

- [54] APPARATUS FOR INSTALLING AND REMOVING FLOW CONTROL UNITS
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- [51] Int. Cl. .... E21b 7/06
- [58] Field of Search..... 166/.5, .6, 117.5, 166/117.6, 315, 224

3,610,336 10/1971 Sizer ..... 166/117.5

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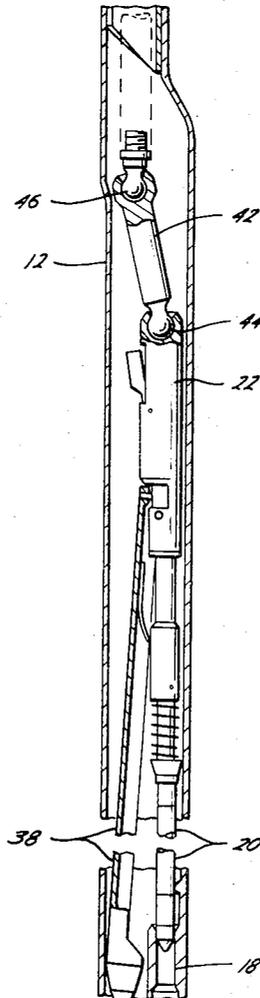
[57] ABSTRACT

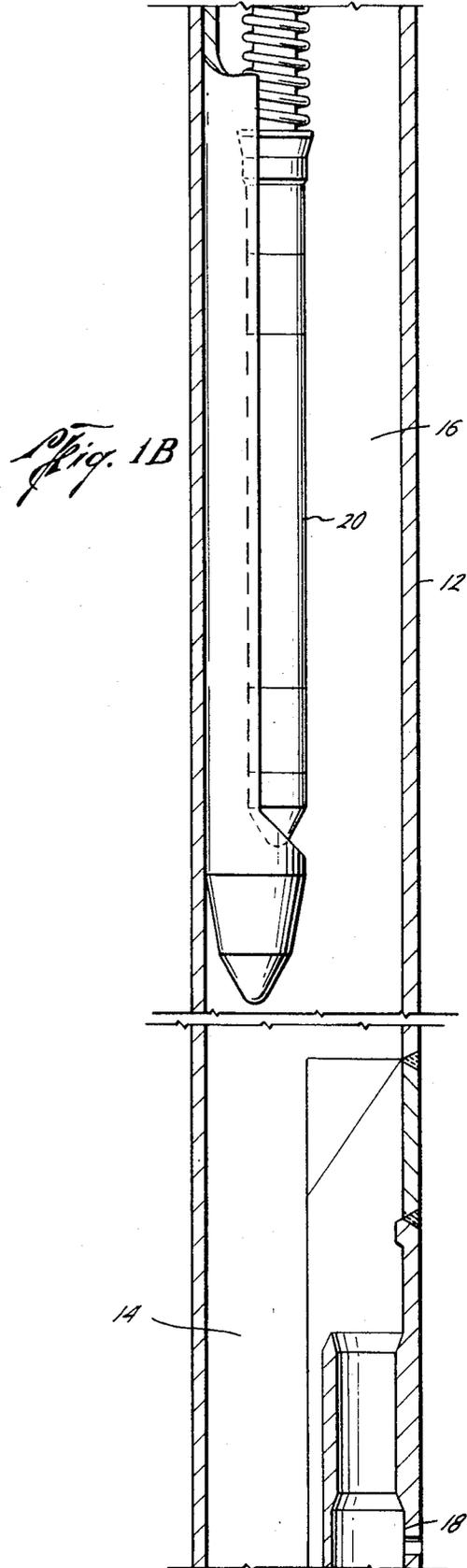
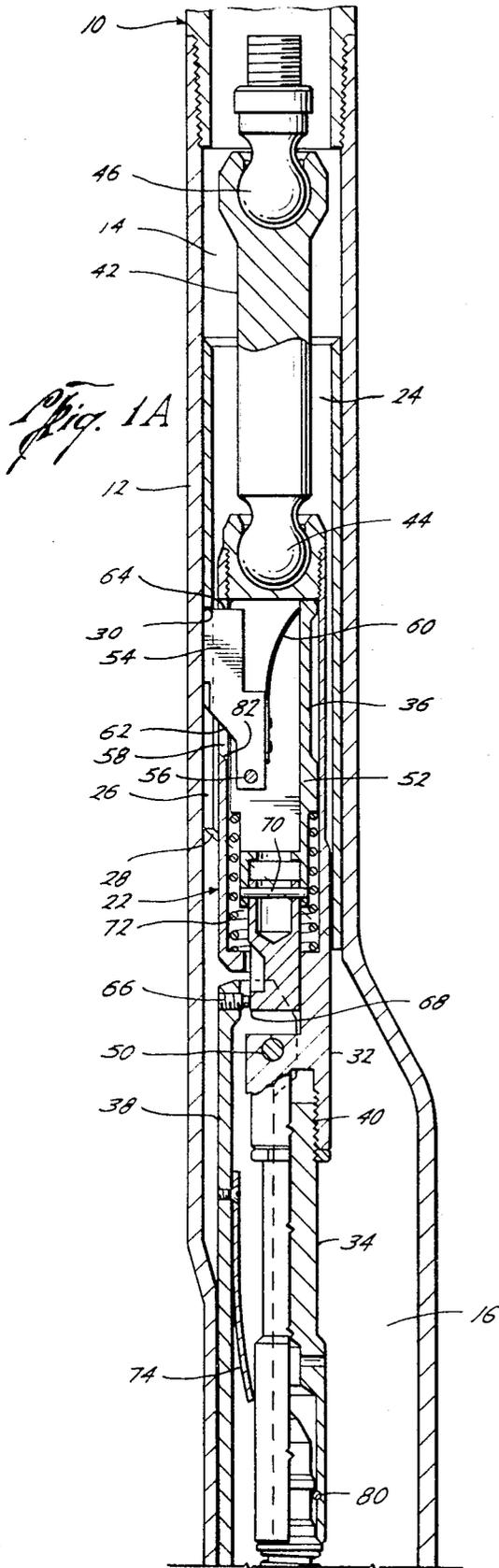
A flow control unit handling apparatus adapted for use in placing a flow control unit in a selected offset seat in a well tubing mandrel and for removing said unit therefrom. An elongate housing adapted to support a flow control unit and pivotally connected at its upper end to a supporting means for raising and lowering the housing in the well tubing and an elongated protective guide means pivotally supported from the housing allowing the apparatus to pass freely downwardly through an offset mandrel. A key for locating, positioning and tripping the apparatus into position to allow a valve to be placed or pulled from a selected offset seat. The apparatus being of a minimum elongate length such that the apparatus may pass through a curved tubing in a pump-down system.

7 Claims, 5 Drawing Figures

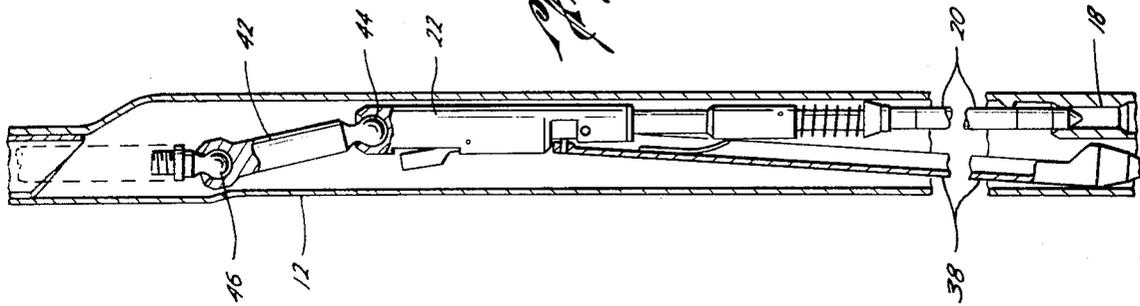
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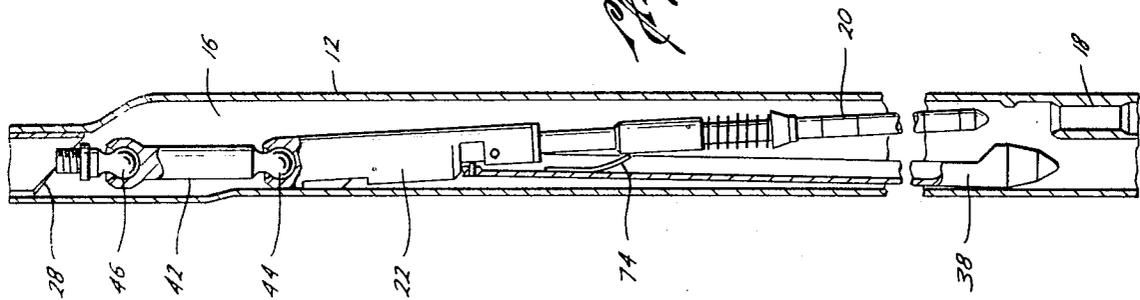




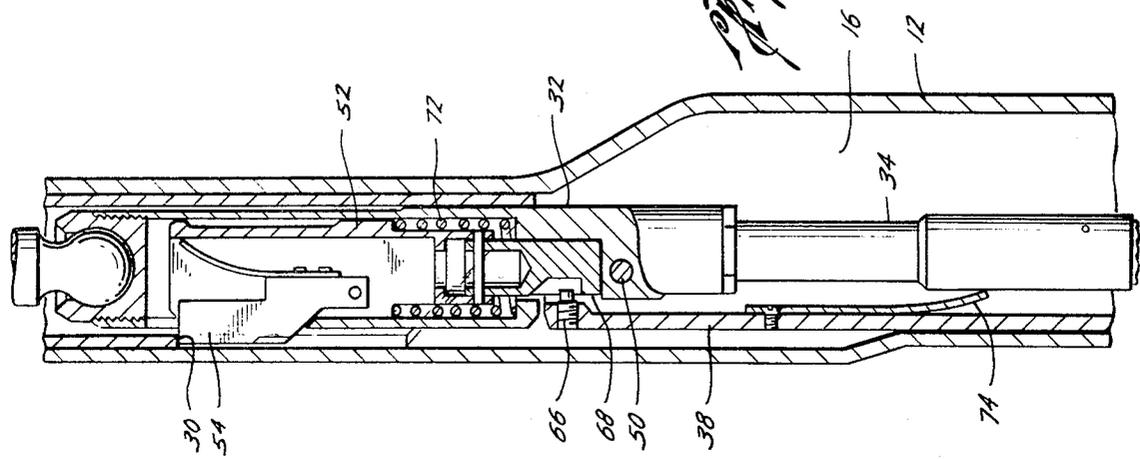
*Fig. 4*



*Fig. 3*



*Fig. 2*



# APPARATUS FOR INSTALLING AND REMOVING FLOW CONTROL UNITS

## BACKGROUND OF THE INVENTION

The use of an apparatus or kickover tool for installing or removing flow valves from an offset sidepocket and utilizing a protective guide shell about the kickover tool for allowing the kickover tool to pass freely downwardly through a mandrel without becoming inadvertently caught in one of the valve seats other than at the desired location is generally shown in U.S. Pat. No. 3,353,608. In addition, the use of a key for orienting and tripping a kickover tool is disclosed in copending application Ser. No. 95,408, filed Dec. 4, 1970.

However, the prior art kickover tools generally included one or more pivoting joints in the housing which are actuated by releasing shear pins. The present apparatus is directed to an elongate housing which eliminates the need for such internal pivoting joints. In addition, it is frequently desirable to raise and lower the kickover apparatus by means of a hydraulic pumping system as well as by a wireline. However, in a pump-down system the well equipment passing through the well tubing is frequently passed through a curved tubing which restricts the linear extent of the well tools being pumped. The prior art kickover tools having pivoting joints or knuckle joints are of too great of a longitudinal length to pass around the curved sections and the present invention by eliminating the internal pivoting joints provides an apparatus of a length that may pass through the curved tubing.

## SUMMARY

The present invention is directed to a flow control unit handling apparatus adapted for use for placing a flow control unit in a selected offset seat in a well tubing and for removing said unit therefrom including a housing adapted to support a flow control unit in which there is a pivoting connection between the supporting means for raising and lowering the housing in the well tubing. An elongate protective guide means is pivotally supported from the housing for protecting the apparatus from catching on obstructions in the well tubing such as a valve seat as the apparatus is lowered through the well tubing. Releasable engaging means coact between the guide means and the housing for holding the guide means longitudinally aligned with the housing thereby preventing the housing from engaging an offset seat as the housing is lowered in the well tubing. Means for releasing the engaging means includes a shoulder protruding upwardly adapted to contact a shoulder in the tubing when the housing is raised. Means are provided between the guide and the housing for shifting the housing about the pivoting connection and away from the guide means and toward the offset seat when the engaging means is released.

A still further object of the present invention is the provision of a second pivoting connection in the supporting means for aligning the housing with the axis of the valve seat after the housing is shifted above the valve seat.

Still a further object of the present invention is the provision of a flow control unit handling apparatus in which the overall length of the housing and guide is such that the apparatus may pass through a curved tubing of a pump-down system.

Other and further objects, features and advantages will be apparent from 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.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is an enlarged elevational view, partly cross-sectional, of the top portion of the apparatus of the present invention being inserted in a conventional offset mandrel,

FIG. 1B is a continuation of FIG. 1A,

FIG. 2 is an elevational fragmentary cross-sectional view of the apparatus of the present invention in position being oriented and released in a well mandrel,

FIG. 3 is an elevational partial cross-sectional view of the apparatus of the present invention in being deflected for inserting a flow control unit in an offset seat in a well mandrel, and

FIG. 4 is an elevational partial cross-sectional view of the apparatus of the present invention in inserting the flow control unit into the offset seat of the mandrel.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and particularly to FIGS. 1A and 1B, a well tubing 10 is shown having connected therein a plurality of vertically spaced mandrels 12, here shown only as one for convenience. Each tubing mandrel 12 includes a main bore 14 therethrough generally having the same size and aligned with the bore of the well tubing 10, and further includes an offset bore 16 whose axis is offset from the main bore 14 and includes an offset valve seat 18 for receiving a flow control unit such as a valve 20. An apparatus 22 is generally employed for raising and lowering, such as on a wireline or by hydraulic pump-down apparatus, to install or remove the valve 20 in or from the seat 18.

The flow control unit handling apparatus 22 is provided for selectively installing or removing a valve in or from one of the desired vertically positioned mandrels 12 and orienting the apparatus 22 relative to the offset valve seat 18 for aligning the apparatus 22 for inserting or removing a flow control unit such as valve 20 from the valve seat 18.

As disclosed in patent application Ser. No. 95,408, filed Dec. 4, 1970, a guide sleeve 24 may be provided aligned with the main bore 14 and preferably positioned above the offset seat 18. The guide sleeve 24 includes a longitudinal guide slot 26, a guide surface 28 positioned below the slot 26 and directed inwardly and upwardly toward the bottom of the slot 26 for guiding a key upwardly and into the slot 26, and an actuating shoulder 30 positioned at the top of and entirely blocking the slot 26 for preventing upward movement of the key to the slot for actuating the handling apparatus 22.

The valve handling apparatus 22 generally includes an elongate rigid housing 32 including an adapter 34 for running or pulling a flow control unit or valve 20, and an orientating and releasing mechanism generally indicated by the reference numeral 36 and a protective guide means 38. The housing 32 is an elongate tubular member which includes suitable connection means such as threads 40 for supporting the valve handling unit 34. The valve handling unit 34, as shown, may be

a running adapter, which is conventional, such as the type JC-3, as sold by Camco, Incorporated of Houston, Texas, which may be utilized to carry the valve 20 for insertion into the valve seat 18.

Suitable supporting means 42 is provided for raising and lowering the apparatus 22 in the well tubing 10 and mandrels 12 by any suitable means such as a wireline or hydraulic pump-down equipment (not shown). The supporting means 42 includes a pivot connection 44 connected to the top of the apparatus 22 for allowing the apparatus 22 to be deflected over and into the offset pocket 16 and above the valve seat 18, as will be more fully described hereinafter. Preferably, the supporting means 42 includes a second pivoting connection 46 for allowing the apparatus 22 to be axially aligned with the valve seat 18.

Referring now to FIGS. 1A and 1B, a protective elongated guide means 28 is provided pivotally connected at 50 to the housing 32. The guide means 38 is arcuately shaped in cross section for ease in moving along the tubing 10 and includes a recess in which the housing 32 and valve 20 may be carried in a retracted position so as to be prevented from falling into or engaging one of the offset bores 16 and engaging the top of the valve seat 18 sidepocket. The guide 38 as described in U.S. Pat. No. 3,353,608 is sized and shaped so it will remain in the bore of the tubing 10 as it is lowered along the tubing 10 and thus will bypass and will not become stuck in the offset bore 16 of the mandrel 12. For instance, the guide 38 is preferably of a length longer than the bore 16 so that it will be telescopically guided along the bore of the tubing 10 and its lower end will remain aligned in the tubing bore and will not fall into the offset bore 16. The guide 38 is also sufficiently large enough in cross section to maintain itself in alignment in the tubing 10 and bore 14 of the mandrel 12 at all times and the lower end thereof is rounded and of a cross-sectional size larger than the valve seat 18 to prevent engagement of the guide 38 on top of the seat.

The orienting and positioning means 38 includes a movable body 52 telescopically and longitudinally movable in the upper portion of the housing 32 and a key 54 pivotally connected to the body 52 at its lower end by shear pin 56. The housing 32 includes an opening 58 through which the guide key 54 is yieldably urged outwardly by a spring 60. While the guide key 54 is yieldably urged outwardly at all times, it will, because of a downwardly facing tapered face 62, readily pass downwardly over protruding shoulders inside of the main bore 14 including any number of orientation sleeves 24. The key 54, includes an upwardly directed actuating shoulder 64 which when the key 54 is below the guide surface 28 will contact the downwardly directed guide surface 28 thereby rotating the valve handling apparatus 22 and rotatably align the apparatus 22 in the well bore as the guide key 54 moves along the guide surface 28 and into the longitudinal guide slot 26.

Further upward movement of the valve handling apparatus 22 will bring the shoulder 64 of the guide key 54 into engagement with the actuating shoulder 30 thereby stopping further upward movement of the movable body 52.

Releasable engaging means 66 is provided coating between the movable body 52 and the protective guide 38 for holding the guide 38 longitudinally aligned with the housing 32 thereby preventing the housing 32 from engaging an offset seat as the apparatus 22 is lowered

in the well tubing. The engaging means may include a pin 66 on the guide 38 and a shoulder 68 connected to the movable body 52 through a shear pin 70. Normally, the movable body 52 is yieldably maintained upwardly to the housing 32 by spring 72. However, as best seen in FIG. 2, when the apparatus 22 is moved upwardly and the key 54 engages the stop shoulder 30 the housing 32 moves upwardly relative to the movable body 52 carrying the pin 66 on the guide 38 up from and off of the shoulder 68. Means for shifting the housing 32 about the pivoting connection 44 and away from the guide means 28 and over the valve seat 18 is provided such as spring 74, as best seen in FIG. 3.

With the release of the housing 32 from the guide 38 and its movement outwardly and above the valve seat 18, the valve handling apparatus 22 may be lowered to cause the lower end of the valve 20 to move into the valve seat 18. The pivoting connections 44 and 46 allow the valve 20 (FIG. 4) to become vertically aligned with the valve seat 18 and further downward movement of apparatus 22 keeps the valve 20 in the seat 18. After the valve seat 20 is seated in the valve seat 18, it may be conventionally disconnected from the adapter 34 by upward movement and released from the adapter 34 by shearing pin 80 (FIG. 1A).

After the valve seat 20 is seated in the valve seat 20 and conventionally disconnected from the adapter 34, the apparatus 22 may be withdrawn from the tubing 10 by moving the apparatus 22 upwardly and jarring the guide key 54 against the shoulder 30 to shear the pin 70 whereby further upward movement of the body 32 will bring a retracting shoulder 82 against the taper 62 of the key 54 retracting the key 54 into the movable body 52 and away from the shoulder 30.

Of course, the valve handling apparatus 22 of the present invention may also be used to remove a valve 20 from a valve seat 18 in a selected mandrel by utilizing a pulling adapter of any conventional type, such as the type JDC of Camc, Incorporated of Houston, as shown in U.S. Pat. No. 3,353,608, in place of the running adapter 34.

It is to be noted that prior art kickover tools are too long to be pumped around a five foot radius tubing having a diameter of four inches since such tubing will accommodate a well tool of longitudinal length of no greater than approximately 34½ inches. The present apparatus 22 does not require internal knuckle joints which must be initially longitudinally secured and thus the present tool may be designed having an overall length from the pivot connection 44 to the bottom end of the guide 38 of only 33½ inches and will therefore pass through a curved pump-down tubing having a five foot radius and four inches in diameter. In addition, the supporting means 42 having the pivoting joints 44 and 46 is of a considerably shorter length so as to pass around a curved tubing and yet will allow the apparatus 22 to be shifted over into the side bore 16 and aligned with the valve seat 18.

In operation, the valve handling apparatus 22 in use in installing a valve 20 in a preselected valve seat 18 is lowered downwardly into the tubing 10 and past any number of mandrels 12 to the desired mandrel 12 in which it is desired to install or remove a flow control unit such as valve 20. On reaching the desired location, the apparatus 22 is raised whereby the guide key 54 engages the guide surface 28 and further upward movement causes the key 54 to rotate and be guided into the

guide slot 26 thereby orientating the apparatus 22 with respect to the offset bore 16, as best seen in FIGS. 1A and 1B. Further upward movement will cause the shoulder 64 on the guide key 54 to contact the engaging shoulder 30 above the slot 26 of the orientation sleeve 24 as best seen in FIG. 1A. Further upward movement of the apparatus 22 will move the housing 32, as best seen in FIG. 2, relative to the movable body 52 carrying the pin 66 on the guide 38 above and off of the shoulder 68 which releases the body 32 from the protected guide 38 and moves the housing 32 toward the offset bore 16. As best seen in FIG. 3, with further downward movement of the apparatus 22, the housing 32 is shifted over by the spring 74 into position above the valve seat 18 and guided therein as the apparatus 22 pivots about pivot connection 44. Further downward movement of the apparatus 22 causes the lower end of the valve 20 to move into the valve seat 18 and become axially aligned therein, and as best seen in FIG. 4, the apparatus 22 utilizes both the pivot connections 44 and 46 for obtaining axial alignment with the valve seat 18. Further downward movement latches the valve 20 conventionally in the seat 18 and an upward jarring action disengages the running adapter 34 from the valve 20.

Of course, as previously mentioned, the apparatus will by similar operation, using a pulling adapter in place of the running adapter 34, remove a flow control unit or valve 20 from the valve seat 18. The apparatus 28 may then be removed from the tubing by upward movement wherein the guide key 54 again engages the shoulder 30 and by upward jarring action will shear the pin 70 allowing retracting shoulder 82 to move the key 54 into the movable body 52 whereby the apparatus 28 may be removed from the tubing 10.

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 with 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 selected offset seat in a well tubing and for removing said unit therefrom comprising,  
 a housing adapted to support a flow control unit, supporting means for raising and lowering the housing in the well tubing,  
 a pivoting connection between the supporting means and the housing for allowing the housing to pivot towards the seat,  
 an elongated guide means adapted to be lowered through the well tubing and bypass said seat, said elongated guide means pivotally supported from the housing,  
 releasing engaging means coacting between the guide means and the housing for holding the guide means longitudinally aligned with the housing thereby preventing the housing from engaging an offset seat as the housing is lowered in the well tubing,  
 means for releasing the engaging means including a

shoulder protruding upwardly and adapted to contact a shoulder in the tubing when the housing is raised in the tubing for actuating the releasing means, and

means for shifting the housing about the pivoting connection and away from the guide means and toward the offset seat when the engaging means is released.

2. The apparatus of claim 1 including,  
 a second pivoting connection in the supporting means.

3. The apparatus of claim 1 wherein the releasing means includes,

a movable body connected to the upwardly protruding shoulder and longitudinally carried by the housing and initially engaging and holding the guide means longitudinally aligned with the housing.

4. The apparatus of claim 1 wherein the distance from the pivoting connection to the free end of the guide means is such that the apparatus may pass through a curved tubing of a pump-down tubing.

5. A flow control unit handling apparatus adapted for use in placing a flow control unit in the selected offset seat in a well tubing having a guide sleeve with a downwardly directed stop shoulder and for removing said unit therefrom comprising,

an elongate rigid housing adapted to support a flow control unit,

supporting means for raising and lowering the housing in the well tubing,

a pivoting connection between the supporting means and the housing for allowing the housing to pivot toward the seat,

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

a longitudinally movable body carried by the housing,

spring means yieldably urging said movable body upwardly in the housing,

a locating key pivotally connected to the body and having an upwardly directed shoulder for coacting with the guide sleeve and stop shoulder,

releasable engaging means coacting between the guide means and the movable body for initially holding the guide means longitudinally aligned with the housing thereby preventing the housing from engaging an offset seat as the housing is lowered in the well tubing, but which is disengaged when the locating key shoulder engages the stop shoulder and the body is moved relative to the guide means, and

means for shifting the housing about the pivoting connection and away from the guide means and toward the offset seat when the engaging means is released.

6. The apparatus of claim 5 including,  
 a second pivoting connection in the supporting means.

7. The apparatus of claim 5 wherein the distance from the pivoting connection to the free end of the guide means is such that the apparatus may pass through a curved tubing of a pump-down tubing.

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