

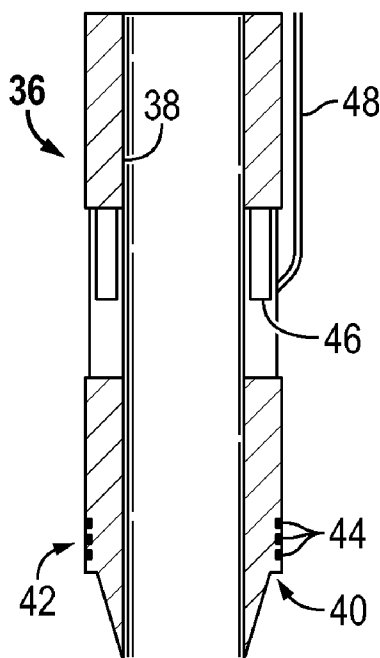


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[Continued on next page]

(54) Title: SIMPLIFIED ISOLATION VALVE FOR ESP/WELL CONTROL APPLICATION

FIG. 3



(57) Abstract: A tool is provided for use in a variety of ESP and other well control applications. The tool employs a simplified design for ESP and well control applications and has a main valve which may be operated by a plurality of different shifting tools.



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SIMPLIFIED ISOLATION VALVE FOR ESP/WELL CONTROL APPLICATION**CROSS REFERENCE TO RELATED APPLICATIONS**

[0001] This application claims priority to U.S. Provisional Patent Application No. 62/025,753 entitled “SIMPLIFIED ISOLATION VALVE FOR ESP/WELL CONTROL APPLICATION” filed July 17, 2014 and incorporated herein by reference in its entirety.

BACKGROUND

[0001] Electrical Submersible Pump (ESP) systems are used in a variety of well applications. For example, ESP systems may be used for pumping well fluids from a downhole location to a surface location. In other applications, ESP systems may be used for injecting fluids or for moving fluids from one location to another, either downhole or at the surface. Generally, ESP systems comprise a submersible pump powered by a submersible motor. Other components may comprise pump intakes and motor protectors.

SUMMARY

[0002] In general, a tool is provided for use in an ESP or other well control application. The tool employs a simplified design for ESP and well control applications and has a main valve which may be operated by a plurality of different shifting tools. Some embodiments of the present disclosure are directed to a system for flow control including a valve system. The valve system includes a valve having an effective diameter that, when open, permits flow through the valve through the effective diameter, and a shifting mechanism operably coupled to the valve such that when the shifting mechanism is actuated the valve at least partially opens or closes. The valve system also includes a seal bore above the shifting mechanism. The system further includes a shifting tool having a seal section configured to engage with the seal bore of the valve system and a shifting section configured to engage with the shifting mechanism of the isolation valve.

Bringing the shifting tool into contact with the valve system the valve at least partially actuates the valve. The shifting tool and valve system maintain the effective diameter.

[0003] In further embodiments the present disclosure is directed to a system for flow control including a valve system having an upper shifting mechanism coupled with a valve which may be shifted between closed and open positions by the upper shifting mechanism, the upper shifting mechanism having a seal bore. The valve system also includes a shifting tool having a seal section received by the seal bore to form a seal while the upper shifting mechanism and the valve are shifted via movement of a shifting section of the shifting tool

[0004] 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] Figure 1 is an illustration of an example of an isolation valve which may be used in ESP and other well control applications, according to an embodiment of the disclosure;

[0007] Figure 2 is an illustration of an example of a mechanical shifting tool which may be used to actuate the isolation valve, according to an embodiment of the disclosure;

[0008] Figure 3 is an illustration of an example of a hydraulic shifting tool which may be used to actuate the isolation valve, according to an embodiment of the disclosure; and

[0009] Figure 4 is an illustration of an example of an electric shifting tool which may be used to actuate the isolation valve, according to an embodiment of the disclosure.

DETAILED DESCRIPTION

[0010] 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. The present disclosure generally relates to a system and methodology for use in an ESP application or other well control application. A tool is provided which employs a simplified design for ESP and well control applications. The tool has a main valve which may be operated by a plurality of different shifting tools selected by an operator or field of use. The shifting tool has a full bore therethrough, and the main valve has an upper bore section which simplifies shifting of the main valve between open and closed positions. This equipment is used to form a wet mate connection which provides the ability to establish optical, electrical, hydraulic, and/or other types of communication between, for example, a surface location and downhole equipment attached to or used with a lower assembly. The formation of wet mate connection is achieved through movement of one or both control line connectors and via a control line actuation mechanism. The valves disclosed herein can include flow control valves, formation isolation valves, or other suitable valves. A flow control valve is a valve that can be opened, closed, or throttled in various ways to control an amount of fluid passing through the valve. A formation isolation valve (FIV) is placed in a well after a lower completion is installed but before production is to begin. The FIV maintains

downhole fluid in the well until equipment is installed to produce the fluid. The FIV is selectively openable to allow production when the equipment is in place.

[0011] By way of example, the shifting mechanism may be selected according to different actuation techniques. For example, the shifting mechanism may be a mechanical mechanism using tubing movement and the resultant forces to shift the main valve. The shifting mechanism also may be a hydraulic mechanism which uses a piston and a hydraulic control line. This approach removes the usage of a lower wet mate connection and can be operated without additional disconnect tools and tubing movement that could otherwise break the integrity of the well and the completion. The shifting mechanism also may be an electrical mechanism using a power cable, such as an ESP power cable. This latter approach also removes the usage of a lower wet mate connection and can be operated without additional disconnect tools and tubing movement that could otherwise break the integrity of the well and the completion.

[0012] Referring generally to Figure 1, an example of an isolation valve system 20 is illustrated for use with ESP operations and other well control operations. The isolation valve system 20 has an upper shifting mechanism 22 and may be activated by mechanically shifting the upper shifting mechanism 22 in the direction of arrows 24. The upper shifting mechanism 22 may comprise a shoulder 26, for engaging a shifting tool, and a seal bore 28. The upper shifting mechanism 22 is shifted to actuate a valve 30 between open and closed positions via a piston 32 or other suitable actuating mechanism. The structure of isolation valve system 20 enables use of a shorter piston 32 and a full bore 34 to facilitate fluid flow and/or tool access. The structure of isolation valve system 20 also is a standardization-based design which facilitates the use of a variety of shifting tools.

[0013] In Figures 2-4, examples of shifting tools 36 are illustrated. The shifting tools 36 also may be designed with a full bore 38 which facilitates fluid flow/tool access through the system. Each embodiment of shifting tool 36 may comprise a shifting section 40 constructed to engage shoulder 26 in a manner that allows controlled shifting

of the upper shifting mechanism 22. Each embodiment of shifting tool 36 also may comprise a seal section 42 having a seal or a plurality of seals 44 positioned to sealably engage seal bore 28 of shifting mechanism 22.

[0014] Figure 2 illustrates an example of a mechanical shifting tool 36 which may be used to shift the upper shifting mechanism 22 and thus to actuate valve 30 via tubing movement. In other words, the tubing or other conveyance by which the mechanical shifting tool 36 is conveyed downhole may be used to actuate the valve 30. Once the mechanical shifting tool 36 is engaged with shoulder 26, the upper shifting mechanism 22 may be transitioned to actuate valve 30 by applying the requisite actuation force (e.g. applying a set down weight) along the tubing/conveyance coupled with the mechanical shifting tool 36.

[0015] Figure 3 illustrates another example of shifting tool 36 in the form of a hydraulic shifting tool. The hydraulic shifting tool 36 employs a piston 46 which is operated by hydraulic pressure provided through a hydraulic control line 48. In this system, the hydraulic shifting tool 36 initially is engaged with upper shifting mechanism 22 at shoulder 26 and seal bore 28. The hydraulic piston 46 under the influence of hydraulic fluid supplied through hydraulic control line 48 is then used to move the shifting section 40 of shifting tool 36 against the upper shifting mechanism 22 with sufficient force to move the upper shifting mechanism 22 and actuate valve 30. In this example, the valve 30 can be actuated without further movement of the tubing or other conveyance once the shifting section 40 is engaged with shoulder 26.

[0016] Figure 4 illustrates another example of shifting tool 36 in the form of an electrical shifting tool. The electrical shifting tool 36 employs an electromechanical actuator 50 which is operated by electrical power provided through a power cable 52, such as an ESP power cable. In this system, the electrical shifting tool 36 initially is engaged with upper shifting mechanism 22 at shoulder 26 and seal bore 28. The electromechanical actuator 50 is then powered via electrical power supplied through cable 52 to move the shifting section 40 of shifting tool 36 against the upper shifting

mechanism 22 with sufficient force to move the upper shifting mechanism 22 and actuate valve 30. In this example, the valve 30 can be actuated without further movement of the tubing or other conveyance once the shifting section 40 is engaged with shoulder 26.

[0017] The shifting tool 36 and isolation valve system 20 may be installed with ESP completions and other flow control systems. The isolation valve system 20 may be used in a variety of applications, including applications providing a downhole barrier once a tubing hanger is un-set. The system also enables maintenance of full bore access through the shifting tool 36 and the isolation valve system 20. The isolation valve system 20 also may be structured with upper seal bore 28 for well integrity. The electrical embodiment of shifting tool 36 enables use of ESP power to generate the forces for actuation of valve 30. The shifting tool 36 and the isolation valve system 20 may be used in a variety of ESP applications, other well applications, and various other flow control applications.

[0018] 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.

CLAIMS

What is claimed is:

1. A system for flow control, comprising:
a valve system having:
a valve having an effective diameter that, when open, permits flow through the valve through the effective diameter;
a shifting mechanism operably coupled to the valve such that when the shifting mechanism is actuated the valve at least partially opens or closes; and
a seal bore above the shifting mechanism;
a shifting tool having a seal section configured to engage with the seal bore of the valve system and a shifting section configured to engage with the shifting mechanism of the isolation valve such that bringing the shifting tool into contact with the valve system the valve is at least partially actuated, wherein the shifting tool and valve system maintain the effective diameter.
2. The system of claim 1 wherein the shifting mechanism is a mechanical shifting mechanism.
3. The system of claim 1 wherein the shifting mechanism is a hydraulic shifting mechanism.
4. The system of claim 1 wherein the shifting mechanism is an electrical shifting mechanism.
5. The system of claim 1 wherein the shifting mechanism of the valve system and the shifting section of the shifting tool have corresponding profiles.
6. The system of claim 5 wherein the corresponding profiles comprise a female sloped shoulder on the isolation valve and a male sloped shoulder on the shifting tool.

8. The system of claim 1 wherein the valve system comprises an isolation valve.
9. The system of claim 1 wherein the valve system comprises a flow control valve.
10. A system for flow control, comprising:
 - a valve system having an upper shifting mechanism coupled with a valve which may be shifted between closed and open positions by the upper shifting mechanism, the upper shifting mechanism having a seal bore; and
 - a shifting tool having a seal section received by the seal bore to form a seal while the upper shifting mechanism and the valve are shifted via movement of a shifting section of the shifting tool.
11. The system of claim 10 wherein the shifting tool is a mechanical shifting tool.
12. The system of claim 10 wherein the shifting tool is a hydraulic shifting tool.
13. The system of claim 10 wherein the shifting tool is an electrical shifting tool.
14. The system of claim 10 wherein the valve system and shifting tool define an interior diameter which is approximately equal throughout the length of the system.
15. The system of claim 12 wherein the hydraulic shifting tool comprises a hydraulic line coupled to a piston, and wherein hydraulic pressure in the hydraulic line causes the piston to move to actuate the valve system.
16. The system of claim 13 wherein the electrical shifting tool is powered by an electric submersible pump (ESP) cable.
17. The system of claim 10 wherein at least one of the valve system and shifting tool are installed with ESP completions.
18. The system of claim 10 wherein at least one of the valve system and shifting tool are installed with a flow control valve.
19. The system of claim 10 wherein the valve system comprises an isolation valve system.

20. The system of claim 10 wherein the valve system comprises a flow control valve.

FIG. 1

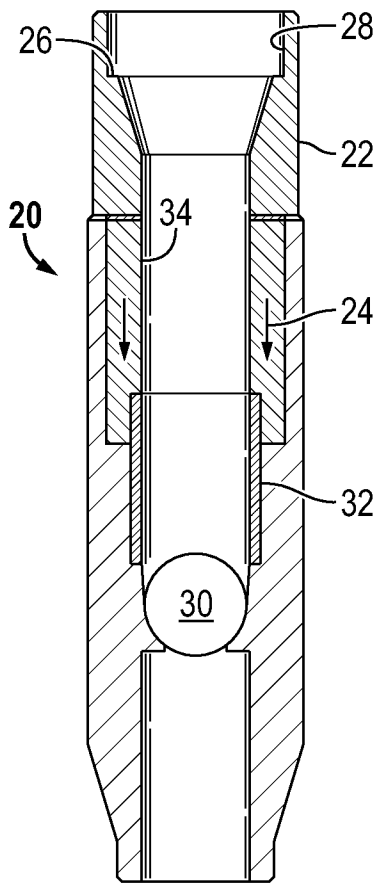


FIG. 2

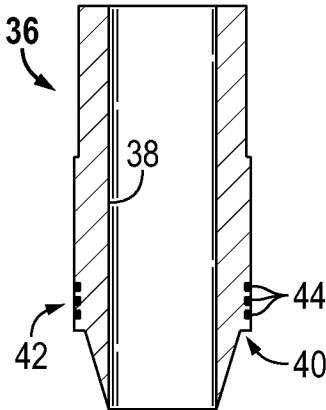


FIG. 3

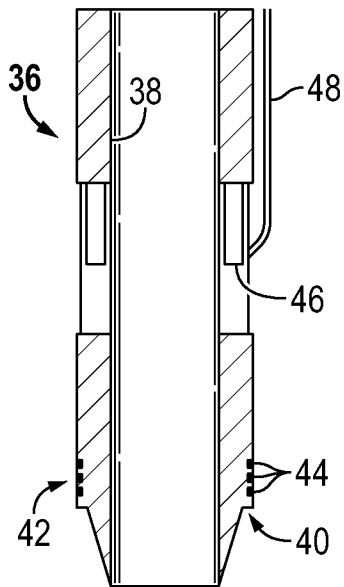
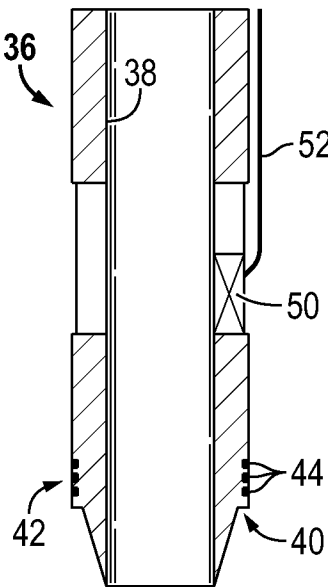


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/017295**A. CLASSIFICATION OF SUBJECT MATTER****F04D 15/00(2006.01)i, F04D 13/10(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04D 15/00; E21B 34/10; E21B 43/00; E21B 33/12; E21B 34/14; E21B 34/06; E21B 43/00; F04B 35/04; E21B 33/124; F04D 13/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: valve, shifting tool, seal, bore, and shoulder

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002-0066573 A1 (PATEL, DINESH R.) 06 June 2002 See paragraphs [0012], [0015], [0018]-[0020] and figure 1.	1-6,8-20
A	WO 2014-055063 A1 (HALLIBURTON ENERGY SERVICES INC.) 10 April 2014 See page 4, line 11 - page 8, line 12 and figures 3, 4.	1-6,8-20
A	US 2003-0150622 A1 (PATEL, DINESH R. et al.) 14 August 2003 See paragraphs [0018], [0019] and figures 2, 3.	1-6,8-20
A	US 2011-0005772 A1 (CECCARELLI, TOMASO U. et al.) 13 January 2011 See paragraphs [0015], [0016] and figure 1.	1-6,8-20
A	US 2009-0260835 A1 (MALONE, BRADLEY P.) 22 October 2009 See paragraph [0022] and figure 2.	1-6,8-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

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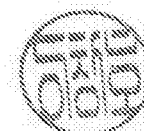
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/017295

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