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F. F. BEEBE ET AL

3,353,608

APPARATUS FOR INSTALLING AND REMOVING FLOW VALVES

Filed Sept. 9, 1965

3 Sheets-Sheet 1

Fig. 1

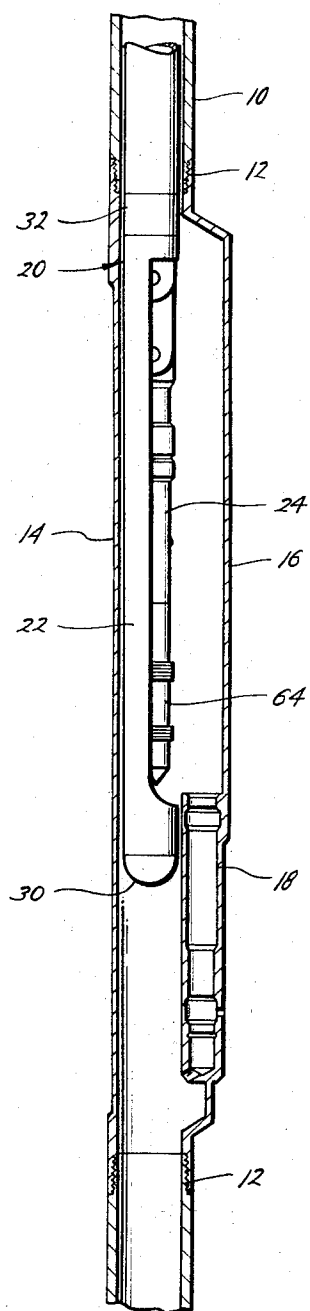


Fig. 2

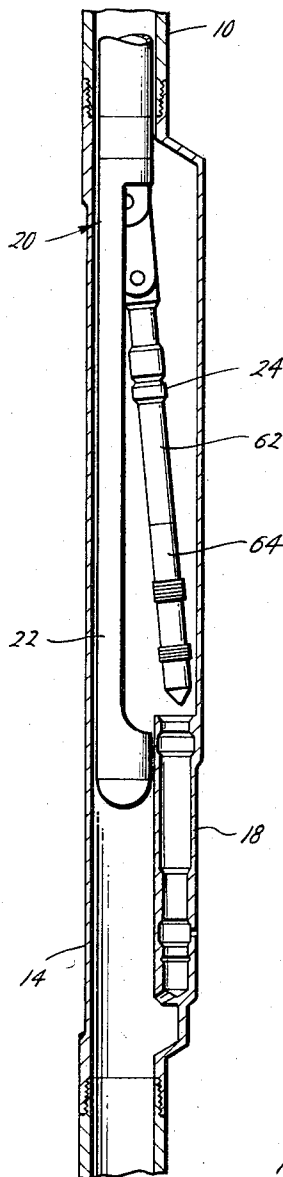
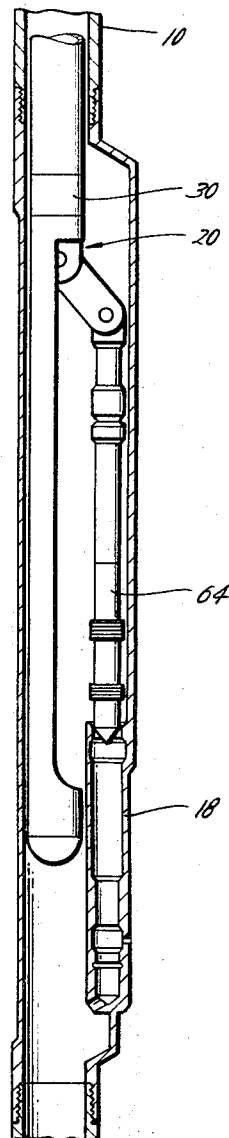


Fig. 3



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Fig. 4A

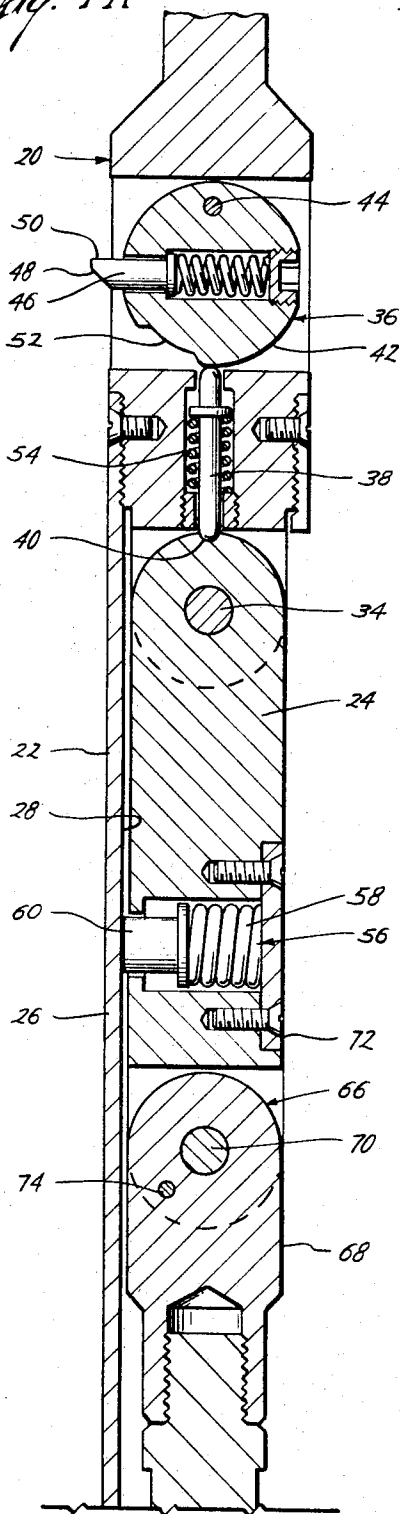
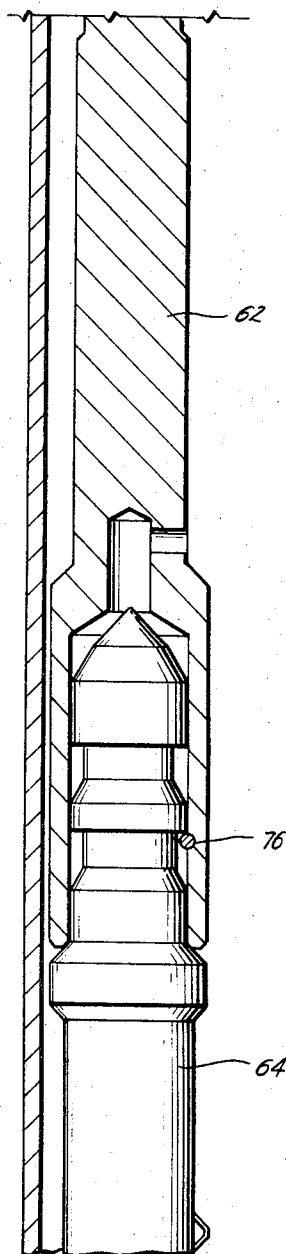


Fig. 4B



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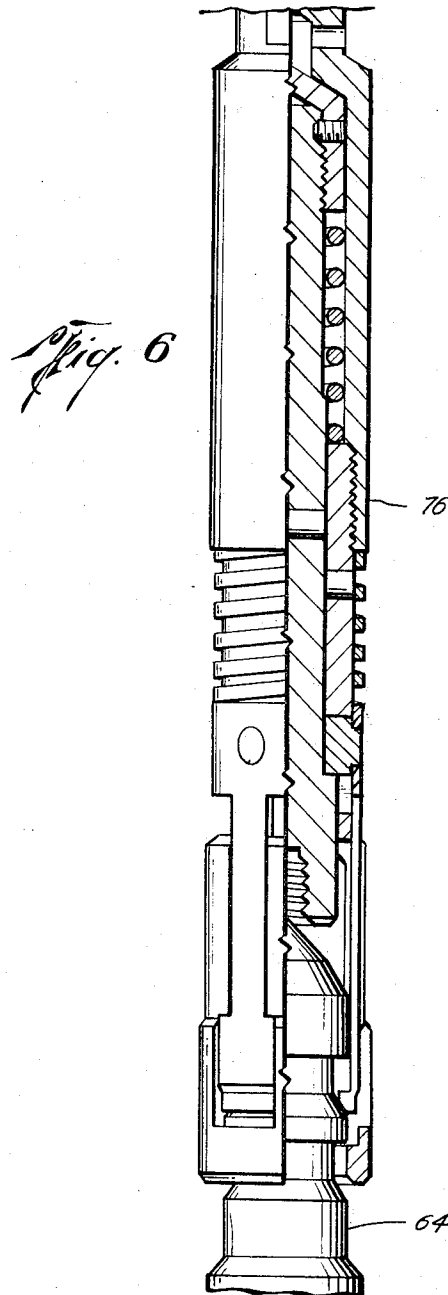
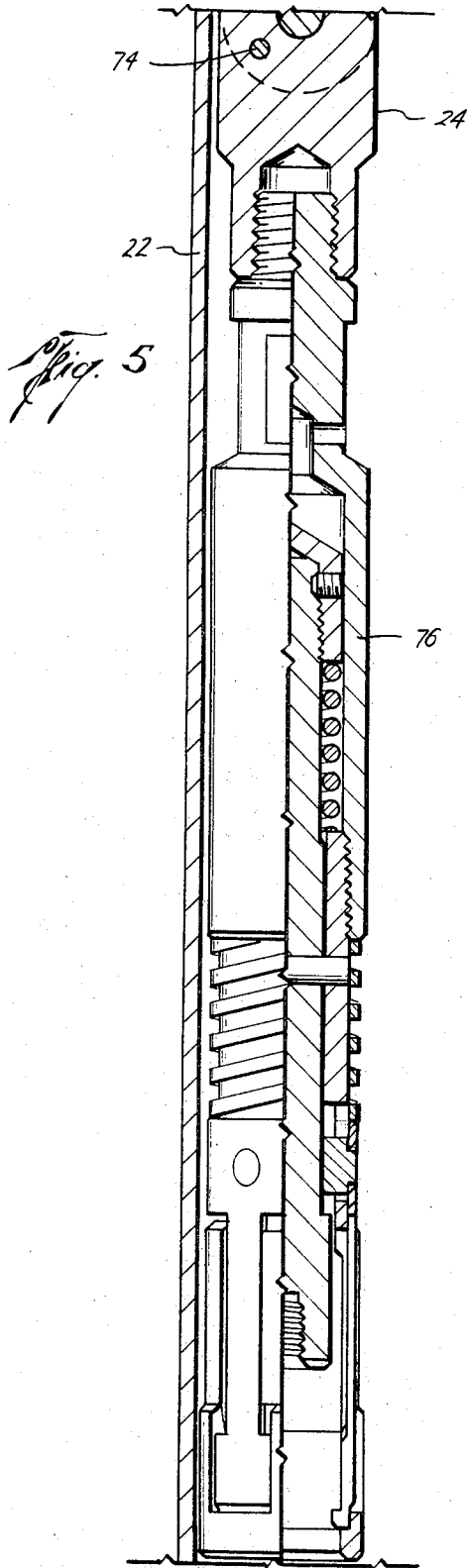
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APPARATUS FOR INSTALLING AND REMOVING FLOW VALVES

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3 Sheets-Sheet 3



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APPARATUS FOR INSTALLING AND REMOVING FLOW VALVES

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4 Claims. (Cl. 166—117.5)

ABSTRACT OF THE DISCLOSURE

An apparatus for installing and removing flow valves in a well tubing having a plurality of flow control receiving stations offset from the tubing each of which is provided with a seat for a flow control unit having an elongate guide means longer in length than each of the receiving sections so as to avoid engagement with the receiving sections as the guide is lowered in the tubing and including a shifting tool pivotally supported from the guide means with a releasable connecting means between the guide means and the shifting tool normally holding the shifting tool aligned with the guide means including a spring loaded actuating pin having a shoulder protruding upwardly for engagement in the tubing for releasing the connecting means when the apparatus is raised in the tubing, and spring means between the guide means and the piston tool for moving the tool away from the guide means when the releasable connection is disengaged. The releasing means including a releasing cam having a notch and pivotally carried by the guide means and normally keeping the piston tool aligned with the guide means until a spring loaded actuated pin connected to the cam and having an upwardly protruding shoulder is raised in the tubing to rotate the cam and the releasing notch to allow disengagement of the shifting tool from the guide means. A pivotal joint in the shifting tool having a shear pin normally preventing the joint from pivoting but upon shearing allowing alignment of a flow control unit carried by the shifting tool with the valve seat.

The present invention relates to an apparatus for installing and/or removing flow valves and the like in the tubing of oil and gas wells. And more particularly, the present invention is directed to a flow control valve handling apparatus for installing and removing flow valves which are connected one above the other in the sides of a string of tubing.

Generally, it is old to provide a shifting tool which is adapted to install or remove a flow valve in valve seats which are spaced one above the other along a well tubing and laterally offset from the well tubing for receiving flow from different levels. However, when lowering such a shifting tool in a well tubing it may inadvertently engage or become caught in one of the valve seats other than at the desired location. In particular, in the use of directional drilling the offset valve receiving sections having the valve seats may be positioned upon the low side of the well tubing so that the conventional shifting tool will fall down in a valve section which is desired to be bypassed when the tool is lowered in the well tubing.

It is the general object of the present invention to provide an apparatus for installing and removing flow valves which will readily guide the setting and removing tool through the well tubing without becoming stuck or engaging any valve receiving section above the desired location.

A still further object of the present invention is the provision of a flow control valve handling apparatus having a guide which holds the shifting tool in a retracted

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position and the guide is so sized and shaped that as it is lowered down the well tubing it will bypass any obstructions such as valve seat receiving sections and will hold the shifting tool in a retracted position until the desired location is reached, after which the shifting tool is released from the guide for use in installing or removing a flow valve from the desired laterally offset seat.

Still a further object of the present invention is the provision of an apparatus for installing and/or removing flow valves which includes an elongate guide means having a length greater than the length of the valve seat receiving sections in a well tubing and which is greater in cross sectional area than the receiving sections whereby the guide means will not engage, but will bypass the receiving sections in the well tubing as the guide means is lowered.

Still a further object of the present invention is the provision of a flow control valve handling apparatus which includes a guide means for bypassing valve seat receiving sections and which has a recess for holding a shifting tool in a retracted position for carrying the shifting tool through the well tubing to the desired valve seat section at which time a releasable connecting means is actuated to release the retracted shifting tool from the guide and suitable means is provided for transversely moving the shifting tool away from the guide and towards the desired receiving section whereby the shifting tool will be positioned above the valve seat, and in which a suitable joint may be provided in the shifting tool so that the lower portion of the shifting tool may be aligned with the valve seat for removing or installing a flow valve.

A still further object of the present invention is the provision of an apparatus for installing and removing a flow valve in a well tubing having collars and a plurality of flow control receiving sections which are offset from the tubing by providing a guide which supports a shifting tool in a retracted position and which will bypass the receiving sections as the guide is lowered, and providing a releasable connecting means normally holding the shifting tool in the retracted position as the guide is lowered and which is adapted to be released on upward movement and contact with a tubing collar to release the shifting tool so that it is transversely moved away from the guide and towards a selected receiving station.

Summary

The present invention is directed to a flow control valve handling apparatus which includes a guide means for bypassing valve seat receiving sections which includes a shifting tool normally positioned in a retracted position aligned with the guide means, means for moving the shifting tool away from the guide and towards a receiving section for installing or removing a valve from a desired valve seat by providing an improvement in a releasing connection between the guide and the shifting tool of a releasing cam normally holding the tool and guide in alignment and which is actuated by a spring loaded pin connected to the cam and having a shoulder protruding upwardly for actuation when the apparatus is raised in the tubing, and further includes a pivotal joint in a shifting tool with a shear pin normally preventing the joint from pivoting but shearing to allow alignment of the shifting tool with the axis of the valve seat.

Other and further objects, features and advantages will be apparent in the following description of a presently preferred embodiment of the invention, given for the purpose of disclosure, and taken in conjunction with the accompanying drawings, where like character references designate like parts throughout the several views, and where

FIGURE 1 is an elevational view, partly in cross section, illustrating the present invention as it is being lowered in a well tubing adjacent a valve receiving section for installing a flow valve.

FIGURE 2 is a side elevational view similar to FIGURE 1 showing the shifting tool released from the guide and moved into the receiving section,

FIGURE 3 is a view similar to FIGURE 2 showing the release of a pivotable joint in the shifting tool for aligning the flow valve with the valve seat,

FIGURE 4A is an enlarged cross sectional view of the top of the present invention,

FIGURE 4B is a continuation of FIGURE 4A,

FIGURE 5 is a fragmentary cross sectional view illustrating the use of the present invention supporting a flow valve pulling adapter, and,

FIGURE 6 is a fragmentary cross sectional view showing the pulling adapter of FIGURE 5 engaging the latch of a flow control valve for removal from a valve seat.

Referring now to the drawings, and particularly to FIGURES 1-3, a string of well tubing 10 is generally shown connected together by collars 12. Special lengths of tubing 14 are provided which include a flow control valve receiving section 16 which is laterally offset from the bore of tubing 10, and generally includes a suitable valve seat 18 for receiving a flow control valve. Generally, a plurality of flow control valve receiving sections are connected in the tubing 10, one above the other, each of which is adapted to receive a flow control valve for receiving production from different levels. The above described tubing structure is conventional and no further description is believed necessary. For example, see Patent No. 2,679,904.

A shifting tool is generally employed and is lowered generally on a wire line to install or remove a flow valve in the valve seat 18. Of course, it frequently happens that the shifting tool will engage one of the upper receiving sections instead of a desired lower section. In particular, in directionally drilled wells, the flow control receiving sections 16 may be on the low side of the tubing 10 and thus a shifting tool would fall down into the receiving section 16 and could not be lowered down to the desired level.

The present invention is directed to providing an apparatus 22 for installing and removing flow valves which includes a guide 20 which when lowered in the tubing 10 generally carries a shifting tool 24 in a retracted position so as to bypass the flow control receiving sections 16 until the proper section 16 is reached.

Referring now to FIGURES 1, 4A and 4B, the guide 22 preferably includes a case 26 which is arcuately shaped in cross section for ease in moving along the tubing 10, and which includes a recess 28 in which the shifting tool 24 may be carried in its retracted position so as to be prevented from falling into or engaging one of the receiving sections 16. The guide 22 is sized and shaped so that it will remain in the bore of the tubing 10 as it is lowered along the tubing and thus will bypass and will not become stuck in one of the receiving sections 16. For instance, the guide 22 is preferably of a length longer than a receiving section 16 so that it will be telescopically guided along the bore of the tubing 10 and its lower end 30 will remain aligned in the tubing bore and will not fall down into the receiving section 16 even though the tubing 10 may be in a nearly horizontal position with the section 16 positioned on an underside. In addition, it is desirable that the lower end 30 and the upper end 32 of the guide 22 be sufficiently large enough in cross section as compared to the inside diameter of the tubing 10 to maintain the alignment of the guiding in a tubing 10 at all times. Furthermore, it is desirable that the lower end 30 of the guide be rounded and of a cross sectional size larger than the valve seat 18 to prevent engagement of the guide on top of the seat.

The shifting tool 24 is supported from the guide 22, such as by a pivot pin 34, and is releasably secured such as in the recess 28 while the apparatus 20 is being lowered in the tubing 10 whereby the shifting tool 24 will be maintained in the bore of the tubing 10 and prevented from falling into or becoming engaged in one of the receiving sections 16 until the desired location is reached. Any suitable releasable connecting mechanism 36 may be used such as an interlocking pin 38 which has one end normally held in a notch 40 in the shifting tool 24 to hold the tool in its retracted position when the apparatus 20 is being lowered. The second end of interlocking pin 38 rests against the outer periphery of a cam 42 which is pivotally mounted on the guide 22 and is in turn normally secured from pivotable movement while being lowered in the tubing by a shear pin 44. The cam 42 in turn carries a spring loaded actuating pin 46 which protrudes outwardly and includes a beveled lower face 48 so that the pin 46 will move inwardly and bypass projections in the tubing 10 such as tubing collars as the apparatus is lowered. However, when the desired location is reached the apparatus 20 is raised and an upward protruding shoulder 50 on the pin 46 will engage a collar 12 thereby shearing pin 44 and causing the cam 42 to rotate. Upon rotation the cam 42 a notch 52 in the cam 42 is rotated into engagement with the top of the pin 38, and spring 54 moves the interlocking pin 38 into the notch 52 and out of the notch 40 on the shifting tool 24 thereby releasing the shifting tool for lateral movement.

On the release of the connecting mechanism 36, a suitable shifting mechanism 56 is provided to positively move the shifting tool 24 into the selected receiving section 16. Thus, the mechanism 56 may include a spring 58 acting against a plunger 60 which in turn may act against the case 26 to cause the shifting tool 24 to move into the offset receiving section 16, as best seen in FIGURE 2.

For installing a flow control valve a suitable running adapter 62, which is conventional, such as the type JC-3 as sold by Camco, Inc. of Houston, Tex., may be utilized to carry a convention flow control valve 64. With the release of the shifting tool 24 from the guide 22 the apparatus 20 is further lowered to cause the lower end of the valve 64 to move into the valve seat 18. Another feature of the present invention is the provision of a pivoted joint 66 in the shifting tool 24 whereby the lower sections 68 of the shifting tool are rotatably connected by a pin 70 to an upper section 72 of the shifting tool 24. Sections 68 and 72 are normally secured together by a shear pin 74. However, when the lower end of the valve 64 engages the valve seat 18, as best seen in FIGURE 3, and the apparatus 20 is further lowered, such as by a jar at the upper end of the apparatus, which is not shown, and which is conventional and forms no part of the present invention, the pin 74 shears, and thereby allows the valve 64 to become aligned with the valve seat 18 to allow close tolerances and effect a better sealing action between the valve 64 and the valve seat 18. Further downward movement or jarring of the apparatus 20 seats the valve 64 securely in the valve seat 18, and as is conventional, releases the running adapter 62 from the valve 64 such as by shearing pin 76, as best seen in FIGURE 4B. The valve 64 is then seated and the apparatus 20 may be withdrawn from the tubing 10 as the shifting tool 24 and the running adapter 62 will then overcome the shifting mechanism 56 as the apparatus 20 is pulled upwardly through the tubing 10.

The apparatus 20 may also be used to remove a flow valve from a selected location without accidentally being run down the tubing 10 and inadvertently connected to the wrong flow valve. Referring now to FIGURES 5 and 6, the shifting tool 24 and guide 22 are the same as shown in FIGURES 1-4 and the shifting tool 24 is shown in FIGURE 5 held in a retracted position relative to the guide 22 as previously described. However, in place of the running adapter 62 a pulling adapter 76 and any conven-

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tional type such as the type JDC of Camco, Inc. of Houston may be utilized. Thus, as shown in FIGURE 6 when the shifting tool has been released from the guide 22, and moved laterally into the selected offset receiving station 16 the pulling tool 76 will move down and over the latch at the top of the flow control valve 64 will shear the pin 74 in the joint 66 so that the shifting tool and pulling adapter 76 may become aligned with the flow control valve 64, similar to FIGURE 3, and an upward movement of the apparatus 20 will pull the flow control valve 64 out of the valve seat 18.

In operation, the apparatus 20 for use in installing a valve 64 in a selected valve seat 18 is assembled as best seen in FIGURES 1, 4A and 4B with the lower pivotable joint secured by shear pin 74, and the shifting tool 24 releasably locked in a retracted position in the recess 28 of the guide 22, such as by the interlocking pin 38 engaging notch 40 and held in place by a shoulder on the cam 42. The cam 42 is in addition secured against rotation by shear pin 44. The apparatus 20 can then be lowered downwardly through tubing 10 and the guide 22 will bypass the upper receiving sections 16 because of the size and shape of the guide relative to the tubing 10 and the receiving sections 16. Thus, the apparatus 20 may be guided to the desired location without the shifting tool 24 becoming stuck in an undesired location. As the apparatus 20 is lowered the beveled shoulder 48 on the protruding pin 50 will be depressed into the cam 42 thereby preventing any actuation of the release mechanism 36. Once the proper location is reached the apparatus 20 is raised and the upper protruding shoulder 50 on the pin 46 will engage a tubing collar 12 to shear the pin 44 and rotate the cam 42 so as to bring the cam notch 52 into engagement with the interlocking pin 38. The spring 58 will move the pin 38 out of the notch 40 on the shifting tool 24, and allow the shifting mechanism 56 to transversely move the shifting tool 24 out of the tubing bore and into the offset receiving section 16 above the valve seat 18, as best seen in FIGURE 2. Further downward movement of the apparatus 20 will shear the pin 74 in the pivotable joint 66 allowing the running adapter 62 and control valve 64 to become aligned with the seat 18, and further downward movement will set the valve 64 and release the adapter 62. The apparatus 20 may then be conveniently withdrawn by the tubing 10.

The apparatus 10 can similarly be used to pull a pre-selected valve 64 by substituting, as best seen in FIGURES 5 and 6, a pulling adapter 76 in place of the running adapter 62 and the present handling apparatus 20 will be similarly actuated so that the pulling tool may engage, grip, and remove the desired control valve 18.

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. A flow control unit handling apparatus adapted for use in placing a flow control unit in a well tubing having collars and having a plurality of flow control receiving sections offset from the tubing each of which is provided with a seat for a flow control unit, and for removing said unit from said seat comprising,

an elongate guide means having a recess, said guide means being arcuately shaped in cross section at said recess and being longer in length than each of said receiving sections whereby the guide means will not engage but will bypass said receiving sections as the guide is lowered in the tubing,

a shifting tool pivotally supported at its upper end from said guide means and positioned in said recess while

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being lowered in said tubing and adapted to support a flow control unit, said guide means projecting below said shifting tool and flow control unit when said shifting tool is aligned with said guide means, spring means connected between the guide means and the shifting tool for yieldably urging said tool out of the recess and towards said selected receiving station when the apparatus is positioned in the tubing adjacent the selection receiving station,

a releasing cam having a releasing notch and pivotally carried by the guide means,

a spring loaded actuating pin connected to the cam and having a shoulder protruding upwardly whereby when the apparatus is raised in the tubing the shoulder will contact a tubing collar and will rotate said cam, and

a spring loaded interlocking pin normally engaging and holding the shifting tool in said recess by engagement with the cam and which will release the shifting tool when the cam is rotated to bring the releasing notch into alignment with the interlocking pin.

2. The apparatus of claim 1 including,

a pivotable joint in the shifting tool, and

a shear pin normally preventing said joint from pivoting.

3. A flow control unit handling apparatus adapted for use in placing a flow control unit in a selected offset seat in a well tubing and for removing said unit therefrom comprising,

an elongated guide means adapted to be lowered through the well tubing and bypass said seat,

a shifting tool supported from said guide means and adapted to support a flow control unit,

releasable connecting means coacting between the guide means and the shifting tool for holding the shifting tool longitudinally aligned with said guide means and away from the offset seat as the guide means is lowered in the well tubing,

means for releasing the connecting means including a spring loaded actuating pin having a shoulder protruding upwardly adapted to contact a shoulder in the tubing when the apparatus is raised in the tubing for actuating the releasing means, and

means for moving the shifting tool away from the guide means and toward the offset seat when the connecting means is released.

4. A flow control unit handling apparatus adapted for use in placing a flow control unit in a well tubing having collars and a plurality of flow control receiving sections offset from the tubing axis each of which is provided with a seat for a flow control unit, and for removing said unit therefrom comprising,

an elongate guide means adapted to be lowered through the well tubing, said guide means being longer than said receiving section whereby said guide means will not engage but will bypass said receiving section as the guide means is lowered,

a shifting tool supported from said guide means and adapted to support a flow control unit,

releasable connecting means coacting between the guide means and the shifting tool for holding the shifting tool longitudinally aligned with said guide means and away from the seats as the guide means is lowered in the well tubing, said guide means projecting below said shifting tool and flow control unit when said shifting tool is aligned with said guide means,

means for releasing the releasable connecting means including a releasing cam, and a spring loaded actuating pin connected to said cam and having a shoulder protruding upwardly whereby when the apparatus is raised in the tubing the shoulder will contact a tubing collar and will actuate said cam for releasing said connecting means, and

means for transversely moving the shifting tool away from the guide means and toward one of said re-

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ceiving sections when the connecting means is re-
leased.

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