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Tausch

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[54] **APPARATUS FOR INSTALLING AND REMOVING FLOW CONTROL DEVICES FROM A MANDREL HAVING ONE OR MORE POCKETS**

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[51] **Int. Cl.** **E21b 7/06**

[58] **Field of Search** 166/117.5, 117.6, 154, 166/156

[56] **References Cited**

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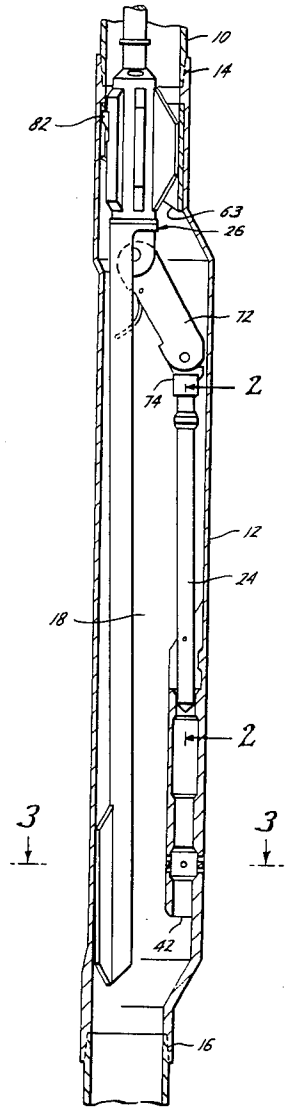
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[57] **ABSTRACT**

An apparatus for installing and removing valves from a mandrel having one or more valve pockets. The apparatus or kickover tool coacts with the mandrel for orientation and includes a shifting tool supporting a flow handling device which includes a plurality of connections for supporting running or pulling tools. The connections are spaced for alignment with one or more valve receiving pockets. The apparatus may selectively or simultaneously install and remove various types of flow control devices into and from one or more of the valve pockets.

5 Claims, 7 Drawing Figures



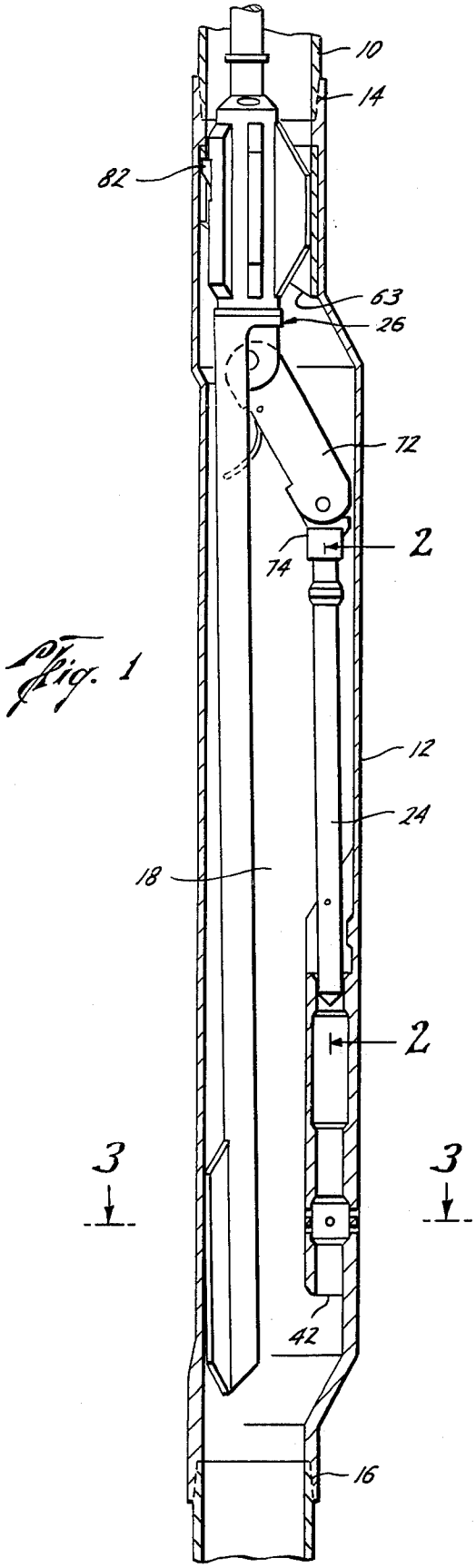


Fig. 1

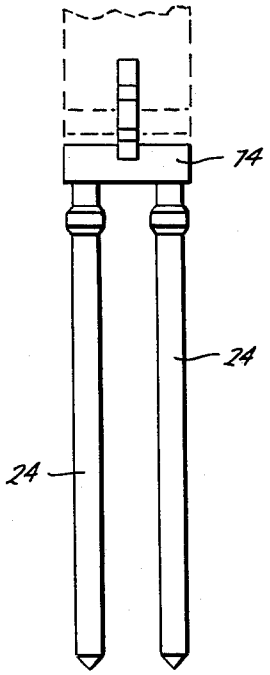


Fig. 2

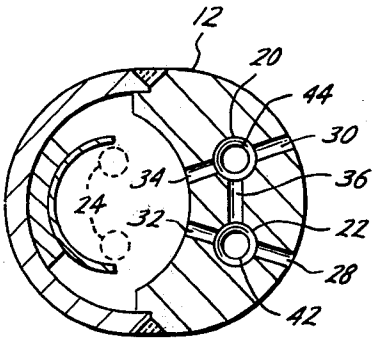


Fig. 3

Fig. 4

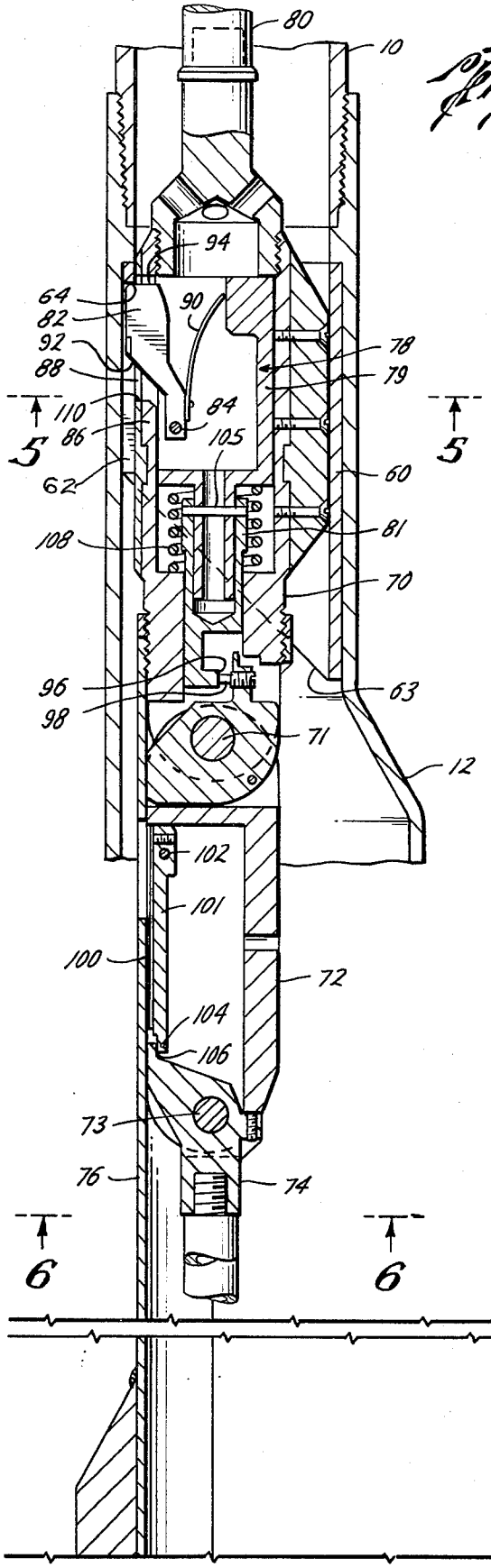


Fig. 5

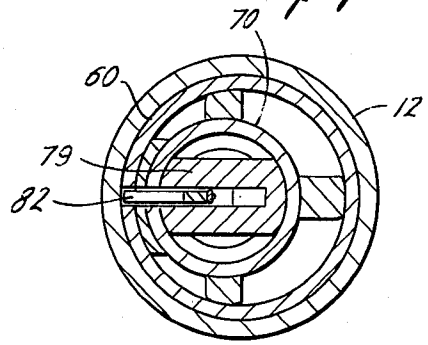


Fig. 6

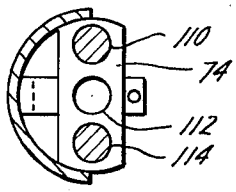
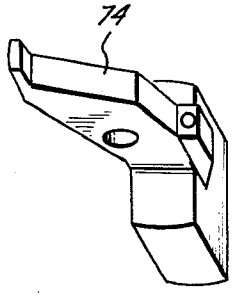


Fig. 7



APPARATUS FOR INSTALLING AND REMOVING FLOW CONTROL DEVICES FROM A MANDREL HAVING ONE OR MORE POCKETS

BACKGROUND OF THE INVENTION

Copending patent application entitled Multiple Valve Pocket Mandrel and Apparatus for Installing and Removing Flow Control Devices Therefrom, Ser. No. 423,923, filed Dec. 12, 1973, discloses a multiple valve pocket mandrel and a kickover tool for selectively installing and removing various types of flow control devices into and from one of the valve pockets. However, the kickover tool of that invention is required to make a separate downhole and uphole trip each time a valve is to be installed or removed since the tool handles only a single valve.

The present invention is directed to an improved apparatus or kickover tool having means for running and pulling flow control devices selectively or simultaneously. In addition, the present kickover tool may be utilized in either a single valve pocket mandrel or a multiple valve pocket mandrel thereby avoiding stock piling a multiple of different types of kickover tools.

SUMMARY

The present invention is directed to an apparatus for installing or removing flow control devices from a single valve pocket mandrel or a multiple valve pocket mandrel.

A further object of the present invention is the provision of an apparatus for installing and removing flow control devices selectively or simultaneously from one or more of a plurality of sidepockets.

A further object of the present invention is the improvement in a flow control handling apparatus which is used for placing a flow control device in or removing a flow control device from a well mandrel having a plurality of flow control pockets in which the apparatus includes orienting means coacting with the mandrel, a shifting tool pivotally supported from a support body, a flow control handling device connected to the shifting tool wherein the flow control handling device includes a plurality of connections for supporting flow control device running and pulling tools. The plurality of connections may include a connection axially aligned with the flow control handling device for running and pulling valves in a single pocket mandrel. The connections may include two connections spaced from each other and positioned offset from the longitudinal axis of the flow control handling device for selectively or simultaneously running and pulling valves from a multiplex pocket mandrel.

Other and further objects, features and advantages will be apparent from the following description of the preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, partly in cross section, illustrating the apparatus of the present invention in position for installing two valves simultaneously into a mandrel having two sidepockets,

FIG. 2 is a cross-sectional view taken along the line 2—2 of FIG. 1,

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1,

FIG. 4 is a fragmentary elevational view, partly in cross section, illustrating the position of the actuating parts of the present invention prior to kicking over the apparatus,

FIG. 5 is a cross-sectional view taken along the line 5—5 of FIG. 4,

FIG. 6 is a cross-sectional view taken along the line 6—6 of FIG. 4, and

FIG. 7 is a perspective view of the flow control handling device of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, in particular to FIGS. 1 and 3, a well tubing **10** is shown having connected thereto a mandrel **12** having upper **14** and lower **16** threaded connections for connection in the well tubing **10.** The mandrel **12** includes a main bore **18** therethrough generally having the same size and aligned with the bore of the well tubing **10,** and further includes a plurality of sidepockets, here shown as sidepockets **20** and **22** which are cylindrical bores whose axes are offset from the main bore **18** for receiving various types of flow control units such as a conventional gas lift valve **24** (FIG. **1**) therein. The valve pockets **20** and **22** may be provided with a plurality of ports for conducting various types of downhole operations. For example, ports **28, 30** may be provided from the sidepockets **22** and **20,** respectively, to a point exterior of the mandrel. Port means **32** and **34** are provided extending between the sidepockets **22** and **20,** respectively, and the open bore **18.** Interconnecting port means **36** is provided between the valve pockets **20** and **22,** and ports **42** and **44** may be provided leading from the bottom of the pockets **22** and **20,** respectively, to the interior of the mandrel **12.** All of the foregoing are more fully described in copending patent application Ser. No. 423,923.

In addition, an apparatus, generally referred to as a kickover tool, and generally indicated by the reference numeral **26** is provided for installing or removing flow control devices into or from the sidepockets **20** and **22.** The present invention is directed to the apparatus **26** for installing or removing one or more flow control devices, either selectively or simultaneously from the sidepockets **20** and **22** or for removing and installing a flow control device in a conventional mandrel having a single sidepocket (not shown). Referring to FIGS. **1** and **4,** a guide sleeve **60** is provided positioned aligned with the main bore **18** of the mandrel **12** and preferably positioned above the sidepockets **20** and **22.** The guide sleeve includes a longitudinal guide slot **62,** a helical guide surface **63** positioned below the slot **62** and directed inwardly and upwardly toward the bottom of the slot **62** for guiding and orienting a key upwardly and into the slot **62,** and an actuating shoulder **64** positioned at the top of the slot **62** for actuating the flow control device handling apparatus **26.** The slot **62** is radially spaced from the aixs of the offset pockets **20** and **22** a predetermined amount for rotating and orienting the handling apparatus **26** relative to the pockets **20** and **22** for installing or removing a flow control device therefrom.

The flow control handling apparatus **26** generally includes a support body generally indicated by the reference numeral **70,** a shifting arm **72** which is pivotally supported from the support body **70** by a pivot **71,** a flow control device handling support **74** which is pivotally carried by the shifting arm **72** about pivot **73,** and

an elongate guide case **76**, and a longitudinally movable body generally indicated by the numeral **78** and carried by the support body **70**. The movable body **78** includes portions **79** and **81**. The support body **70** includes any suitable means for moving the apparatus **26** through the tubing **10** and mandrel **12**, such as a hydraulic pump, or as shown, for example, only, a connection **80** for attachment to a wireline. An orienting key **82** is pivotally connected to the movable support body portion **79** at its lower end by a shear pin **84**. The support body **70** may also include an outer case **86** enclosing the movable body **78** and having an opening or window **88** through which the orienting key **82** is yieldably urged outwardly by a spring **90**. The key **82** is yieldably urged outwardly at all times but because of the downwardly facing tapering face **92** is radially passed downwardly over protruding shoulders inside of the well tubing **10** and mandrel **12**. The key **82** also includes an upwardly directed actuating shoulder **94** which, when the key is below the guide surface **63**, will contact the surface **63** thereby rotating and aligning the flow control handling apparatus **26** in the well bore as the key **82** moves along the guide surface **63** and into the longitudinal guide slot **62** and into engagement with the actuating shoulder **64** thereby stopping further upward movement of the movable body **78**. Suitable engaging means, such as shoulder **96**, is connected to the lower end of the second part **81** of the movable body for engaging a portion of the shifting arm such as pin **98**, when the movable body **81** is initially in an upward position, to keep the arm **72** initially aligned within the guide case **76** and thus aligned with the main bore **18** in the well tubing **10** as the apparatus **26** is initially moved down the well bore. However, when the apparatus **26** is moved into the mandrel **12** in which it is desired to install or remove a flow control device, and as best seen in FIG. **4**, when the orienting key is moved upwardly into the guide slot **64** and the key shoulder **94** engages the actuating shoulder **64** further upward movement of the movable body **78** is prevented. However, further upward movement of the support body **70** will disengage the releasable connection between shoulder **96** and pin **98** as the pin **98** moves upwardly past the shoulder **96** allowing the shifting arm **72** to be actuated, rotated about pin **71** and shifted laterally over a sidepocket as a spring **100** acts between the inside of the guide case **76** and the shifting arm **72** to shift the shifting tool **72** and the valve handling support **74** over and above the sidepocket as more fully described in U.S. Pat. No. 3,788,397. The spring **100** is preferably a leaf spring, one end of which is preferably secured to a spring hinge **101** which in turn is supported about a pivot pin **102** on the shifting arm **72**. The second end of the hinge **101** is secured from movement by a shear pin **104** connected to the shifting arm **72**. Thus, the shear pin **104** holds the spring **100** under compression so that when the shoulder **96** and pin **98** are disengaged, the kickover spring **100** may laterally move the shifting arm **72** over the sidepockets. At this point, the valve handling support **74** is still aligned with the shifting tool **72**. However, when the valve **20** is inserted into a sidepocket, and a downward jar is taken on the apparatus **26**, the valve handling support **74** will rotate about its pivot support **73** from the shifting arm **72**. The valve handling support **74** includes a shoulder **106** which is positioned in engagement with the hinge **101** and the shear pin **104**. When the valve handling support **74** pivots about the pivot pin **73**, the shoulder **106** will shear pin **104** thereby freeing the spring hinge **101** to rotate about pin **102** and release the compressive force in the spring **100**.

Further downward movement of the apparatus **26** moves the flow control device **24** into a valve seat and further downward movement or jarring of the apparatus **26** seats the flow control device **24** in a pocket and disconnects the running adapter **74** from the flow control device **24**. Of course, the apparatus **26** may, by similar operation using a pulling adapter in place of the running adapter **74**, remove a flow control device **24** from the sidepocket. The above description of the kickover tool is generally described in U.S. Pat. No. 3,788,397.

However, the described kickover tool normally functions to retrieve a valve from a mandrel having a single pocket or as described in patent application Ser. No. 423,923 selectively installs or removes a single flow valve from a selected one of the sidepockets **20** or **22**. The present device is an improved apparatus for simultaneously or selectively installing or removing a flow control device from either or both of the pockets **20** and **22** of the mandrel **12**. Referring now to FIG. **6**, the valve handling support **74** is provided with a plurality of connections, such as threaded holes **110**, **112** and **114** for supporting flow control device running and pulling tools. Preferably, the valve handling support **74** includes the connections **110** and **114** which are positioned offset from the longitudinal axis of the flow handling support **74** and spaced for alignment with the sidepockets **20** and **22** for simultaneously installing, as best seen in FIGS. **1** and **2**, valves **24** into the pockets **20** and **22**. The connections **110** and **114** support the valves **24**, as best seen in dotted outline in FIG. **3**, so that when the valve handling apparatus **26** is aligned in the orienting sleeve **60** the valves **24** will be oriented for being kicked over the pockets **20** and **22** for installation or removal therefrom as best seen in FIG. **1**. However, the apparatus **26** may be made more versatile and be useful for installing or removing a flow control valve from a conventional single sidepocket mandrel by placing a third connection **112** axially aligned with the flow control device **74** for coacting with the pocket of a conventional single pocket mandrel. With the three connections **110**, **112** and **114**, the tool **26** could be used for a plurality of operations and avoid the problem of having to stock a different supply of kickover tools for the various types of mandrels. It is to be understood that while flow control devices may be simultaneously removed and installed from the pockets **20** and **22**, a single flow control device may be installed or removed by utilizing only one of the connections **110** or **114** depending upon the pocket being worked.

Once flow control devices have been installed or removed in the pocket **20** or **22**, the apparatus **26** may be retracted upwardly, that is, the key **82** is raised in the mandrel **12**, the shoulder **94** will again engage the shoulder **64** in the sleeve **60** and the tool **26** can be jarred upwardly shearing shear pin **105** which has a lower shear point than the emergency shear pin **84**. With the shear pin **105** sheared, the support body **70** may be moved upwardly relative to the movable body **78** against the action of the resetting spring **108**. It is also noted that the support body **70** has a retracting shoulder **110** which will engage the tapered surface **92** on the key **82** on upward movement of the support

body **70** relative to the first part **79** of the movable body **78** thereby retracting the key **82** into the interior of the case **86** whereby the apparatus **26** may be moved uphole. The above description of the operation of the flow handling device **26** is more fully described in co-pending U.S. Pat. No. 3,788,397.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as others inherent therein. While a presently preferred embodiment of the invention is given for the purpose of disclosure, numerous changes in the details of construction and arrangement of parts may be made which will readily suggest themselves to those skilled in the art and which are encompassed within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a flow control handling apparatus adapted for use in placing a flow control device in or removing a flow control device from a well mandrel having a plurality of flow control device receiving pockets which are positioned side by side to each other and including an orientation sleeve having a longitudinal orientation slot positioned in a predetermined radially spaced relationship relative to said pockets, said apparatus including a support body, an orientation key pivotally connected to the body for engagement with the orientation slot, a shifting arm pivotally supported from the support body, the improvement comprising,

a flow control handling device connected to the shifting arm, said flow control handling device including a plurality of vertically directed connections which are positioned side by side to each other for supporting flow control device running and pulling tools, said connections spaced for alignment with the plurality of receiving pockets.

2. A flow control handling apparatus adapted for use in placing a flow control device in or removing a flow control device from a well mandrel having one or more flow control device receiving pockets and including an orientation sleeve having a longitudinal orientation slot positioned in a predetermined radially spaced relationship to said pockets comprising,

a support body adapted to be used in the mandrel,

a movable body carried by and longitudinally movable relative to the support body,

an orientation key pivotally connected to the movable body,

a shifting arm pivotally supported from the support body,

releasing means on said movable body initially holding the shifting arm aligned in the bore but releasable on movement of the movable body relative to the support body,

shifting means connected to the shifting arm for shifting the shifting arm into the selected sidepocket when the releasing means is released, and

a flow control handling device connected to said shifting arm, said handling device including a plurality of connections for supporting flow control device running and pulling tools.

3. The apparatus of claim **2** wherein one of the connections is axially aligned with the flow control handling device.

4. The apparatus of claim **2** wherein two of the connections are spaced from each other and positioned offset from the longitudinal axis of the flow control handling device.

5. The apparatus of claim **3** including two connections positioned offset from the longitudinal axis of the flow control handling device.

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