 and the full closed position P2 as generally illustrated in FIG. 8. The one or more flappers 22 may be seated on valve seat 42 when in the full closed position P2. Flapper retention device 28 comprises a latch 29 for selectively holding flapper 22 in the open position for example in response to detection of a hold trigger position of operator 26. Latch 29 may comprise, without limitation, one or more of an electromagnetic coil, permanent magnet, piston, sleeve, tube, and rod. In accordance with an embodiment of the disclosure, flapper retention device 28 is electrically operated and requires low electrical power relative to the electrical power needed to actuate operator 26 to open flapper 22 and to maintain flapper 22 open via operator 26.

[0030] Flapper retention device 28 may include one or more position sensors 46, 48 to provide an activation, or hold, signal to activate flapper retention device 28 to selective hold flapper 22 for example in the first position. Flapper retention device 28 may be deactivated to release flapper 22 to allow it to move to the full closed position P2 by transmission of a release signal or by interruption of the hold signal. As will be understood by those skilled in the art with benefit of this disclosure, position sensors 46, 48 may be located with various elements of flow control device 12 without departing from the scope of the disclosure. The position sensor(s) can be located to sense the position of operator 26 either directly or indirectly (i.e., through a position associated with a mechanical element). Thus, the position of operator 26 may be detected by utilizing one or more position sensors. Position sensor 46, 48 can be an inductive, potentiometer, or other types of sensors. For example, a position sensor 46 can be an encoder built into or operatively connected for example with electrical motor 52 as illustrated in FIG. 3. FIGS. 4 through 14 also illustrate by way of example, a first position sensor 46 that is cooperative with a second position sensor 48. In various embodiments, a first position sensor 46 is carried by housing 38 and a second cooperative position sensor 48 is carried by operator 26.

[0031] In the embodiment depicted in FIGS. 3-8, flapper retention device 28 includes a local controller 36 and local power source 32 depicted as carried by housing 38 and operationally connected to latch 29 and one or more of position sensors 46, 48. Local controller 36 and or local electrical power source 32 may be incorporated into one or more devices, such as position sensors 46, 48 and latch 29. Similarly, electrical power 32 may be located at the surface or distal from flow control device 12 and transmitted for example via control line 34. In the depicted embodiments, position sensors 46, 48, power source 32, controller 36, and latch 29 are operationally connected via conductor 50. The various devices can be electrically connected to one another for example by electrical conductors, wirelessly, and by wired pipe. For example, electrical power can be supplied by direct electrical connection, for example via conductor 50, or through a wall of housing 38 by inductive coupling.

[0032] In the embodiment depicted in FIGS. 3-8, latch 29 of flapper retention device 28 is an electromagnetic coil which is selectively energized to magnetically hold flapper 22 in the open position. In the depicted embodiment, electromagnetic coil latch 29 is carried by housing 38, although it may be carried by flapper 22.

[0033] Referring to FIGS. 1-8, flow control device 12 is controlled by the operation of actuating system 30. When energized by application of hydraulic pressure or by operation of electric motor 52, operator 26 is axially moved from the second position, with flapper 22 in the closed position P2 (see FIGS. 1, 8) downward relative to surface 16 to the first position forcing flapper 22 off of valve seat 42 and to the full open position (see FIGS. 4, 5). Upon detection, for example by position sensors 46, 48, of operator 26 being in a selected position (e.g., a hold trigger position), a hold signal is transmitted for example via conductor 50 to activate latch 29 of flapper retention device 28 to hold flapper 22 in the full open position. For example, in the embodiment of FIGS. 3-8, latch 29 is an electromagnetic coil that is energized in response to the hold signal. In this embodiment, the hold trigger position corresponds to end 27 of operator 26 being located in the closure path of flapper 22.

[0034] When an undesired, or abnormal, condition such as a blowout or pressure kick occurs, hydraulic control pressure is reduced in a hydraulic actuation system 30 and stored energy device 17 (see FIGS. 3, 4) urges operator 26 upward to its second or closed position. In an electrical actuation system 30, electric motor 52 may be operated to retract operator 26 to its second position and/or stored energy device 17 may urge operator 26 to its second position. Stored energy device 17 may comprise a variety of devices, such as one or more springs. By way of example, stored energy device 17 may comprise one or more coil springs, gas springs, wave springs, power springs or other suitable devices to store energy upon movement of operator 26 to the first position.

[0035] In a conventional operation, flapper 22 would begin to close as soon as operator 26 was moved clear of the leading surface 23 of flapper 22. According to one or more embodiments of this disclosure, flapper retention device 28 delays the release of flapper 22 until operator 26 has been urged clear of the closure path CP of flapper 22. FIG. 5 illustrates operator 26 actuated to its first position and flapper 22 in the full open position. FIG. 6 illustrates operator 26 in an intermediate position after being released from its first position as depicted in FIG. 5, for example in response to an abnormal well condition. In FIG. 5 operator 26 has not retracted past the leading surface 23 of flapper 22 and operator 26 is not clear of the closure path of flapper 22.

[0036] FIG. 7 illustrates operator 26 retracted clear of closure path CP to its second position above valve seat 42. FIG. 7 further illustrates that flapper retention device 28 has been deactivated to release flapper 22 and allow it to move to the closed position P2. In this embodiment, the release trigger position to signal release, or deactivation, of flapper retention device 28 may be at the point that operator 26 clears valve seat 42. The release trigger position for the release signal may vary depending on the type of flapper retention latch 29 that is utilized. For example, the utilization of an electromagnetic coil latch 29 provides for an instantaneous release of flapper 22 upon deactivation of latch 29, thus the release trigger position will be proximate to end 27 clearing valve seat 42. In other embodiments of flapper retention device 28, release of flapper 22 from the hold position is effected by the physical movement of latch 29 (e.g., a permanent magnet, a piston, a shaft, a sleeve) from a hold position to a released position, thereby creating a time delay between initiation of the deactivation process and the actual release of flapper 22. In these configurations the release trigger position may correspond to a position in which operator end 27 is still located within the closure path of flapper 22 but still provide adequate time for end 27 to move out of the closure path prior to flapper 22 closing on valve seat 42. Therefore, the released trigger position is referred to herein as corresponding to end 27 of operator 26 being located out of the closure path of flapper 22. This delayed closing of flapper 22 relative to movement of operator 26 prevents flapper 22 from impacting operator 26, thereby avoiding damage to operator 26 and/or flapper 22.

[0037] Referring now to FIGS. 9 and 10, an embodiment of a flapper retention device 28 incorporating a permanent magnet as latch 29 is illustrated. Permanent magnet latch 29 is operationally connected to an actuator 58 by a shaft 60. Upon detection, for example by one or more of position sensors 46, 48, of a hold trigger position, actuator 58 is activated to move permanent magnet latch 29 into a hold position, for example as depicted in FIG. 9, wherein the permanent magnet latch 29 attracts and holds flapper 22 in the open position. Upon detec-

tion, for example by one or more of position sensors 46, 48, of a release trigger position of operator 26, actuator 58 can be activated to move latch 29 to a position releasing the magnetic holding force on flapper 22, for example as illustrated in FIG. 10. In the illustrated embodiment, permanent magnet latch 29 is moved axially between the hold position and the released position. As discussed above, the release trigger position of operator 26 may be prior to end 27 of operator 26 clearing flapper 22 to facilitate the time required for latch 29 to be moved from the hold position to the release position. Actuator 58 may include, for example, a solenoid, stepper motor, linear actuator, and the like.

[0038] Referring now to FIGS. 11 and 12, an embodiment of a flapper retention device 28 incorporating a piston as latch 29 is illustrated. Upon detection, for example by one or more of position sensors 46, 48, of a hold trigger position, actuator 58 is operated to axially move piston latch 29 into a hold position, for example as depicted in FIG. 11, wherein the piston latch 29 directly engages flapper 22 and holds it in the open position. Upon detection, for example by one or more of position sensors 46, 48 of a release trigger position of operator 26, actuator 58 can be activated to move latch 29 out of engagement with flapper 22 as illustrated for example in FIG. 12. As discussed above, the release trigger position of operator 26 may be prior to end 27 clearing flapper 22 to facilitate the stroke length of movement of latch 29 to the released, or disengaged, position. However, the release trigger position corresponds to end 27 being removed from closure path CP of flapper 22.

[0039] Referring now to FIG. 13, an embodiment flow control device 12 incorporating a flapper retention device 28 utilizing a sleeve as latch 29 is illustrated. In accordance with an embodiment, sleeve latch 29 is slidably positioned within bore 24 and forms an open ended cavity 64 with housing 38. Sleeve latch 29 is operationally connected to an actuator 58, e.g., electric linear actuator, via a shaft 60 for axial movement with bore 24 as depicted by the arrow 62. Upon detection, for example by one or more of position sensors 46, 48, of a hold trigger position, actuator 58 is operated to axially move sleeve latch 29 into a hold position, for example as depicted in FIG. 13, wherein a portion 66 of flapper 22 is disposed in cavity 64 of sleeve latch 29 thereby preventing movement of flapper 22 from the open position. Upon detection, for example by one or more of position sensors 46, 48 of a release trigger position of operator 26, retention device 28 is deactivated to the released position in which flapper 22 (e.g., portion 66) is removed from cavity 64 and thus flapper 22 is free to move to the closed position against seat 42. Retention device 28 may be deactivated by axially moving sleeve latch 29 away from valve seat 42 in response to operating actuator 58 and/or stored energy device 68. As discussed above, the release trigger position of operator 26 may be prior to operator end 27 clearing flapper 22 to facilitate the stroke length of movement of sleeve latch 29 to the released, or disengaged, position.

[0040] FIG. 14 illustrates an example of an embodiment of a flow control device 12 comprising more than one flapper 22 operational to restrict fluid flow 7 when in the closed position (see FIG. 2). In the open position, as depicted in FIG. 14, each of flappers 22 is retained in the open position by retention device 18.

[0041] Although only a few example embodiments have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from this

invention. Accordingly, all such modifications are intended to be included within the scope of this disclosure as defined in the following claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures. Thus, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas they screw employees a helical surface, in the environment unfastening wooden parts, a nail and a screw may be equivalent structures. It is the express intention of the applicant not to invoke 35 U.S.C. §112, paragraph 6 for any limitations of any of the claims herein, except for those in which the claim expressly uses the words “means for” together with an associated function. The term “comprising” within the claims is intended to mean “including at least” such that the recited listing of elements in a claim are an open group. The terms “a,” “an” and other singular terms are intended to include the plural forms thereof unless specifically excluded.

What is claimed is:

1. A flow control device, comprising:
 - a housing comprising a valve seat having a bore there-through;
 - a flapper carried by the housing and moveable through a closure path between a closed position contacting the valve seat and an open position;
 - an operator having an end, the operator axially moveable within the housing between a first position wherein the end is located in the closure path and a second position wherein the end is located out of the closure path; and
 - a flapper retention device electrically activated to a hold position to retain the flapper in the open position in response to the operator being in the first position and the flapper retention device electrically deactivated to a released position permitting movement of the flapper in response to the operator being in the second position.
2. The flow control device of claim 1, further comprising an electrical motor operationally connected to the operator to move the operator to the first position.
3. The flow control device of claim 1, wherein the flapper retention device comprises a magnet.
4. The flow control device of claim 1, wherein the flapper retention device comprises an electromagnetic coil.
5. The flow control device of claim 1, wherein the flapper retention device comprises a sleeve disposing a portion of the flapper when the flapper retention device is in the hold position.
6. The flow control device of claim 1, wherein the flapper retention device comprises a piston engaging the flapper when the flapper retention device is in the hold position.
7. The flow control device of claim 1, wherein the flapper retention device comprises:
 - a position sensor to detect the position of the operator and to generate a hold control signal in response to detecting the operator in the first position and to generate a release control signal in response to detecting the operator in the second position; and
 - a latch activated to the hold position in response to the generated hold control signal and the latch deactivated to the released position in response to the generated release control signal.
8. The flow control device of claim 7, further comprising an electrical motor operationally connected to the operator to move the operator to the first position.

9. The flow control device of claim 7, further comprising an electric actuator to move the latch between the hold position and the released position.

10. The flow control device of claim 7, wherein the latch comprises an electromagnetic coil electrically energized to magnetically hold the flapper when in the hold position.

11. The flow control device of claim 7, wherein the latch comprises a permanent magnet movable between the hold position in magnetic connection with the flapper and the released position.

12. The flow control device of claim 11, wherein the flapper retention device comprises an electric actuator to move the latch between the hold position and the release position.

13. A wellbore method, comprising:

utilizing a flow control device disposed in a wellbore on a tubular string, the flow control device comprising a housing carrying a valve seat having a bore there-through, and a flapper carried by the housing and moveable through a closure path between a closed position contacting the valve seat and an open position;

moving the flapper to the open position in response to axially moving the operator in the housing to a first position wherein an end of the operator is in the closure path; and

electrically activating a flapper retention device to a hold position retaining the flapper in the open position in response to detecting the operator in the first position.

14. The method of claim 13, wherein the axially moving operator to the first position comprises operating an electric motor located in the housing.

15. The method of claim 13, further comprising deactivating the flapper retention device to a released position permitting the flapper to move to the closed position in response to detecting the operator in a second position wherein the end of the operator is located out of the closure path.

16. The method of claim 15, wherein the flapper retention device comprises an electromagnetic coil.

17. A well system, comprising:

a tubular string disposed in a wellbore, the tubular string carrying a housing comprising a valve seat having a bore therethrough;

a flapper carried by the housing and moveable through a closure path between a closed position contacting the valve seat and an open position;

an operator having an end, the operator axially moveable within the housing between a first position wherein the end is located in the closure path and a second position wherein the end is located out of the closure path; and

a flapper retention device electrically activated to a hold position to retain the flapper in the open position in response to the operator being in the first position and the flapper retention device electrically deactivated to a released position permitting movement of the flapper in response to the operator being in the second position.

18. The well system of claim 17, wherein the flapper retention device comprises:

a position sensor to detect the position of the operator and to generate a hold control signal in response to detecting the operator in the first position and to generate a release control signal in response to detecting the operator in the second position; and

a latch activated to the hold position in response to the generated hold control signal and the latch deactivated to the released position in response to the generated release control signal.

19. The well system of claim **18**, wherein the flapper retention device further comprises an electric actuator to move the latch between the hold position and the release position.

20. The well system of claim **17**, further comprising an electrical motor operationally connected to the operator to move the operator to the first position.

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