

[54] **APPARATUS FOR INSTALLING OR REMOVING A FLOW CONTROL DEVICE FROM A WELL TUBING**

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

[56] **References Cited**

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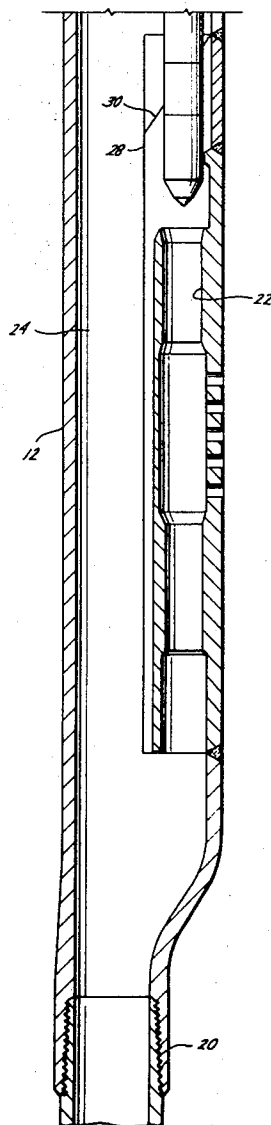
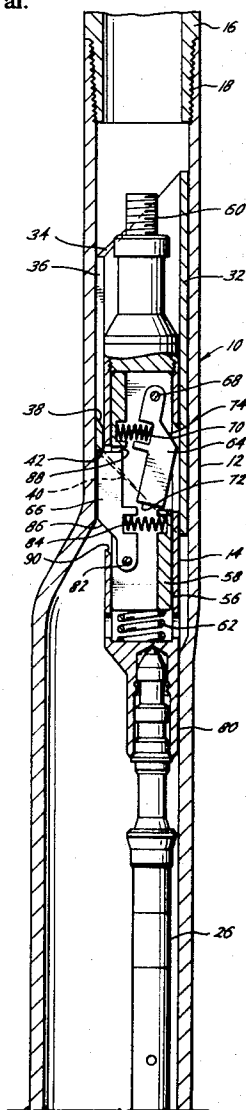
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[57] **ABSTRACT**

An orienting mandrel having a pocket for receiving a flow control device and a coaxing orienting tool for installing and removing a flow control device from the mandrel pocket. The mandrel having a connection at the top and bottom for attachment to a well tubing with the mandrel pocket positioned directly below the top tubing connection and the mandrel including a bore extending between the tubing connections but including a portion offset from the pocket with the tubing connection at the bottom of the mandrel being in alignment with the offset bore portion, and orienting means in the mandrel coaxing with the orienting tool. On downward movement through the well tubing the orienting tool coacts with orientation means in the mandrel for moving the flow control device out of alignment with the pocket thereby allowing the tool to pass through the mandrel, but on upward movement the orienting tool moves into alignment with the pocket for allowing flow control devices to be installed or removed from the pocket.

9 Claims, 5 Drawing Figures



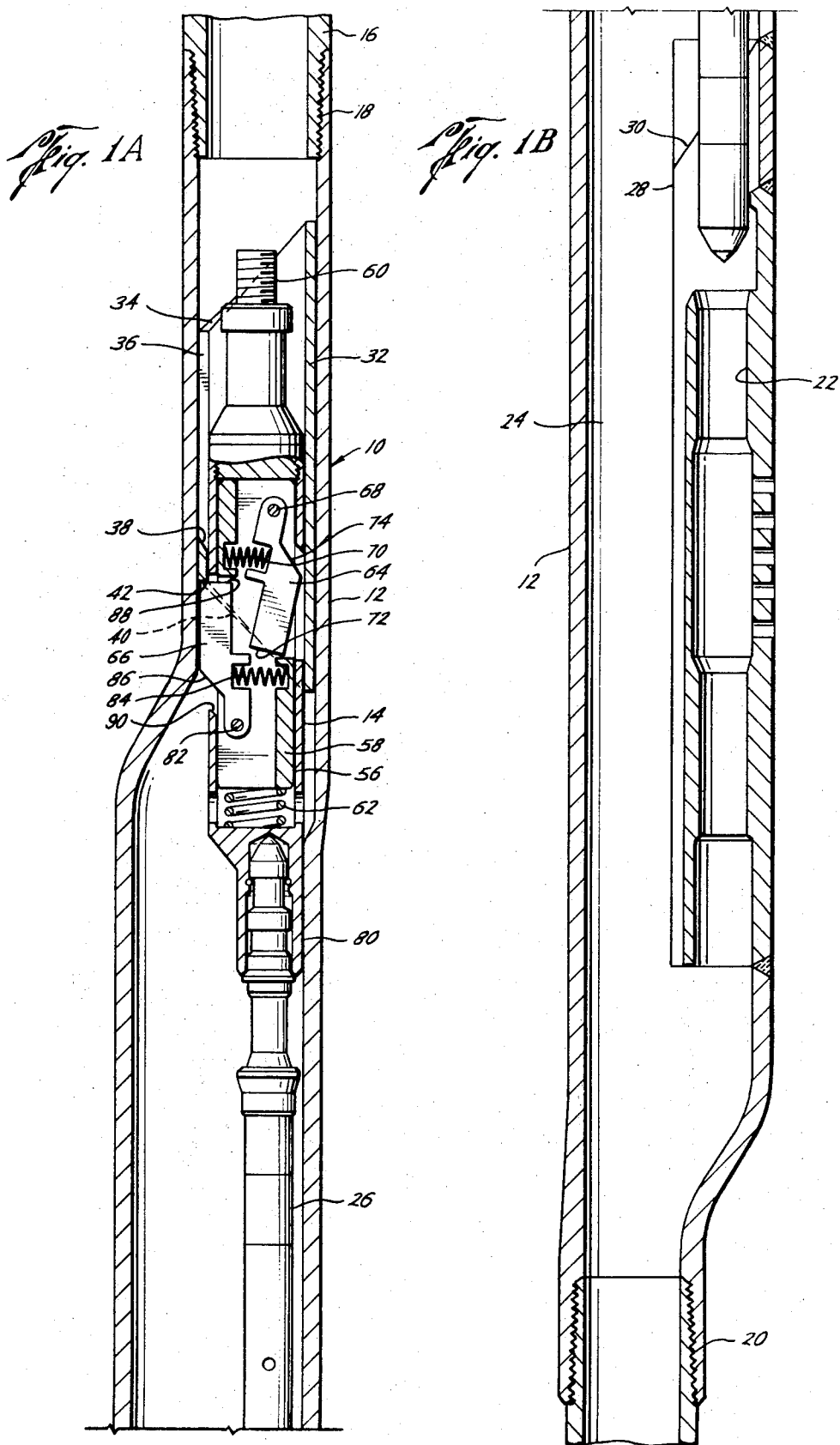


Fig. 2

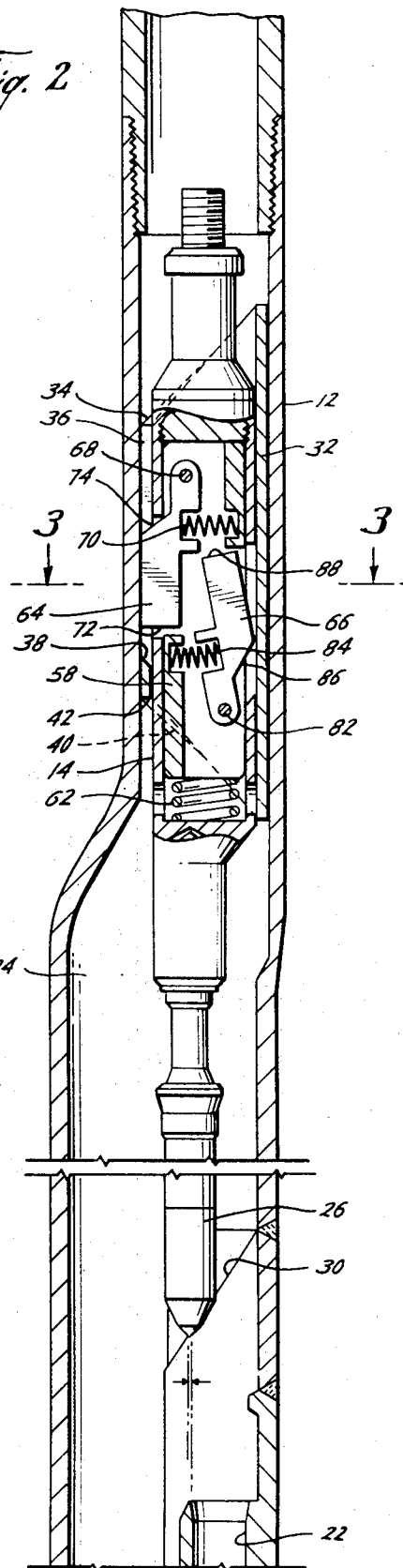


Fig. 3

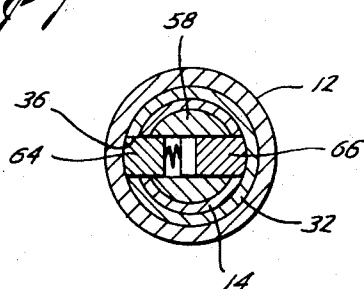
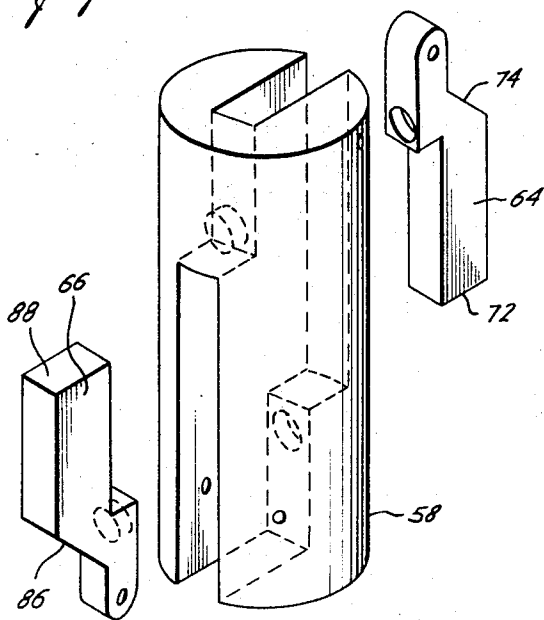


Fig. 4



APPARATUS FOR INSTALLING OR REMOVING A FLOW CONTROL DEVICE FROM A WELL TUBING

BACKGROUND OF THE INVENTION

Generally, it is old to provide a mandrel having a sidepocket for receiving a flow control device such as a gas lift valve which is installed and removed through an orienting sleeve in the mandrel by a kickover tool. However, kickover tools are generally lengthy in design which is undesirable in certain applications.

The present invention is directed to an improved mandrel and improved running and orienting tool which may be relatively short in length and does not require a kickover tool but in which a flow control device can be positively installed in a selected mandrel in a well tubing.

SUMMARY

The present invention is directed to a mandrel and an orienting tool for installing and removing flow control devices from a pocket in the mandrel. The mandrel pocket is positioned directly below the tubing connection at the top of the mandrel. The mandrel includes a bore extending between the ends of the mandrel and includes an offset portion from the pocket and the tubing connection to the well tubing at the bottom of the mandrel is in alignment with the offset bore portion. Orienting means are provided in the mandrel above the pocket for orienting an orienting running tool out of alignment with the pocket on downward movement through the mandrel but orienting the orienting running tool into alignment with the pocket on upward movement through the mandrel.

The present invention is further directed to a mandrel having a two-way orienting sleeve having a first upwardly directed guide surface extending downwardly and a deflecting shoulder below the lower end of the first guide surface for orienting a running tool out of alignment with the mandrel pocket on downward movement, and a second downwardly directed guide surface extending upwardly and positioned below the first guide surface with a stop shoulder above the top of the second guide surface for engaging and orientating a running tool into alignment with the mandrel pocket.

Yet a further object is the provision of an orienting and running apparatus for coaxing with the mandrel for installing and removing a flow control device from the mandrel pocket which includes two radially locating fingers, one with a shoulder facing downwardly which coacts with the first guide surface for orienting the running apparatus and flow control device supporting assembly out of alignment with the pocket to allow the orienting tool to pass through the mandrel, and a second finger having a shoulder facing upwardly which engages the second guide surface and stop shoulder to place the tool and flow control handling assembly in alignment with the pocket allowing the setting or pulling operation to be completed. A flow control device supporting member is connected to the running tool body at a point off of the longitudinal axis of the body for moving the flow control device into and out of alignment with the mandrel pocket as the orientation tool is rotated.

Yet a still further object of the present invention is the provision of an orientation or running tool for in-

stalling or removing a flow control device from a mandrel pocket in which the first locating finger is pivotally connected to the body adjacent the upper end of the finger with first spring means urging the first finger outwardly from the body and the body having a tapered upper edge for pivoting by obstructions while moving freely upwardly through the well bore. The second locating finger is pivotally connected to the body adjacent the lower end of the finger and includes a second spring means urging the second body outwardly and having a tapered lower edge for pivoting by obstructions and moving freely downwardly through the well tubing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A and 1B are continuations of each other and are fragmentary elevational views, in cross section, illustrating the apparatus of the present invention shown in position for installing a flow control device in the mandrel pocket,

FIG. 2 is a fragmentary elevational view, in cross section, showing the apparatus of the present invention moving downwardly through the mandrel and bypassing the pocket,

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 2, and

FIG. 4 is an enlarged exploded perspective view of a portion of the orientating running tool.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and particularly to FIGS. 1A and 1B, the present invention is generally indicated by the reference numeral 10 and generally includes a mandrel 12 and an orienting and running tool 14.

The mandrel 12 includes the usual means for connection in a well tubing 16 such as a threaded box 18 at the top of the mandrel and a threaded box 20 at the bottom of the mandrel 12.

The mandrel 12 includes a sidepocket 22 and a bore 24 extending between the tubing connections 18 and 20 for passage of well tools through the mandrel 12. However, it is to be noted that the pocket 22 is positioned directly below the tubing connection 18 in the upper portion of the bore 24 although preferably not coaxial therewith. However, as will be seen, the pocket 22 is in sufficient alignment with the upper portion of the bore to allow the installation and removal of flow control devices 26, such as a gas lift valve, from the pocket 22 without requiring a lengthy kickover tool having pivoted connections for transversely shifting a valve from the mandrel bore to an offset sidepocket.

The sidepocket 22 may also include a guide means 28 for preventing other well tools passing through the bore 24 from catching on the sidepocket and is sized to allow only flow control devices 26, such as a gas lift valve, to engage the sidepocket 22. Deflector 30 directs other well tools into the bore 24, all as more fully described in copending patent application Ser. No. 180,315.

A two-way orientation sleeve generally indicated by the reference numeral 32 is positioned in the mandrel 12 above the pocket 22 and includes means for orienting the flow control device 26 carried by the running tool 14 out of alignment with the pocket 22 when the

tool 14 is moved downwardly through the well tubing and the orienting means 32, and also includes means for orienting the flow control device 26 into alignment with the pocket 22 upon upward movement of tool 14 into the orientation means 32.

As best seen in FIGS. 1A and 2, the orientation sleeve 32 generally includes a first guide surface 34 providing an upwardly directed surface for engaging the downwardly moving tool 14. The guide surface 34 is preferably helical and extends downwardly. A slot 36 may be provided leading from the bottom of the first guide surface 34 and terminates in a deflecting shoulder 38. A second guide surface 40 is provided below the first guide surface 34. The second guide surface 40 is preferably helical and extends upwardly and a stop shoulder 42 is positioned above the top of the second guide surface for engaging and guiding the orientation tool 14 to position the flow control device 26 over the pocket 22 for installing or removing a flow control device 26.

Referring to FIGS. 1A and 2, the orientation or running tool 14 may include a first body 56 and a second body 58 telescopically movable in the body 56. Spring means 62 is provided between the body 56 and 58 for yieldably urging the body 58 upwardly. A suitable connector 60 is provided connected to the body 58 such as a threaded connection whereby the tool 14 may be moved in the well tubing 16 and one or more mandrels 12 by any suitable means such as a wireline or a hydraulic pump in assembly, both of which are conventional and no further description need be made.

A flow control handling device 80 is provided connected to the body 56 of the running tool 14 for supporting the flow control device 26 for installing the flow control device 26 in the sidepocket 26 or for supporting a retrieving mechanism (not shown) for removing the flow control device 26 from the sidepocket 22. It is to be noted that the axis of the handling apparatus 80 is connected to the body 56 at a point off of the longitudinal axis of the body 56. This eccentric connection allows the running tool 14 to be rotated in one direction for bypassing the pocket 22 in a particular mandrel 12 and moving down the well tubing 16 to other mandrels 12 for selectively installing or removing flow control devices 26 in the desired mandrel 12. When the desired mandrel 12 is reached, the running tool 14 may be rotated to rotate the eccentric connection 80 into alignment with the desired sidepocket 22 for installing or removing a flow control device 26.

The running tool 14 includes two radially extending locating fingers 64 and 66. Locating finger 64 is connected to the body 56 by a pin 68 adjacent the upper end of the finger 64 and a spring 70 is provided yieldably urging the finger 64 radially outward whereby a downwardly directed shoulder 72 on the finger 64 may engage the upwardly directed guide surface 34 and then enter the slot 36 for rotating the running tool 14 to move the eccentric handling device 80 and flow control device 26, as best seen in FIG. 2, out of alignment with the well pocket 22.

Thus as the running tool 14 is moved down the tubing 16 and through the orientating sleeve 34, the shoulder 72 on finger 64 contacts the upwardly directed guide surface 34 and rotates the running tool 14 to move the eccentric handling apparatus 80 out of

alignment with the pocket 22. As the running tool 14 is further moved down the orienting sleeve 32, the first locator finger 64 engages a deflecting shoulder 38 and moves inwardly allowing the running tool 14 to readily pass downward through the orienting sleeve 32 and the mandrel 12 without becoming aligned with the pocket 22. As best seen in FIG. 2, the end of the flow control device 26, is outside the sidepocket 22 and passes by the pocket 22 and the deflector 30 will engage the remainder of the running tool 14 and directs tool 14 into the offset portion 24 of the mandrel bore. It is also noted that the first locator finger 54 includes a tapered upper edge 74 so that the first locator finger may readily bypass obstructions in the well tubing 16 and mandrel 12 as the running tool 14 is moved upwardly in the well tubing.

The second locating finger 66 is pivotally connected to the body 58 by a pin 82 and is yieldably urged radially outward by a spring 84. The locating finger 66 includes a tapered lower edge 86 whereby the finger 66 may readily pivot by obstructions in the well tubing and the mandrel 12 as the tool 14 is carried downwardly in a well tubing. However, the locating finger 66 includes an upwardly directed shoulder 88, which, when the running tool 14 is moved upwardly through the desired mandrel 12, will contact the downwardly directed guide surface 42 to rotate the running tool 14, as best seen in FIG. 1A, thereby rotating the eccentric handling apparatus 80 into position over the pocket 22. As the locator finger 66 reaches the uppermost portion of the guide surface 40 it contacts the stop shoulder 42 to indicate that the well control device 26 is aligned over the pocket 22.

When the locator finger 66 contacts and engages the stop shoulder 42, the running tool 14 may then be lowered for installing or removing a flow control device 26 from the pocket 22. Of course, as the running tool 14 is being removed from the well tubing after performing its operation, the finger 66 will again contact the shoulder 42. A sufficient upward movement on the outer body 56 will longitudinally move body 56 relative to the internal body 58 and overcome the spring 62 so that a retracting shoulder 90 on the outer body 56 will contact the tapered surface 56 on the locator finger 66 and retract finger 66 away from the stop shoulder 42.

Thus, flow control devices may be installed in a well tubing on a relatively short running tool 14, which is particularly useful in hydraulic pump operations, although the present invention is equally applicable to wireline service, and the running tool 14 will actively and positively align the handling connection 80 over the well pocket 22 for installation and for removing a flow control device 26 from the well pocket 22. The running tool 14 may be run down the well tubing 16 and the upper locating finger 64 will contact the upwardly directed guide surface 34 of each mandrel 12 to rotate the running tool 14 and move the control device 26 out of alignment with the seat 22. The running tool 14 may be continued to be moved downward through the mandrel 12 and the well bore 16 to be set in any selected mandrel 12. When the running tool 14 reaches the selected mandrel and passes through the orientation sleeve 32, it is then raised whereby the lower locator finger 66 may contact the downwardly directed guide surface 40 and come into engagement with the

stop shoulder 42 at which time the eccentric handling apparatus 80 and flow control device 26 or tool pulling device is aligned with the pocket 22. The running tool 14 may be lowered to perform the desired operation.

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 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. A mandrel for connection in a well tubing comprising,
 - a mandrel body having a connection at the top and bottom for attachment to the well tubing,
 - a pocket for receiving a flow control device, said pocket positioned directly below the tubing connection at the top of the mandrel body,
 - a bore extending between the tubing connections and including a portion offset from the pocket, the tubing connection at the bottom of the mandrel body being in alignment with the offset bore portion,
 - orientation means in the mandrel body above the pocket, said means including means for orientating a tool out of alignment with the pocket on downward movement through the orientation means, and including means for orientating a tool into alignment with the pocket on upward movement through the orientation means.
2. The apparatus of claim 1 wherein the orientation means includes,
 - an upwardly directed guide surface for orientating a tool out of alignment with the pocket, and
 - a downwardly directed guide surface for orientating a tool into alignment with the pocket.
3. The apparatus of claim 1 wherein the orientation means includes,
 - a first curved guide surface extending downwardly,
 - a deflecting shoulder below the lower end of the first guide surface,
 - a second curved surface extending upwardly and positioned below the first guide surface, and
 - a stop shoulder above the top of the second guide surface.
4. The apparatus of claim 1 wherein the orientation means includes,
 - a first helical upwardly directed guide surface extending downwardly,
 - a deflecting shoulder below the lower end of the first guide surface,
 - a second helical downwardly directed guide surface extending upwardly and positioned below the first guide surface, and
 - a stop shoulder above the top of the second guide surface.
5. An apparatus for installing or removing a flow control device from a well tubing comprising,
 - a mandrel body having a connection at the top and bottom for attachment to the well tubing,
 - a pocket for receiving a flow control device, said pocket positioned directly below the tubing connection at the top of the mandrel body,

a bore extending between the tubing connections and including a portion offset from the pocket, the tubing connection at the bottom of the mandrel body being in alignment with the offset bore portion,

orientation means in the mandrel body above the pocket, said means including upwardly directed means for orientating a tool out of alignment with the pocket on downward movement through the orientation means, and including downwardly directed means for orientating a tool into alignment with the pocket on upward movement through the orientation means,

a tool for running or pulling a flow control device including,

a body,

a first locating finger pivotally connected to the body and including a downwardly directed shoulder for engaging the upwardly directed means, and

a second locating finger pivotally connected to the body and including an upwardly directed shoulder for engaging the downwardly directed means.

6. The apparatus of claim 5 wherein the orientation means includes a first helical upwardly directed guide surface extending downwardly,

a deflecting shoulder below the lower end of the first guide surface,

a second helical downwardly directed guide surface extending upwardly and positioned below the first guide surface, and

a stop shoulder above the top of the second guide surface.

7. The apparatus of claim 5 including,

flow control device supporting member connected to the body at a point off of the longitudinal axis of the body.

8. An apparatus for installing or removing a flow control device from a well tubing comprising,

a mandrel body having a connection at the top and bottom for attachment to the well tubing,

a pocket for receiving a flow control device, said pocket positioned directly below the tubing connection at the top of the mandrel body,

a bore extending between the tubing connections and including a portion offset from the pocket, the tubing connection at the bottom of the mandrel body being in alignment with the offset bore portion,

an orientation means in the mandrel body above the pocket including,

a first upwardly directed guide surface extending downwardly,

a deflecting shoulder below the lower end of the first guide surface,

a second downwardly directed guide surface extending upwardly and positioned below the first guide surface, and

a stop shoulder above the top of the second guide surface,

a tool for running or pulling a flow control device in said mandrel including,

a tool body,

a first locating finger pivotally connected to the tool body adjacent the upper end of the finger

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and including a downwardly directed shoulder for engaging the upwardly directed guide surface, and having a tapered upper edge for pivoting by obstructions in moving upwardly in the well tubing,
 first spring means urging said first finger outwardly from the body,
 a second locating finger pivotally connected to the tool body adjacent the lower end of the finger and including an upwardly directed shoulder for engaging the downwardly directed guide sur-

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face, and having a tapered lower edge for pivoting by obstructions in moving downwardly in the well tubing,
 second spring means urging said second finger outwardly from the body.
 9. The apparatus of claim 8 including,
 flow control device supporting member connected to the body at a point off of the longitudinal axis of the tool body.

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