July 16, 1957 J. F. MUSE 2,799,344

APPARATUS FOR LOWERING AND ELEVATING TOOLS IN WELL BORES

Filed Dec. 31, 1954

Fig. 1.

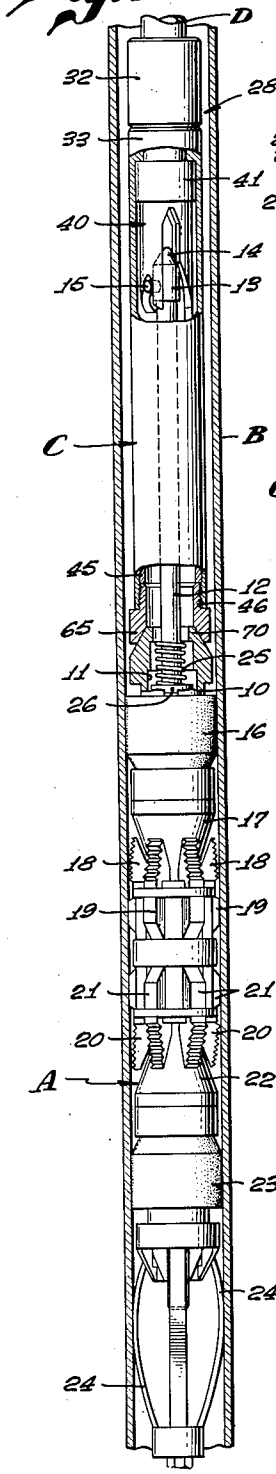



Fig. 2.

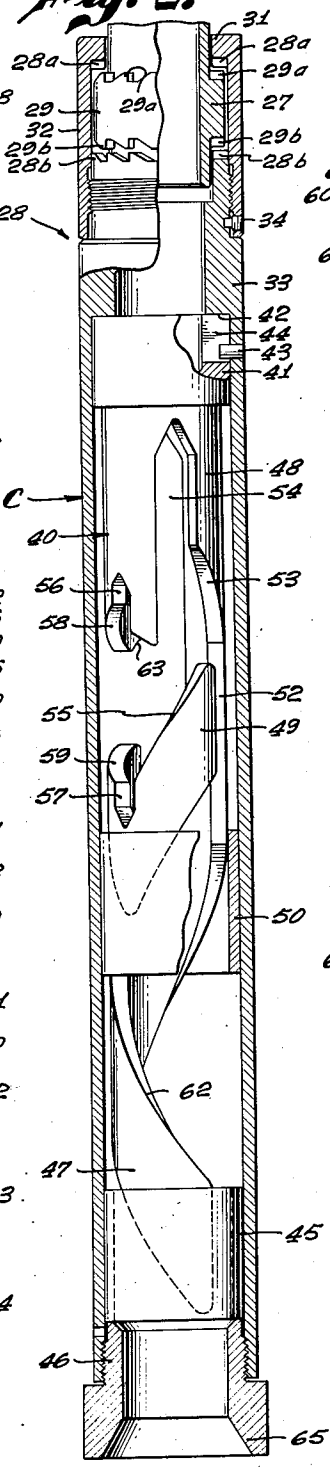



Fig. 3.

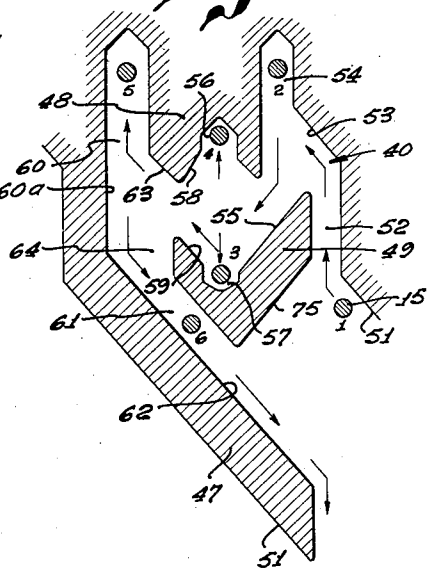
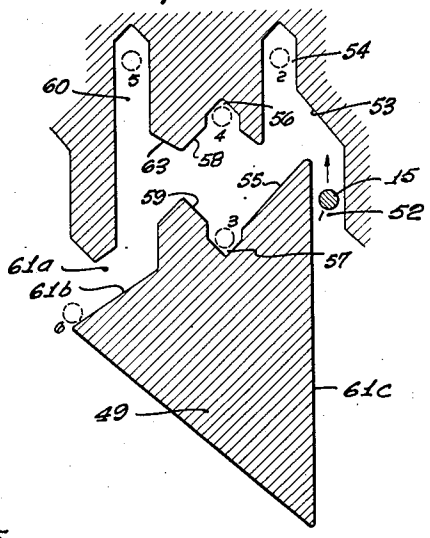



Fig. 4.




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# APPARATUS FOR LOWERING AND ELEVATING TOOLS IN WELL BORES

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Application December 31, 1954, Serial No. 479,203

10 Claims. (Cl. 166—123)

The present invention relates to subsurface well bore apparatus, and more particularly to apparatus for lowering other tools or devices in the well bore and elevating or retrieving such devices from the well bore.

An object of the present invention is to provide an apparatus adapted to lower and elevate a well device in a well bore, the apparatus being easily coupled to the well device while the latter is in the well bore and easily released from the well device whenever desired, the apparatus giving a definite indication to the operator when it is in a position to be released from the well device.

Another object of the invention is to provide an improved apparatus capable of lowering a well packer, and the like, to a desired location in the well bore without anchoring the packer in the well bore, the apparatus being capable of being released from the well packer, and of then being coupled thereto when it is desired to reshift the packer to another location in the well bore, or to remove the packer from the well bore.

A further object of the invention is to provide an apparatus connectible to a tubular string and capable of lowering a well device in a well bore, of being released from the well device, and of then being reconnected to the well device for the purpose of either lowering or raising the latter in the well bore, the apparatus giving a definite indication to the operator when it is in a position to be released from the well device, and then being moved easily to a released position without imposing any torque on the tubular string.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a side elevation, partly in longitudinal section, of a well packer being lowered in a well casing disposed in a well bore;

Fig. 2 is an enlarged longitudinal section, parts being shown in elevation, of the running-in and retrieving tool, by means of which the apparatus is lowered and raised in the well bore;

Fig. 3 is a diagrammatic representation, shown in a single plane, of the development of the slotted portion of the retrieving tool, and the various operative positions of the pin movable in the slot;



Fig. 4 is a view similar to Fig. 3 of another embodiment of the invention.

The invention is illustrated in the drawings in association with a well packer A, which is specifically designed to function as a bridge plug to be anchored in a well casing B in packed-off condition against longitudinal movement in both an upward and a downward direction. The well packer is lowered in the well casing by a running-in tool C secured to the lower end of a tubular running-in string D extending to the top of the well bore.

The specific well packer or bridge plug A disclosed, by itself, forms no part of the present invention and is fully described in the joint application of Reuben C. Baker and Martin B. Conrad, for "Well Packer Apparatus," Serial No. 425,646, filed April 26, 1954, now Patent No. 2,751,012. In that application, the well packer A is described as being run in the well casing B to the desired setting point merely by pushing it down the casing. During such pushing action, fluid in the well casing is capable of by-passing around the packer. Following its arrival at desired setting location in the casing, the running-in string D can be released from the packer and pressure either from above or below the packer, as the case may be, is effective to anchor the packer to the well casing against downward or upward movement, the packer also being sealed against the casing to prevent leakage of fluid thereby. After the well packer has performed its function in the well casing, it can be retrieved by means of the running-in and retrieving tool C, or shifted to another location in the well casing. The well packer can be pulled in an upward direction, if it is to be elevated to a new location in the latter, or it can be pushed downwardly to a new location below its initial setting point.

In general, the well packer A includes a tubular body **10** having a passage **11** therethrough that is valve controlled, as well as a control rod **12** which extends through the body to substantially its lower end, the control rod projecting upwardly above the body to a substantial extent and terminating in an enlarged head **13** having a tapered upper guiding end **14**. A single pin **15** projects laterally from the enlarged head **13** for cooperation with the running-in and retrieving tool C.

Secured to the body **10** is an upwardly facing generally cup-shaped packing member **16** sealingly engaging the well casing B, as well as an upper expander **17** that tapers in a downward direction for cooperation with an upper set of circumferentially spaced slips **18** having friction drag portions **19** adapted to frictionally engage the wall of the well casing. The upper expander **17** and upper set of slips **18** coact with each other to anchor the well packer A to the casing B against downward movement therewithin.

Similarly, a set of circumferentially spaced lower slips **20** is disposed around the body **10** of the tool, having friction drag portions **21** to frictionally engage the wall of the well casing, these slips **20** being cooperable with a lower upwardly tapering expander **22** secured on the body. A downwardly facing lower packing cup **23** is also adapted to sealingly engage the well casing B. The lower slips **20** and lower expander **22** coact with each other to anchor the well packer to the casing against upward movement therewithin.

The upper and lower packing cups **16, 23** frictionally engage the wall of the well casing B, and, since these

packing cups are secured to the tubular packer body 10, the control rod 12 can be shifted longitudinally within the body, to determine the ability of the upper and lower expanders 17, 22 to anchor their respective slips 18, 20 against the wall of the well casing. In the event that the packing members 16, 23 provide insufficient friction for securing the relative movement of the control rod 12 within the packer body, a friction drag device 24 may be secured to the lower end of the body, this friction drag device frictionally engaging the wall of the well casing B.

Further details of the well packer are unnecessary to an understanding of the present invention, and may be found in the above-identified patent application. It is sufficient to state, at this point, that when the control rod 12 is disposed in a central or neutral longitudinal position within the body 10, to which position it is normally urged by springs 25 engaging valve members 26 within the packer body adapted to engage the rod (of which only an upper valve head is disclosed), pressure on the packer imposed from above can shift the upper packing member 16, packer body 10 and upper expander 17 in a downward direction relative to the slips 18, to cause the upper expander to expand and hold the upper set of slips in anchoring engagement with the well casing B. By the same token, with the control rod 12 in its neutral position, pressure from below the well packer will urge the lower packing cup 23, body 10 and lower expander 22 in an upward direction relative to the slips 20, the lower expander shifting the lower slips outwardly into anchoring engagement with the wall of the well casing B, to prevent upward movement of the well packer within the casing. When in such neutral position, the control rod allows the upper and lower valves 26 (of which only the upper valve is disclosed in the drawings, there being a lower valve in the packer body) to prevent flow of fluid in both longitudinal directions through the packer body 10.

As further explained in the above-identified patent application, the shifting of the control rod 12 in a downward direction relative to the packer body 10 will cause it to open the lower valve in the packer body and allow fluid to by-pass around the well packer by flowing through the packer body. At the same time, such downward shifting of the control rod 12 within the body 10 will serve the purpose of holding the slips 18, 20 in a central or neutral position with respect to the expanders 17, 22, preventing relative movement between the body and expanders with respect to the slips, so as to prevent the upper expander 17 from being wedged within the upper slips 18. Similarly, the control rod 12 can be shifted upwardly with respect to the body 10 from its neutral or central position, to open the upper valve member 26 and allow fluid to by-pass through the body passage 11 and around the well packer. When in this upper position, the control rod 12 will again hold the slips 18, 20 in a central or neutral position with respect to the expanders 17, 22 and will prevent the lower expander 22 from moving upwardly with respect to the lower slips 20 to expand and anchor the latter outwardly against the wall of the well casing.

As explained above, when the control rod 12 is allowed to occupy a neutral or central position within the body 10, then the body 10 and the expanders 17, 22 can shift longitudinally with respect to the slips 18, 20, longitudinal movement of the latter being resisted by the frictional engagement of their drag block portions 19, 21 against the wall of the well casing B. Accordingly, the running-in and retrieving tool C constitutes a device for shifting the control rod 12 downwardly within the body 10, when the well packer A is being lowered within the well casing B, to prevent the upper slips 18 from being anchored against the casing. The tool C can also become coupled or connected to the control rod 12, for the purpose of elevating the latter within the body of the tool, to prevent the lower expander 22 from being wedged upwardly within the lower slips 20, to anchor the latter against the well casing. When the tool C is connected to the well packer A, to shift the control rod 12 in the upward direction just described, the entire apparatus can be elevated in the well casing to the desired location in the latter, or may be removed completely from the well casing.

The running-in and retrieving tool C is connected to the lower end of the tubular running-in string D, that may consist of tubing extending to the top of the well bore. The lower end of the running-in string may be constituted by a tubular sub 27 piloted within the tubular housing 28 of the retrieving apparatus. The sub 27 has an enlarged clutch portion 29 having oppositely facing upper and lower sets of axial teeth 29*a*, 29*b* projecting from its upper and lower ends and adapted to coact with upper and lower sets of companion axial clutch teeth 28*a*, 28*b* formed on an inwardly directed flange 31 of a clutch housing portion 32 and also on the main portion 33 of the clutch housing. The sub 27 is movable upwardly in the housing to engage the upper sets of teeth 29*a*, 28*a*, or downwardly in the housing to engage the lower sets of teeth 29*b*, 28*b*, or it may occupy an intermediate portion in which its teeth are out of engagement with both sets of housing teeth. The clutch is of an overrunning type, its teeth possessing a ratchet form, being sloped in such direction that the sub 27 can transmit left-hand rotation to the housing 28, and permit the housing to automatically unclutch from the sub 27 and advance ahead of the latter in a left-hand turning direction. The aforesaid automatic clutching and unclutching can occur when the lower sets of teeth 29*b*, 28*b* are engaged, or during engagement of the upper sets of teeth 29*a*, 28*a*.

The lower end of the housing 32 is threaded onto the upper end of the main housing portion 33 of the running-in and retrieving tool C. Inadvertent disconnection between the clutch housing 32 and the main housing 33 may be prevented by one or more set screws 34. The lower clutch teeth 29*b* of the enlarged sub portion 28 are adapted to engage the lower teeth 28*b* of the housing 33, so that downward movement of the sub 27 will cause corresponding downward movement of the housing 28.

The housing 28 has a slotted structure 40 embodied therewithin in which the transverse pin 15 on the tapered head 13 may move, for the purpose of controlling the position of the control rod 12 within the body 10 of the well packer. The slotted portion 40 is formed within a sleeve structure contained within the housing member 33. The upper portion 41 of the sleeve structure snugly conforms to the inner wall of the housing member 33 and engages a downwardly facing shoulder 42 in the housing, being prevented from rotating with respect to the housing by one or more transverse pins 43 secured to the housing member 33 and extending into longitudinal slots 44 in the upper end of the sleeve portion 41. The sleeve structure further includes a lower portion 45 snugly engaging the inner wall of the housing member 33 and contacting the upper end of a lower guide 46 that is threaded into the lower end of the housing member 33. Integral with the lower sleeve member 45 and secured to its inner wall is a helical rib or leg 47 that extends upwardly to the upper sleeve portion 41, with which it is integral. Thus, the guide 46 will engage the lower end of the lower sleeve member 45 and, through the helical leg 47, will cause the upper sleeve portion 41 to abut the depending housing shoulder 42.

The slot 40 in the sleeve structure is formed within the upper portion 48 of the structure, as well as within an intermediate portion 49 of the structure and the helical leg 47. The intermediate structure 40 is integral with, or otherwise suitably secured to, an intermediate sleeve member 50 which is integral with the helical leg 47, and which also snugly engages the inner wall of the

housing member 33. In effect, the upper 41, intermediate 50 and lower portions 45 of the sleeve structure, as well as the portions 48, 49, 47 in which the slot 40 is actually formed, are integral with one another, being made from a single casting.

The slot 40 is formed around the entire circumference of the sleeve structure, its development being shown most clearly in the diagrammatic view of Fig. 3. The pin 15 on the control rod head 13 can move relatively in an upward direction against the lower inclined guide surface 51 on the helical leg 47 which will serve to guide the pin into the vertical slot portion 52 terminating at another inclined guide surface 53 which slopes in an upward direction to the left, as seen in Fig. 3, this surface guiding the pin 15 into a vertical or locating slot portion 54 in the upper region of the sleeve structure.

It is evident that the locating slot portion 54 in displacement to the left of the vertical slot portions 52, such displacement being provided to preclude the inadvertent downward and return movement of the pin into the entrance vertical slot portion 52. Instead, relative downward movement of the pin in the locating slot 54 will result in its engaging a guide surface 55 on the upper end of the intermediate sleeve portion 49, which is inclined in a downward direction toward the left, as seen in Fig. 3, this guide surface causing the pin to shift relatively to the left and into alignment with opposed upper and lower vertical slot portions 56, 57 in the upper and lower sections 48, 49 of the sleeve structure, respectively, that enable the well packer A to be either lowered in the well casing B, or elevated in the well casing, by shifting the control rod 12 downwardly with respect to the packer body 10, or upwardly with respect to the packer body.

Adjacent the upper lowering slot portion 56 is a guide surface 58 inclined downwardly to the left, whereas adjacent the elevating slot portion 57 is a guide surface 59 that is inclined upwardly to the left. These opposed inclined guide surfaces 58, 59 will direct the pin 15 into a releasing vertical slot 60 that extends upwardly to substantially the same degree as the locating slot 54, and which also opens downwardly into an exiting slot portion 61 inclined in a downward direction toward the right and formed by the upper surface 62 of the helical leg 47. The upper sleeve structure 48 is also provided with a guiding surface 63 that is inclined upwardly toward the left from the inclined guiding surface 58 extending downwardly from the upper lowering slot portion 56. The upwardly inclined guiding surface 63 is disposed above an enlarged area 64 of the releasing slot portion 60, in order that inadvertent upward entry of the pin 15 into the exiting slot portion 61 will cause the pin to enter only the upper portion of the release slot 60 and will preclude it from moving back into alignment with the upper lowering slot portion 56 or the lower elevating slot portion 57. In addition, the enlarged area 64 of the releasing slot will facilitate movement of the pin 15 from the upper lowering slot portion 56 to the exiting slot portion 61.

Although reference has been made to the movement of the pin 15 to the left, in connection with diagram disclosed in Fig. 3, actually, the pin is normally stationary insofar as rotary motion is concerned, and it is the housing 28 that is rotated to the right, or in a left-hand direction, the rotation being accomplished by turning the tubular running-in string D to the left, this motion being transmitted through the clutch teeth 29*a*, 28*a*, or 29*b*, 28*b* to the housing.

The housing 28 and its guide 45 are of such length with respect to the slot 40 provided within the housing that the lower end 65 of the guide will engage the upper end 70 of the body 10 to bear thereagainst at the time that the pin 15 is disposed within the upper running-in slot portion 56, the rod 12 being pushed downwardly within the body to the position in which it prevents relative longitudinal movement between the body 10 and its expanders 17, 22, on the one hand, and the slips 18, 20, on the other hand. However, the control rod may be shifted downwardly within the body 10 to the extent preventing the slips 18 from being expanded out against the casing B, the absence of the guide 46 engaging the upper end of the body 10. Inasmuch as the control rod 12 itself, as explained in the above-identified patent application, may be shifted to a position in which it exerts a downward force on the body 10 to preclude relative downward movement between the rod 12 and body 10, and between the expanders and the slips.



In the use of the running-in and retrieving tool C, in connection with the retrievable bridge plug A, it is first desired to lower the plug to the specific location in the well casing B in which it is to be set. The retrieving housing 28 is disposed over the control rod 12 at the top of the hole, the pin 15 moving into the slotted structure and bearing against the lower inclined surface 51 of the helical leg 47, which is the No. 1 position shown in Fig. 3. The tubular string D and housing 28 are now lowered, with the tubular string turned to the left slowly, this motion being transmitted through the one-way clutch 29*b*, 28*b* to the housing 28, in order to rotate the slotted structure relative to the pin, causing the pin 15 to move relatively up through the vertical slot portion 52 and into the No. 2 or locating position in the locating slot 54.

The housing 28 is elevated and turned slightly to the left, which will shift the pin 15 into the No. 3 position. At the top of the well bore, it is easily ascertainable that the pin is properly located in the elevating slot 57. The apparatus is then lowered in the well casing. As the well packer or bridge plug enters the latter, the drag block portions 19, 21 of the slips will engage the wall of the casing, whereupon the downward weight disposed on the tubing string D will shift the housing 28 and sleeve structure contained therewithin downwardly, causing the pin 15 to move from the lower elevating slot portion 57 into the running-in slot portion 56 aligned therewith (No. 4 position in Fig. 3). When the upper end of the running-in slot portion 56 engages the pin 15, it shifts the rod 12 downwardly within the packer body 10 to the extent determined by engagement of the lower end 65 of the guide 46 with the upper end 70 of the body 10. When in this position, as explained above and in the aforementioned patent application, further relative downward movement between the rod 12 and body 10 cannot occur, which, by virtue of an interconnection between the rod 12 and the slips 18, 20 also precludes relative movement between the slips 18, 20 and the expanders 17, 22, the slips occupying the neutral position disclosed in Fig. 1. The apparatus can then be run in the well casing B on the lower end of the string of tubing D, pushing the bridge plug A downwardly with the tubing without anchoring the slips against the housing, the pin 15 occupying and remaining in the No. 4 position disclosed in Fig. 3.

When the location in the well casing B has been reached at which the well packer A is to be anchored, the running-in and retrieving tool C is released from the rod 12. A left-hand torque is taken on the tubular running-in string D, which shifts the housing 28 and the sleeve structure to the left, in view of the action of the one-way clutch 29*a*, 28*a* coupling the tubular sub 27 to the housing 28 when the sub is turned in the left-hand direction. With such left-hand torque imposed on the tubing string D and the housing 28, the tubing string D is elevated slowly, to raise the running-in slot portion 40 with respect to the pin 15. Inasmuch as the slotted sleeve structure is being urged in a counterclockwise direction (actually to the right, as seen in Fig. 3), the pin 15 comes out of the running-in slot

portion 56. The pin 15 will engage the inclined guide surface 58 and move over against the left wall 60*a* of the releasing slot portion 60.

The operator can readily determine that the pin is in the releasing slot portion 60 since the lowering of the tubing string D and the housing 28 will shift the housing downwardly against the body 10, the control rod 12 being free from the downward force imposed by the housing structure that it possesses when in the No. 4 position. Such action will cause the control rod 12 to shift to a neutral position and will result in downward movement of the tubing string D, shifting the body 10 of the tool and the expander 17 downwardly within the slips 18, expanding the latter outwardly into anchoring engagement with the wall of the well casing. Accordingly, the operator will be advised of the fact that the pin 15 is in the releasing slot portion 60 by virtue of his inability to further lower the tubing string.

Accordingly, a positive indication is given to the operator that the retrieving head C is in the proper position for its release from the well packer A. The operator will now move the tubing string D and housing 28 upwardly, which will elevate the housing structure relative to the pin 15 and cause the pin to engage the upper surface 62 of the helical leg 47. Such engagement will impose a left-hand torque on the housing, which will be transmitted through the one-way clutch 29*a*, 28*a* to the tubing string D, thereby giving a further indication to the operator that the pin is in the exiting portion 61 of the slot. The tubing string and housing can now be elevated until the pin 15 moves completely out of the housing 28.

Following removal of the running-in and retrieving tool C from the well packer A, the springs 25 of the latter can close the valves 26 and the passage 11 through the packer body 10, and also shift the control rod 12 to the neutral position within the body, permitting relative longitudinal movement between the body 10 and the expanders 17, 22, on the one hand, and the slips 18, 20, on the other hand, in order to anchor the plug in the well casing, depending upon the existence of a pressure differential above or below the location of the bridge plug or well packer A.

In order to retrieve the well packer or bridge plug A, the tubular running-in string D is lowered in the well casing B, the flaring end 65 of the guide 46 insuring the movement of the housing 28 and the sleeve structure therein over the control rod 12 and head 13. The tubular string D and the housing 28 connected thereto are turned slowly to the left during the lowering movement and when the rod head 13 enters the guide 46, the pin 15 will be guided into the sleeve by bearing against the inclined guiding surface 51 of the helical leg 47. In the event that the tubular string D and housing 28 are not rotated slowly to the left during such lowering movement, the housing 28 will partake of such rotation by itself upon engagement of the lower inclined surface 51 of the leg 47 with the pin 15, inasmuch as the overrunning clutch 29*b*, 28*b*, permits such action to occur under the camming influence of the stationary pin 15. If the pin 14 were to move away from the inclined surface of the leg, it can do nothing more than move against the inclined surface 75 of the intermediate sleeve structure 49, which will also guide the pin into the vertical entrance slot portion 52, the pin continuing its movement along the inclined guiding wall 53 to the No. 2 position within the locating slot 54, which is disaligned with the entrance slot portion 52. The pin 15 will not engage the upper end of the locating slot portion 54 since before that occurs the lower end 65 of the guide 46 will have engaged the body 10 and will have shifted the latter downwardly so as to expand the upper slips 18 against the casing. The fact that the well packer A is taking weight will advise the operator that the pin 15 is in the locating slot portion 54.

While continuing the left-hand torque on the tubular running-in string D and the housing 28, the operator will now elevate them slowly, causing the inclined guide surface 55 in alignment with the locating slot portion 54 to engage the pin 15. The left-hand or counter-clockwise movement of the housing 28 will then urge the pin relatively into alignment with the retrieving slot portion 57, the upward movement of the housing insuring the disposition of the pin in that particular slot portion, designated as position No. 3 in Fig. 3. Continued upward movement of the tubing string and housing 28 will now shift the control rod 12 upwardly with respect to the body 10, or to a neutral position,, which will prevent the slips 18, 20 from being set against the well casing B during upward movement of the packer in the latter. With the pin 15 in the position just described, the well packer A can be elevated in the casing B to a new setting location, or it can be removed completely from the well casing.

Instead of elevating the well packer A in the well casing, it may be desired to lower it to a new position. All that need be done after the pin 15 has been located in the elevating slot portion 57 is to lower the tubing string D and housing 28 without any torque being imposed on the tubing string. Such lowering will shift the housing 28 and the sleeve structure downwardly until the pin 15 enters the running-in slot portion 56 (position No. 4), the upper end of this slot portion engaging the pin 15 and shifting the control rod 12 downwardly to its neutral position, the lower end 65 of the guide 46 engaging the upper end 70 of the body 10. The tubing string can now be lowered to carry the running-in and retrieving tool C and the well packer A down the casing to a new location.

If it is again desired to release the tool C from the well packer A, a left-hand torque is taken on the tubing string and the latter elevated slowly to elevate the housing 28, which will cause the pin 15 to move relatively to the left of the upper running-in slot 56 and against the vertical wall 60*a* of the release slot 60. If the operator wishes to assure himself that the pin 15 is in the vertical release slot 60, he need merely lower the tubing string D and housing 28. With the pin in the releasing slot, the control rod 12 will have shifted to its neutral position, whereupon downweight imposed upon the tubing string D and the housing 28 will cause the housing to anchor the well packer A against downward movement in the casing. The operator now elevates the tubing string and housing, the pin 15 moving relatively downward from the releasing slot 60 and out through the existing slot 61 to a fully released position, in which the housing can be elevated entirely above the pin 15 and the control rod head 13.

It is to be noted that the upper end of the running-in slot 56 is substantially lower than the upper end of the locating slot portion 54 and of the releasing slot portion 60. This arrangement is provided so that the pin 15 within the running-in slot portion 56 will be engaged by the sleeve structure 48 to effect downward shifting of the control rod 12 within the body 10 to the neutral and non-slip setting position. On the other hand, the locating slot portion 54 and the releasing slot portion 60, by extending much higher in the sleeve structure 48, allows the lower end 65 of the guide 46 to engage the body 10 and anchor the upper slips 18 against the casing before the pin 15 can engage such upper ends of the slots 54, 60, and shift the control rod 12 downwardly in the housing to a neutral position. Thus, the operator is given a positive indication, by the fact that downward weight anchors the packer A against downward movement, that the pin 15 is in the locating slot portion 54 or in the releasing slot portion 60.

With the slot construction disclosed in Fig. 3, the movement of the pin 15 from the releasing slot portion 60 and out through the exit slot portion 61 imposes a left-hand torque on the tubing string D. With the slot con-

struction shown in Fig. 4, such left-hand torque is eliminated. Instead of causing the release slot portion 60 to merge into an exiting slot portion that is inclined in a downward direction to the right, as shown in Fig. 3, the lower end of the release slot portion merges into an exiting slot portion 61*a*, which is inclined in a downward direction toward the left, such as shown in Fig. 4. Thus, once the pin 15 has been located in the releasing slot portion 60, the elevation of the tubing string D and housing 28 will cause the pin to engage a guiding surface 61*b* formed on the intermediate sleeve portion 49, that is inclined in a downward direction to the left, as seen in Fig. 4, which will automatically rotate the housing 28 to the left without the necessity for turning the sub 27 and the tubing string D, since the overrunning clutch 29*a*, 28*a* will permit the housing to rotate ahead of the sub. Thus, the pin 15 will move out through the exit slot portion 61*a* against a vertical locating wall 61*c* on the intermediate housing structure 49, which is in alignment with the entrance slot portion 52. The operator need merely elevate the tubing string D and housing 28 to cause the pin 15 to slide relatively downward along the wall 61*c* completely out of the housing.

It is, therefore, apparent that running-in and retrieving apparatus for a well packer, or similar well tool, have been provided which give the operator a positive indication that the pin 15 of the well packer is in a releasing position. With the form of the slot disclosed in Fig. 4, this purpose is achieved, but the imposition of a reverse torque on the tubing string, as in the Fig. 3 embodiment of the invention, is avoided.

The inventor claims:

1. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin: a member adapted to be connected to a running-in string and adapted to be moved alongside the device and its coupling pin; said member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having a generally vertical pin retaining slot portion extending upwardly from and communicating with said intervening inclined slot portion and offset circumferentially from said locating slot portion in a direction away from said entrance portion; said structure further having a generally vertical release slot portion extending upwardly substantially above the upper end of said pin retaining slot portion and communicating with said pin retaining slot portion and circumferentially offset from said pin retaining slot portion in a direction away from said entrance portion; said structure further having an exit portion below and communicating with said release slot portion and through which the pin can move relatively downward completely out of said structure.

2. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin; a member adapted to be connected to a running-in string and adapted to be moved alongside the device and its coupling pin; said member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having a generally vertical pin retaining slot portion extending upwardly from and communicating with said intervening inclined slot portion and offset circumferentially from said locating slot portion in a direction away from said entrance portion; said structure further having a generally vertical release slot portion extending upwardly substantially above the upper end of said pin retaining slot portion and communicating with said pin retaining slot portion and circumferentially offset from said pin retaining slot portion in a direction away from said entrance portion; said structure further having an exit slot portion below and communicating with said release slot portion and through which the pin can move relatively downward completely out of said structure, said exit slot portion being inclined downwardly in a direction toward said entrance portion.

3. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin: a member adapted to be connected to a running-in string and adapted to be moved alongside the device and its coupling pin; said member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having a generally vertical pin retaining slot portion extending upwardly from and communicating with said intervening inclined slot portion and offset circumferentially from said locating slot portion in a direction away from said entrance portion; said structure further having a generally vertical release slot portion extending upwardly substantially above the upper end of said pin retaining slot portion and communicating with said pin retaining slot portion and circumferentially offset from said pin retaining slot portion in a direction away from said entrance portion; said structure further having an exit slot portion below and communicating with said release slot portion and through which the pin can move relatively downward completely out of said structure, said exit slot portion being inclined downwardly in a direction away from said entrance portion.

4. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin: a member adapted to be connected to a running-in string and adapted to be moved alongside the device and its coupling pin; said member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having a generally vertical pin retaining slot portion communicating with said intervening inclined slot portion and offset circumferentially from said locating slot portion in a direction away from said entrance portion; said structure further having a generally vertical release slot portion extending upwardly substantially to the same height as said locating slot portion and communicating with said pin retaining slot portion and circumferentially offset from said pin retaining slot portion in a direction away from said entrance portion; said structure further having an exit slot portion below and communicating with said release slot portion and through which the pin can move relatively downward completely out of said structure, said exit slot portion being inclined downwardly in

a direction away from said entrance portion and exiting into said entrance portion.

5. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin; a member adapted to be connected to a running-in string and adapted to be moved alongside the device and its coupling pin; said member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having generally vertical upper and lower pin retaining slot portions extending above and below and communicating with said intervening inclined slot portion and offset circumferentially from said locating slot portion in a direction away from said entrance portion; said structure further including a generally vertical release slot portion extending substantially above the upper end of said upper retaining slot portion and communicating with said retaining slot portion, said release slot portion being circumferentially offset from said retaining slot portions in a direction away from said entrance portion; said structure further having an exit portion below and communicating with said release slot portion and through which the pin can move relatively downward completely out of said structure.

6. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin: a member adapted to be connected to a running-in string and adapted to be moved alongside the device and its coupling pin; said member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having a generally vertical pin retaining slot portion below and communicating with said intervening inclined slot portion and offset circumferentially from said locating slot portion in a direction away from said entrance portion, said structure closing the lower end of said pin retaining slot portion to confine the pin therein; said structure further having a generally vertical release slot portion extending upwardly substantially to the same height as said locating slot portion and communicating with said pin retaining slot portion and circumferentially offset from said pin retaining slot portion in a direction away from said entrance portion; said structure further having an exit portion below and communicating with said release slot portion into which the pin can move relatively downward completely out of said structure said exit slot portion being inclined downwardly in a direction away from said entrance portion and exiting into said entrance portion.

7. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin; a member adapted to be connected to a running-in string and adapted to be moved alongside the device and its coupling pin; said member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having a generally vertical pin retaining slot portion above and communicating with said intervening inclined slot portion and offset circumferentially from said locating slot portion in a direction away from said entrance portion, said structure closing the upper end of said pin retaining slot portion to confine the pin therein below the upper end of said locating slot portion; said structure further including a generally vertical release slot portion extending substantially above the upper end of said retaining slot portion and communicating with said retaining slot portion, said release slot portion being circumferentially offset from said retaining slot portion in a direction away from said entrance portion; said structure further having an exit portion below and communicating with said release slot portion and through which the pin can move relatively downward completely out of said structure.

8. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin; a first member adapted to be connected to a running-in string; a second member operatively connected to said first member for movement longitudinally therewith and adapted to be moved alongside the device and its coupling pin; a one-way clutch for transmitting rotation of said first member to said second member; said second member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having a generally vertical pin retaining slot portion extending upwardly from and communicating with said intervening inclined slot portion and offset circumferentially from said locating slot portion in a direction away from said entrance portion; said structure further having a generally vertical release slot portion extending upwardly substantially above the upper end of said pin retaining slot portion and communicating with said pin retaining slot portion and circumferentially offset from said pin retaining slot portion in a direction away from said entrance portion; said structure further having an exit portion below and communicating with said release slot portion and through which the pin can move relatively downward completely out of said structure.

9. In apparatus as defined in claim 8; wherein said one-way clutch includes axially extending ratchet teeth on said second member; and axially extending ratchet teeth on said first member movable into and out of engagement with said teeth on said second member upon longitudinal movement of said first member relative to said second member.

10. In apparatus for moving a device in a well bore, the device having a laterally extending coupling pin: a member adapted to be connected to a running-in string and adapted to be moved alongside the device and its coupling pin; said member having a slotted structure therein including an entrance portion to receive the pin and a locating generally vertical slot portion above and circumferentially offset from said entrance portion and communicating therewith; an inclined guiding wall below said locating slot portion to engage and guide the pin relatively circumferentially away from said entrance portion; said guiding wall defining the lower side of an intervening slot portion inclined in a downward direction circumferentially away from said entrance portion; said structure having a generally vertical pin retaining slot portion extending upwardly from and communicating with said intervening inclined slot portion and offset

circumferentially from said locating slot portion in a direction away from said entrance portion; said structure further having a generally vertical release slot portion extending upwardly substantially above the upper end of said pin retaining slot portion and communicatng wth said pin retaining slot portion and circumferentially offset from said pin retaining slot portion in a direction away from said entrance portion; said structure further having an exit slot portion below and communicating with said release slot portion and through which the pin can move relatively downward completely out of said structure,



said exit slot portion being inclined downwardly in a direction away from said entrance portion and exiting into said entrance portion.

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