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(54) Title: RE-CLOSABLE COIL ACTIVATED FRACK SLEEVE

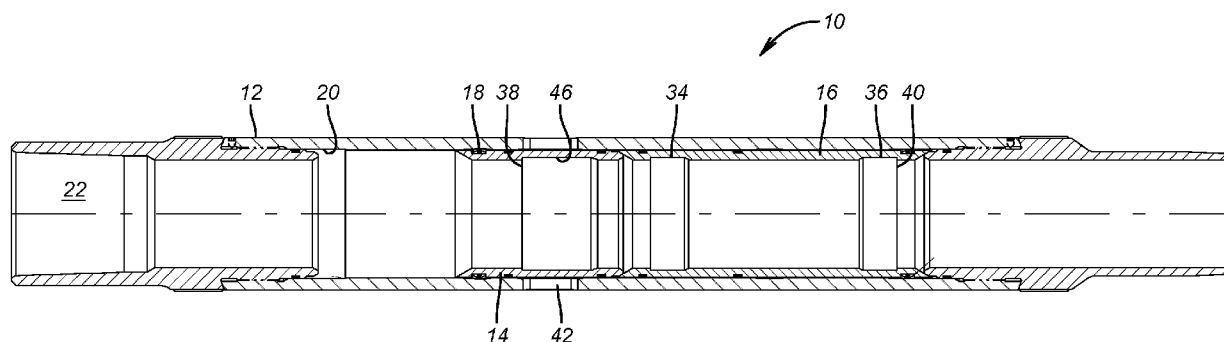


FIG. 1

(57) Abstract: A bottom hole assembly for performing a borehole treatment has a plurality of ported valve housings where the housings have an assembly of shifting sleeves. The first sleeve is shifted uphole to open the port in the housing and lock the first sleeve in the ports open position. A second sleeve in the same housing is shifted in the same direction as the first sleeve to close the ports in the housing. The second sleeve has profiles for shifting it up to close the housing ports and back down to reopen the housing ports after closing them.

RE-CLOSABLE COIL ACTIVATED FRACK SLEEVE

Inventors: Jeffrey B. Koch; David A. Luft and Edward A. Rapin

FIELD OF THE INVENTION

[0001] The field of the invention relates to sequentially operated sliding sleeve valves to selectively open and then close a port in a treatment valve and more particularly where one sleeve is pulled up to open the port and a second sleeve is also pulled up to close port.

BACKGROUND OF THE INVENTION

[0002] In the past frack or other treatment valves operated with a single sleeve that had to be moved in opposed directions to open and close the ports. In some deviated boreholes enough force to shift a sleeve in the downhole direction with set down weight is not available. Sliding sleeve valves were used in pairs or did not have the capacity to be reopened after closing or had other limitations making them unsuitable for treatment in certain applications. The following references are illustrative of some known designs of sliding sleeve valves for borehole treatment operations: US 7591312; US 8127847 and US 2009/0139717.

[0003] The present invention addresses the issues of the prior designs of sliding sleeve valves for treatment applications in a borehole by providing a tandem sleeve design where the sleeves are pulled uphole. The first sleeve movement opens housing ports and movement of a second sleeve in the same direction moves the second sleeve to where the first sleeve started for the closed position of the ports in the valve housing. The closing sleeve can also be functioned back down in the event the ports in the valve housing need to be reopened. The opening sleeve can be locked in the open position after it is shifted. Known spears using selectively supported collets can be used to shift the opening sleeve and a linkage type shifting tool such as an HB-3 shifting tool from Baker Hughes Incorporated can be used to shift the closing sleeve to close the housing ports. Two HB-3 shifters oriented in mirror image can be used to move the closing sleeve up for closing the housing ports with one shifter and to move the closing sleeve back down to reopen the housing ports.

[0004] Those skilled in the art will have a better understanding of the present invention from a review of the description of the preferred

embodiment and the associated drawings while recognizing that the full scope of the invention is to be determined from the appended claims.

SUMMARY OF THE INVENTION

[0005] A bottom hole assembly for performing a borehole treatment has a plurality of ported valve housings where the housings have an assembly of shifting sleeves. The first sleeve is shifted uphole to open the port in the housing and lock the first sleeve in the ports open position. A second sleeve in the same housing is shifted in the same direction as the first sleeve to close the ports in the housing. The second sleeve has profiles for shifting it up to close the housing ports and back down to reopen the housing ports after closing them.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a section view of a valve housing with dual sleeves with the ports closed;

[0007] FIG. 2 is a section view of an inner assembly collet type shifting tool located below an upper sleeve before the upper sleeve is shifted;

[0008] FIG. 3 is the view of FIG. 2 with the upper sleeve groove engaged for shifting up to open the housing ports;

[0009] FIG. 4 is an enlarged view of FIG. 3;

[0010] FIG. 5 shows a linkage type shift tool of the inner assembly at the lower groove of the second sleeve;

[0011] FIG. 6 is an enlarged view of FIG. 5;

[0012] FIG. 7 is the view after the upper groove of the lower sleeve is engaged, shifted and released to show the linkage type shifting tool past the shift groove in the upper sleeve and ready to move into another valve housing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] FIG. 1 shows a valve assembly **10** that is one of an array in a bottom hole assembly for treating a zone. A housing **12** has an upper sleeve **14** and a lower sleeve **16**. A snap ring **18** expands into a groove **20** in housing **12** to retain the upper sleeve **14** after it is shifted in an uphole direction by an inner assembly preferably run into passage **22** on coiled tubing. The inner assembly preferably has a resettable packer that is not shown that is located between spaced shifting tools **24** and **26**. The shifting tool **24** is a known

design made available by Baker Hughes Incorporated and known as an HB-3. It is linkage operated and the links **28** and **30** that relatively pivot to bring out a profile **32** that can be configured to grab a recess such as **34** or **36** to shift a second sleeve **16** in one of opposed directions. Recess **34** has a right angle at uphole end **38** while recess **36** has the right angle in mirror image on the downhole end **40**. Sleeve **16** is moved by tool **24** in the uphole direction to close ports **42** by engagement into recess **34**. Recess **36** is engaged by an oppositely oriented linkage in recess **36** to move sleeve **16** away from ports **42** to reopen them. A single tool **24** can have oppositely oriented linkages **28** and **30** or **30** and **28** so that a single tool body can shift sleeve **16** in opposed directions. Alternatively two tools **24** can be provided in opposite orientation and one will grab recess **34** to close ports **42** while the other will grab recess **36** to reopen ports **42**.

[0014] Sleeve **14** is shifted by a known design of a collet type shifter that can support or unsupport collet heads **44** using a j-slot and string manipulation. FIG. 2 shows the collet heads **44** below the target recess **46** on the way to get locked into recess **46** for an upward pull on sleeve **14** to open housing ports **42**. The sleeve **14** is locked with snap ring **18** going into groove **20** at the conclusion of shifting. Resistance will be felt at the surface to indicate sleeve **14** has fully shifted and the ports **42** are open. At that time the string is manipulated to unsupport the collet heads **44** as well as the resettable packer in the work string that is not shown so that a different valve housing can be used to continue treatment of a zone. It should be noted that the sequence of movements is to slide open sleeve **14** and then perform a treatment through openings **42** with the resettable packer set to hold pressure. After the treatment ends the resettable packer is released and the inner string is moved so that tool **24** can engage recess **34** and pull up sleeve **16** to close ports **42**. The inner string then moves to the next valve assembly **10** and the treatment continues. After treatment through all the desired valves **10** the inner string can be used to shift down sleeve **16** with tool **24** engages in recess **40** so that production, for example, can commence.

[0015] Those skilled in the art will appreciate that the use of separate sleeves that shift up allows a piston cylinder assembly such as **50** in a test fixture to apply the necessary force in an uphole direction to move a sleeve.

Pulling tension on the coiled tubing is employed to move shifting sleeve **14** with a shifting tool to open ports **42** and sleeve **16** to close the same ports. For reopening any ports **42** weight is set down to move sleeve **16** in a downhole direction. Sleeve **14** stays locked after being initially shifted uphole.

[0016] It is preferred to employ an inner string that has the capability in a single trip to shift sleeve **14** up and sleeve **16** up and then down. Sometimes there may be a delay from when all the ports **42** are closed after treatment and when production begins and in that case the inner string is removed with the coiled tubing. Although coiled tubing is preferred, rigid tubing is also envisioned. Other types of known shifting tools can be used to get the requisite movements of the sleeves **14** and **16** in the uphole direction for sequential treatment of a zone with uphole movement of the opening sleeve **14** and the closing sleeve **16**. Treatment flow can be through the coiled tubing backstopped by a set resettable packer.

[0017] The above description is illustrative of the preferred embodiment and many modifications may be made by those skilled in the art without departing from the invention whose scope is to be determined from the literal and equivalent scope of the claims below:

We claim:

1. A treatment method for a zone in a borehole, comprising:
operating at least one port (42) in at least one valve housing, said housing part of a bottom hole assembly comprising multiple spaced said housings in said zone, between open and closed positions;
moving a first sleeve (14) to open said at least one port (42);
characterized by
moving a second sleeve (16) in the same direction as said first sleeve (14) to close said at least one port.
2. The method of claim 1, comprising:
moving said first (14) and second (16) sleeves in an uphole direction.
3. The method of claim 1, comprising:
moving said second sleeve (16) into a position formerly occupied by said first sleeve (14) to close said at least one port (42).
4. The method of claim 1, comprising:
locking (18,20) said first sleeve (14) in a shifted position with said at least one port (42) open.
5. The method of claim 4, comprising:
releasing a snap ring (18) into a groove (20) in said valve housing (12) for said locking.
6. The method of claim 1, comprising:
moving said second sleeve (16) in a downhole direction to reopen said at least one port (42) after moving said second sleeve (16) in an uphole direction to close said at least one port (42).
7. The method of claim 1, comprising:
manipulating a shifting assembly (24, 26) in said valve housing on coiled tubing for moving said sleeves (14,16).
8. The method of claim 1, comprising:
providing different shifting tools (24, 26) for moving said first (14) and second (16) sleeves on a common shifting assembly.
9. The method of claim 8, comprising:
shifting said first sleeve (14) with a first shifting tool (26) that selectively supports at least one collet in a first recess (46) in said first sleeve (14).

10. The method of claim **9**, comprising:
shifting said second sleeve (16) with a second shifting tool (24) that uses a plurality of pivoting linkages (28,30) engaging a second recess (34) located in said second sleeve (16) .
11. The method of claim **10**, comprising:
providing spaced mirror image second (34) and third (36) recesses in said second sleeve (16) .
12. The method of claim **11**, comprising:
configuring said pivoting linkages on a common body to engage both said second (34) and said third (36) recesses.
13. The method of claim **11**, comprising:
configuring said pivoting linkages on different tool bodies to engage both said second (34) and said third (36) recesses for opposed movement of said second sleeve (16) .
14. A treatment valve for a zone in a borehole, comprising:
a housing (12) having a passage therethrough and end connections for securing said housing (12) to a tubular string; **characterized by**
said housing (12) further comprising a lateral port (42) selectively opened and closed with discrete sleeves mounted in said housing (12).
15. The valve of claim **14**, wherein:
said sleeves (14,16) moving in a single direction to open and close said lateral port (42).
16. The valve of claim **14**, wherein:
said sleeves comprise a first sleeve (14) whose movement is locked (18,20) after shifting to open said at least one lateral port (42) and a second sleeve (16) movable in opposed directions.
17. The valve of claim **14**, wherein:
said sleeves (14, 16) moving in an uphole direction to open and then close said at least one lateral port (42).

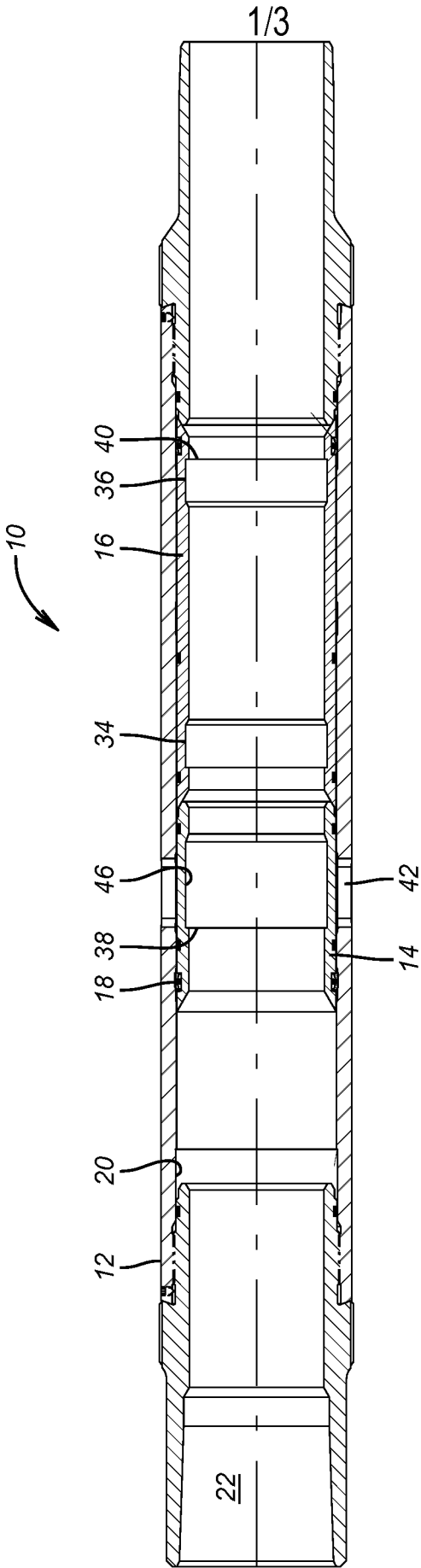


FIG. 1

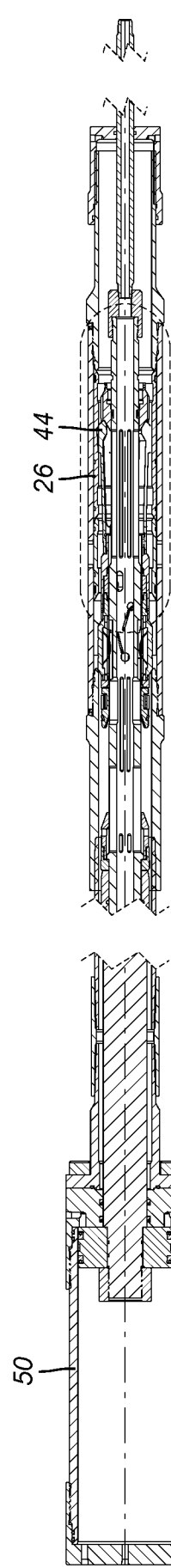


FIG. 2

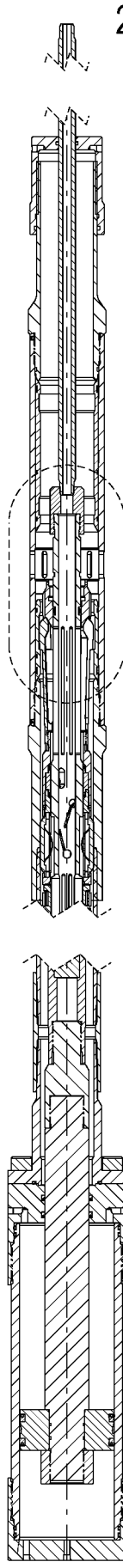


FIG. 3

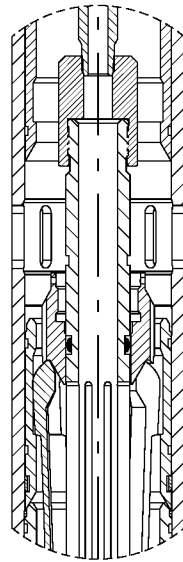


FIG. 4

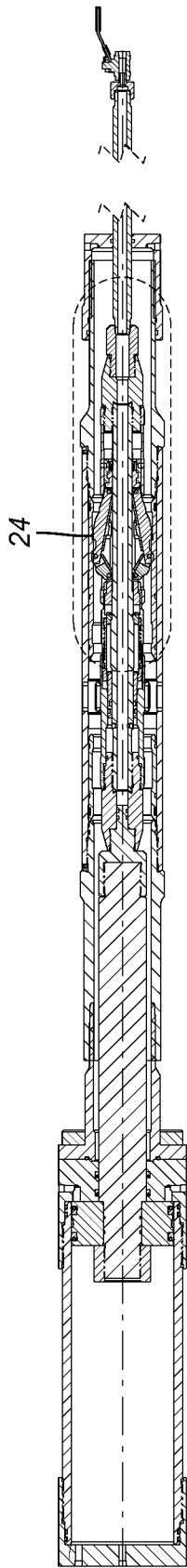


FIG. 5

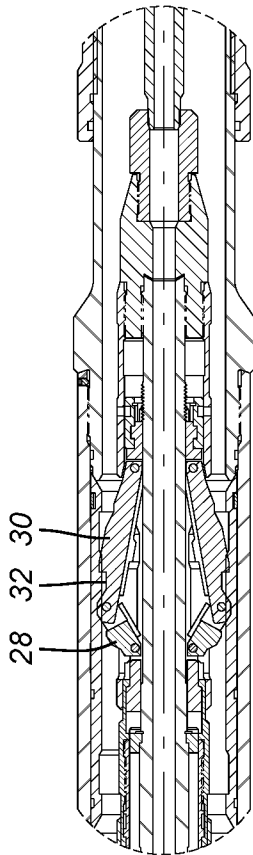


FIG. 6

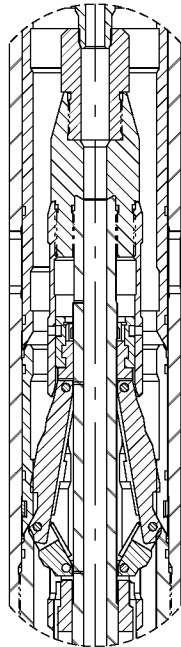


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/022749**A. CLASSIFICATION OF SUBJECT MATTER****E21B 34/06(2006.01)i, F16K 3/314(2006.01)i**

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

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
E21B 34/06; E21B 43/00; E21B 33/14; F16K 51/00; E21B 34/08; E21B 34/10; F16K 3/314Documentation 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 modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: sleeve, valve, port, tool, open and closed position, shift**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013-0175040 A1 (MADERO et al.) 11 July 2013 See paragraphs [0008]-[0012], claim 1 and figures 1-2.	1-5, 7-17
Y		6
Y	US 2012-0247767 A1 (THEMIG et al.) 04 October 2012 See paragraph [0095] and figures 4A-4E.	6
A	US 4312406 A (MCLAURIN et al.) 26 January 1982 See column 4, line 3 - column 5, line 16 and figures 1-2.	1-17
A	US 5263683 A (WONG, FRED S.) 23 November 1993 See claims 1-26 and figures 1-3.	1-17
A	WO 03-083256 A1 (BAKER HUGHES INCORPORATED) 09 October 2003 See page 2, line 23 - page 6, line 3 and figures 1a-1f.	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2018/022749

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