Sept. 19, 1944. I. A. MILLER 2,358,466

WELL TOOL

Filed Sept. 12, 1940 2 Sheets-Sheet 1

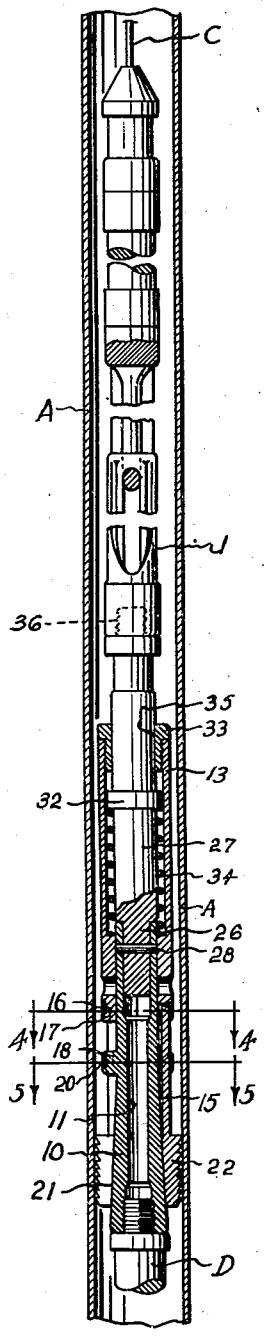


Fig. 1.

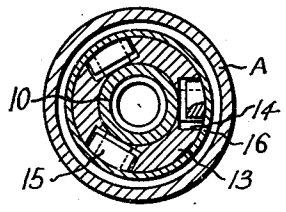


Fig. 4.

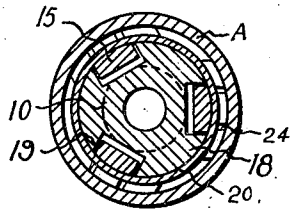


Fig. 5.

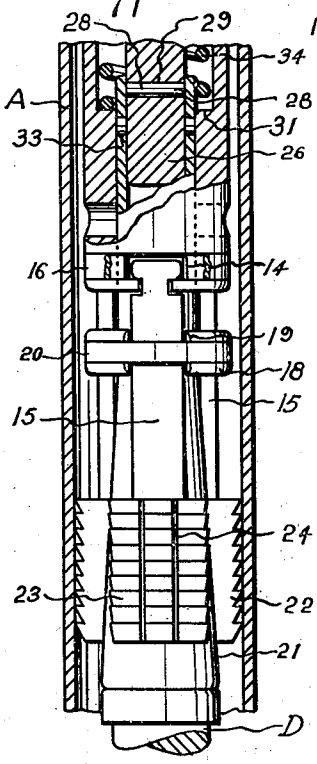


Fig. 2.

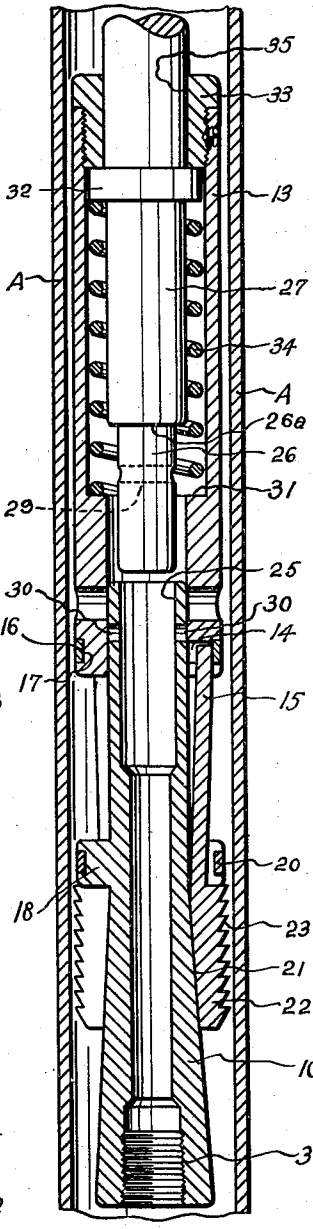


Fig. 3.

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WELL TOOL

Filed Sept. 12, 1940 2 Sheets-Sheet 2

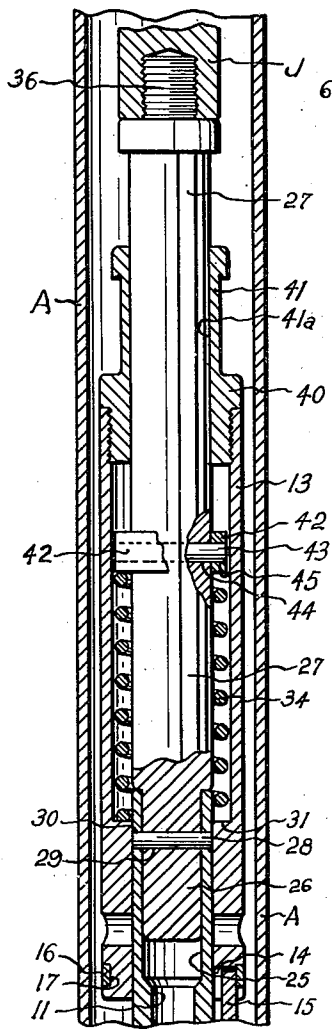


Fig. 6.

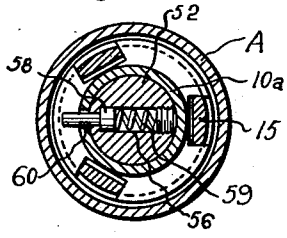


Fig. 9

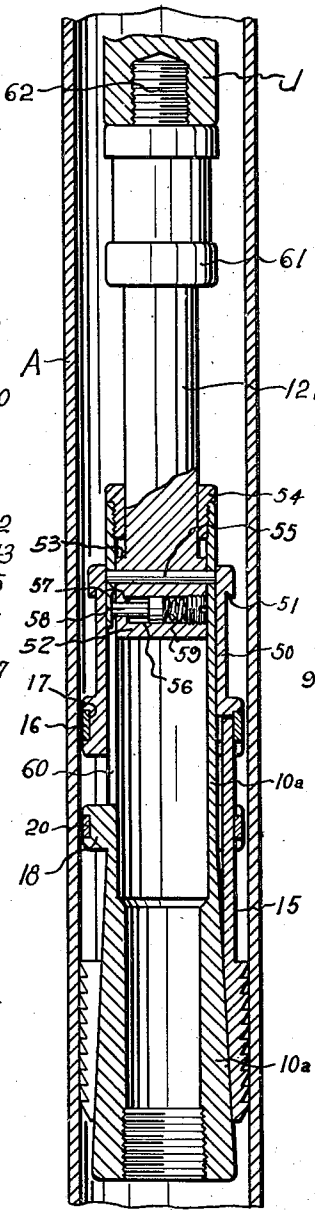


Fig. 7.

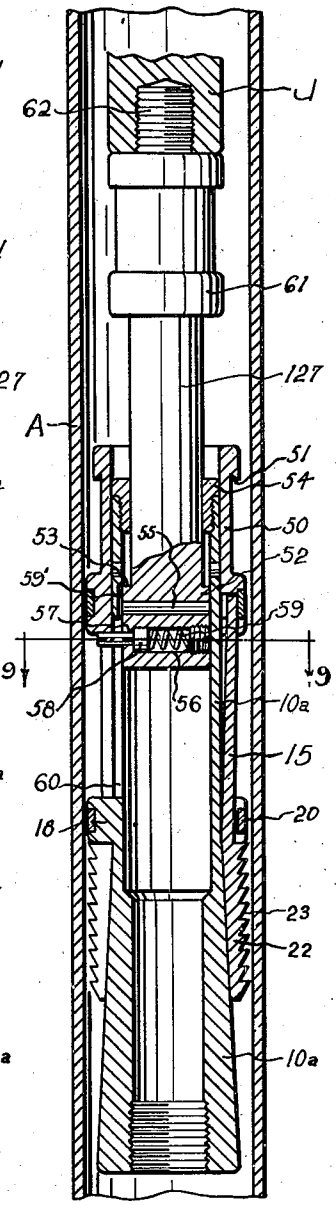


Fig. 8.

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2,358,466

WELL TOOL

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Application September 12, 1940, Serial No. 356,405

5 Claims. (Cl. 166—1)

This invention relates to new and useful improvements in well tools.

One object of the invention is to provide an improved well tool which may be run into a well on a flexible line, such as a wire line or cable, against the upwardly flowing well fluids, and which is arranged to be connected with a bottom hole well device, such as a tubing or casing perforator, paraffin scraper, pressure bomb, or the like.

An important object of the invention is to provide an improved running tool which may be lowered through the well bore on a flexible line and which, in the event that an excessive well pressure, or an upward surge of the well fluid, occurs, has means for automatically locking or arresting the tool against upward movement during the lowering operation, thereby obviating the danger of the device being blown or forced upwardly from the well bore.

Another object of the invention is to provide an improved running tool, of the character described, having locking or arresting means which ride on the wall of the well bore or tubing and in a non-gripping position as the tool is lowered therethrough, said means being arranged to immediately and automatically assure a gripping position upon upward movement of the tool, whereby further upward displacement thereof is prevented during the lowering operation; the locking means being so constructed that it may be retracted from a gripping position engagement at any time by manipulation from the surface so as to permit removal of the tool from the well bore or tubing.

A particular object of the invention is to provide an improved tool, of the character described, having retractible gripping means mounted on a support, together with a connecting element which is normally and releasably secured to the support and which may be utilized to lower the tool through the well bore; said connecting element being constructed so that, upon its being released or disconnected from the support, it will co-act with the locking means to effect retraction of said means to permit withdrawal of the tool from the well bore.

Still another object of the invention is to provide a running tool, wherein the connecting element which is releasably connected to the support and which is arranged to co-act with the retractible locking means to effect withdrawal of the tool, may be detachably connected with the locking means, whereby, if for any reason the locking means cannot be dislodged from its locked position by said connecting element, the connecting element may be released from the locking means and removed individually, after which the support and locking means may be removed by other means.

A still further object of the invention is to provide an improved running tool, of the character described, for lowering well devices downwardly through the upwardly flowing well fluids within a well bore, said tool being constructed so that a jarring element may be associated therewith, whereby the device may be set and released by manipulating the flexible line.

A still further object of the invention is to provide an improved device of the character described, which may be lowered into the well and locked therein at a desired depth, said device being constructed so that it may be unlocked and lowered for additional well operations, whereby removal of the device from the well in order to reset the same at another position and prior to completion of all desired well operations, is not necessary.

A construction designed to carry out the invention will be hereinafter described together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is a view, partly in elevation and partly in section, of an improved running tool, constructed in accordance with the invention and showing the same being lowered through a well tubing,

Figure 2 is an enlarged view of the lower portion of the tool in a gripping position,

Figure 3 is a view, partly in elevation, and partly in section, showing the tool being removed from the tubing,

Figure 4 is a horizontal, cross-sectional view taken on the line 4—4 of Figure 1,

Figure 5 is a horizontal, cross-sectional view taken on the line 5—5 of Figure 1,

Figure 6 is a view, partly in elevation and partly in section of the upper portion of a modified form of the invention,

Figure 7 is a view, similar to Figure 1, of another form of the invention, with the parts in their respective positions during the lowering operation,

Figure 8 is a similar view, illustrating the modified tool being removed from the tubing, and

Figure 9 is a horizontal, cross-sectional view taken on the line 9—9 of Figure 8.

This application is filed as a continuation-in-part of my co-pending application, Serial No. 284,417, filed July 14, 1939, which application has now matured as Patent No. 2,287,319, granted June 23, 1942.

In the drawings, the numeral 10 designates an elongate mandrel or support having an axial bore 11 extending therethrough. The upper portion of the outer surface of the mandrel is substantially cylindrical and a slip supporting sleeve or carrier 13 is slidable longitudinally on this portion. The lower portion of the sleeve has a plurality of radial T-shaped slots 14 therein, which slots are spaced equidistant therearound and the upper ends of gripping elements 15, which upper ends are also T-shaped (Fig. 2), are inserted within said slots. A retaining ring 16 which fits within an annular groove 17 formed in the periphery of the sleeve 13, surrounds the sleeve and prevents outward displacement of each gripping element from its slot. Manifestly, the gripping elements are suspended from the sleeve 13 and are movable longitudinally and radially with relation to the mandrel.

For limiting the downward movement of the sleeve on the mandrel, the latter is formed with an external flange 18, preferably integral therewith. As is clearly shown in Figure 2, the flange is provided with a slot 19 for each gripping element, whereby the gripping elements extend downwardly past said flange. A confining ring 20 surrounds the flange and confines the elements within the slots of said flange, whereby said gripping elements are retained in close proximity to the outer surface of the mandrel. As is clearly shown in Figure 2, as well as in Figures 4 and 5, the gripping elements are spaced from each other, whereby vertical fluid passages are formed therebetween to permit a relatively free flow of fluid around the outside of the mandrel.

Immediately below the flange 18, the surface of the mandrel is flared or inclined outwardly to form a clip expanding portion 21. Each gripping element 15 includes an arcuate slip 22 at its lower end and the inner surface of each slip engages and rides upon the inclined surface 21 of the mandrel. The outer surface of each slip is formed with gripping teeth 23 which are adapted to engage the inner wall of a well tubing A to prevent upward displacement or movement of the assembly, as will be explained. When the slips 22 are at the upper end of the inclined portion 21 (Fig. 3), and immediately below the flange 18, they are retracted and out of engagement with the tubing wall; however, movement of the mandrel upwardly with relation to the slips causes outward radial movement of the slips to the position shown in Figures 1 and 2, whereby said slips engage the tubing wall. In such position, the assembly cannot be displaced upwardly within the tubing. Vertical grooves 24 may be formed in the outer surface of each slip and extend throughout the length thereof to provide additional fluid passages.

The upper end of the bore 11 of the mandrel 10 is enlarged as shown at 25 and receives a reduced shank 26, which is formed on the lower end of an elongate, cylindrical rod or connecting element 27. An annular shoulder 26a is formed at the intersection of the shank and rod. The shank 26 is releasably connected to the mandrel by a releasable means, such as a frangible shear pin 28, which extends through a diametrically disposed opening 29 in the shank and through radial openings 30 formed in the mandrel, and when so connected, the shoulder 26a engages the upper end of the mandrel. The elongate rod or connecting element 27 extends upwardly from the upper end of the mandrel 10 and is disposed within the sleeve 13. As is clearly shown in Figure 1, the sleeve 13 extends upwardly for some distance above the mandrel 10 and the extended portion of said sleeve has its bore enlarged, whereby an upwardly facing internal annular shoulder 31 is formed within said sleeve. That portion of the cylindrical rod or connecting element 27 which is within the sleeve 13 is provided with an external annular flange or collar 32 which is preferably formed integral with the connecting element. The upper end of the sleeve is closed by a cap 33 which is threaded thereinto and when the shear pin 28 is connecting the element to the mandrel, the bottom of this cap is spaced from the top of the collar 32. A coiled spring 34 is confined between the collar or flange 32 and the internal shoulder 31 within said sleeve, said spring surrounding the connecting rod or element 27. The spring 34 constantly exerts its force to urge the slip carrying sleeve 13 downwardly, whereby the gripping elements having the slips 22 at their lower ends are urged downwardly and outwardly along the slip expanding portion 21 of the mandrel.

The upper end of the connecting element 27 extends through the bore 35 of the cap 33 and the extreme upper end thereof is provided with an upstanding pin 36 (Fig. 6), whereby the connecting element 27 may be connected with a jarring device J or in the event a jarring device is not employed, with a flexible line or cable.

In the operation of the device, the tool is assembled, as shown in Figure 1, and a suitable well device D, such as a tubing perforator, pressure bomb or other bottom hole instrument, is connected to the lower end of the mandrel, such connection being made by means of screw threads 37 or other means which are provided at the lower end of the bore 11 of the mandrel. The device may be lowered through the tubing while the well fluids are flowing upwardly therein and during the lowering operation the parts are in the position shown in Figure 1, the device being suspended from a flexible line or cable C. The well fluids may freely by-pass the assembly, flowing upwardly through the spaces between the gripping elements 15.

During the lowering operation, the arcuate slips 22 are at the lower end of the mandrel in their expanded position and contact the wall surface of the bore of the tubing A, but since said device is moving downwardly, and also due to the shape and disposition of the teeth 23 of the slips, said slips do not grip the wall surface but merely ride therealong. The coiled spring 34, which is exerting its pressure downwardly on the slip carrier 13, is relatively light and serves to hold the slips in an expanded but non-gripping position at the lower end of the inclined portion 21 on the mandrel and thereby prevents the frictional engagement of the slips with the tubing wall from moving said slips upwardly to a retracted position as the assembly is lowered. Thus, during the lowering of the device, the slips and mandrel move as a unit, with the slips in their outer or expanded position; it is noted however, that the slips are in a non-gripping position during the lowering operation. In the

event that there is any tendency of the device to stick or hang during the lowering of the same, the provision of the jarring device J at the upper end of the connecting element 27 will permit jarring down on the mandrel 10, whereby the assembly may be forced downwardly.

It may occur that during the lowering of the device there may be an upward surge of the well fluid or liquid, or a sudden high pressure may be built up in the tubing below the device. In such event, this pressure would act against the well device D which is attached to the lower end of the mandrel 10, whereby said mandrel, as well as the entire assembly, would be urged upwardly by the pressure. As explained, the slips are at the lower portion of the inclined portion of the mandrel in their expanded position in engagement with the tubing wall. Any upward thrust against the mandrel tending to move said mandrel upwardly will result in the slips immediately biting into or gripping the tubing wall A. Such gripping of the tubing by the teeth 23 of the slips prevents an upward movement or displacement of the mandrel and of the device. A continuous force exerted against the underside of the mandrel will act to force the slips into tighter gripping engagement with the tubing. From the foregoing, it will be seen that in the event of an excessive pressure below the device, or of an upward surge of the well fluid during the lowering operation, the slips which are in constant engagement with the tubing wall, will immediately grip the tubing to arrest upward movement of the device and thereby prevent the same from being blown upwardly from the well tubing. It is further noted that, if desired, the assembly may be locked in the well tubing by pulling on the flexible line or cable, whereby the mandrel will be moved uwardly with relation to the slips to expand said slips to locking engagement with the tubing wall.

After the condition which has caused the slips to grip or bite into the tubing has ceased and it is desired to release the slips, it is necessary only to jar downwardly on the rod or connecting element 27, whereby due to the engagement of the shoulder on the connecting element with the upper end of the mandrel, the mandrel will be jarred downwardly relative to the slips which are engaging the wall of the tubing. Such downward movement of the mandrel 10 with relation to the slips, whereby the slips are moved toward the smaller upper end of the inclined portion 21 of the mandrel, will result in a retraction of said slips to disengage the teeth thereof from their gripping position with the tubing wall, after which the lowering of the device may be continued.

After the well device D, which is carried by the improved assembly, has been lowered to its proper position and the well operation completed, it is desirable to remove the assembly from the tubing. To accomplish this removal, if the assembly is not already locked or set in the well tubing either by well pressure or flowing fluids or, has been described, by manipulation of the flexible line, it is necessary to pull upwardly on the flexible line or cable to which the element 27 is connected, whereby an upward pull is transmitted to the mandrel 10 through the connecting element 27. Such upward movement of the mandrel causes the teeth of the slips 22 to grip the tubing wall and arrest further upward movement of the assembly. Continued upward pull on the connecting element, or an upward jarring on said element may be produced by manipulating the wire line, and such upward jarring will shear the pin 28 to disconnect the element or rod 27 from the mandrel. A downward jar is then imposed on the mandrel 10 through the shoulder on the connecting element 27 striking the upper end of said mandrel and this jar moves the mandrel downwardly with relation to the slips until the flange 18 on said mandrel strikes the upper end of the slips, as is clearly shown in Figure 3. In such position, the slips are retracted and the external flange or collar 32 on the element 27 engages the underside of the cap 33. After the flange 32 has engaged the cap 33, upward movement on the connecting element results in a withdrawal of the entire assembly from the tubing.

From the foregoing, it will be seen that a simple and effective running tool is provided. The device may be readily run into, locked and removed from the well on a wire line during a single trip into the well, whereby time and labor is minimized. During the lowering operation, the slips 22 are in their expanded position but the shape of the slip teeth is such that no gripping of the tubing by said slips occurs to prevent downward movement. In case of an upward force being exerted on the assembly, the slips immediately and automatically bite into or grip the tubing wall to arrest upward movement and thereby prevent unintentional upward displacement of said device. The arrangement permits the slips to be disengaged from their gripping position to continue the lowering operation after the upward force on the assembly ceases. When it is desired to remove the device, it is necessary only to disconnect the element 27 from the mandrel 10 by shearing the pin 28, after which jarring downwardly on the mandrel releases or retracts the slips. After the slips are retracted an upward pull on the connecting element results in a removal of the entire assembly from the well tubing. It is particularly noted that the running tool may be employed for running various bottom hole devices into the well and for removing the same therefrom.

In some instances, it might occur that after the pin 28 has been sheared, a downward jar on the element 27 will not be sufficient to retract the slips 22. In such case, it would be desirable to first remove the connecting element separately from the mandrel and slip assembly, and for this purpose, a construction, shown in Figure 6, is adaptable. In this form of the invention, a cap member 40 is substituted for the cap 33 which is mounted within the upper end of the sleeve 13. The cap 40 is provided with a retrieving connection 41 which surrounds the connecting element 27. Instead of providing the element 27 with the integral collar 32, a slidable collar 42 surrounds the element and is disposed within the sleeve 13, such collar being connected to the element 27 by means of a frangible pin 43 which extends through a diametrically disposed opening 44 in the element and also through openings 45 in said collar.

In the operation of this form of the invention, the same procedure is followed as hereinbefore described. However, if after the element 27 has been disconnected from the mandrel and it is found that it is impossible to release or retract the slips 22, then the pin 43 may be sheared by an upward pull or jar on the connecting element 27. When this pin is sheared, it is possible to remove the connecting element or rod 27 from

the well tubing, said element sliding through the bore 41a of the cap 40. After the connecting rod or element 27 is removed, a suitable retrieving tool (not shown) may be lowered downwardly into the well to engage the retrieving connection 41. Through the use of the proper retrieving tool, which may be similar to the tool illustrated in the patent to H. C. Otis No. 1,898,261, the slips 22 may be moved upwardly from their gripping position and the device removed from the well.

Another form of the invention is shown in Figures 7 to 9. In this form, the mandrel and slip assembly operate in substantially the same manner as the forms hereinbefore described. However, in place of the mandrel 10, a mandrel 10a, similar in construction to the mandrel 10, is employed. A short sleeve 50 is substituted for the sleeve 13 which is shown in the first two forms, and this sleeve is provided with an annular flange 51 at its upper end, said flange having its underside undercut to provide a retrieving connection. The sleeve 50 is slidable on the upper portion of the mandrel and carries the gripping elements 15, as has been described.

The bore of the mandrel 10a receives the lower end of a connecting element 127, which element is substituted for the connecting element 27 of the other forms. The connecting element 127 is enlarged at its lower end and this enlarged lower end 52 has a sliding fit within the bore of the mandrel 10a. The enlargement of the lower end of the element 127 results in the formation of an external annular shoulder 53 on said connecting element. The connecting element 127 extends through a bushing 54 which is threaded into the upper end of the mandrel 10a and this bushing prevents upward displacement of the connecting element 127 from the bore of the mandrel. Normally, the enlarged portion 52 of the element 127 is connected to the mandrel in the position shown in Figure 7 by a suitable releasable means which is illustrated as a shear pin 55.

Below the shear pin 55, the enlarged portion 52 of the element 127 is provided with a diametrically extending opening 56 which has one end reduced to provide an internal shoulder 57. A spring-pressed plunger 58 is mounted within the opening 56 and is constantly urged radially outwardly by a coiled spring 59. When the shear pin 55 is connecting the element 127 with the mandrel 10a, the outer end of the plunger 58 is engaged within a recess or keyway 59' which extends vertically within the wall of the bore of the mandrel. The keyway 59' is alined vertically with an elongate vertical slot 60 which is provided within the wall of the mandrel, said slot extending downwardly from the keyway to a point just above the flange 18 on said mandrel. The purpose of the keyway is to maintain the plunger 58 in alinement with the slot 60 which extends through the wall of the mandrel. The upper end of the connecting element 127 is formed with an enlarged head 61 and this head has an upstanding pin 62 thereon, whereby the element 127 may be connected either to a jarring device or to the flexible line or cable.

The operation of this form of the invention is very similar to the operation of the other forms. During lowering of the device the parts are in the position shown in Figure 7, with the teeth of the slips engaging the tubing wall and riding downwardly thereon. In the event of an upward force or pressure being exerted against the lower end of the mandrel 10a, the slips immediately grip the tubing wall whereby unintentional upward displacement of the assembly is prevented.

When it is desired to remove the device, an upward jar is exerted on the element 127 so as to shear the pin 55 and disconnect the element 127 from the mandrel 10a. Such upward jar will of course serve to set the slips or to move the same into their gripping position. The connecting element 127 is then moved downwardly through the bore of the mandrel 10a and as said element moves downwardly relative to the mandrel, the plunger 58 moves out of the keyway and into the slot 60, said plunger engaging the bore of the sleeve 50 which is of course, surrounding the upper portion of the mandrel. A continued downward movement of the element 127 will result in the plunger moving downwardly in the slot until it passes beneath the lower end of the sleeve 50 and as soon as this occurs, the spring 59 moves said plunger outwardly beneath said sleeve, the flange on the inner end of the plunger limiting the travel of the plunger, to prevent complete ejection from the element 127. By the time the plunger has moved beneath the lower end of the sleeve 50, the bottom of the head 61 at the upper end of the connecting element has engaged the upper end of the cap 54 which is threaded into the mandrel. Obviously, a downward jar on the connecting element 127 will be imparted through the engagement of the head 61 with the upper end of said mandrel, whereby the mandrel is jarred downwardly to effect release of the slips from the tubing wall, and thereby move the parts to the position shown in Figure 8. Thereafter, an upward pull on the element 127 will result in withdrawal of the entire assembly.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A well tool including, a support adapted to be lowered into a well pipe, gripping means slidable on and confined against displacement from the support, the gripping means being normally in a non-gripping position to permit lowering of the tool, means on said support coacting with said gripping means for urging and holding the same in gripping position upon relative upward movement of the support, a carrier slidable on said support and having the gripping means mounted thereon, a connecting element, a collar on the connecting element, means on the carrier overlying the collar, means detachably connecting said element to the support whereby the element may be detached from said support by an upward pull on said element when the gripping means are in gripping position, such disconnection of the element permitting the same to undergo limited movement relative to the support and carrier, whereby said element may be utilized to jar down on said support to release the gripping means and may then be moved upwardly to engage its collar with the overlying means of the carrier and effect removal of the entire assembly from the well pipe, and means detachably connecting the collar to the element, whereby said collar may be detached to permit removal of said element from the support and gripping means.

2. A well tool as set forth in claim 1 together with means confined between the collar and carrier for urging said carrier downwardly relative to the support so as to move the gripping means into engagement with the well pipe and the coacting means of said support.

3. A well tool as set forth in claim 1 together with resilient means surrounding the support and engaging the carrier so as to urge the same downwardly relative to said support and move the gripping means into engagement with the well pipe and the coacting means of the support.

4. A well tool for lowering a well device into a well casing or tubing including, a mandrel, a connecting element having a flexible line attached thereto, gripping slips slidable on the mandrel and confined against displacement therefrom, said slips being normally in a non-gripping position to permit lowering of the tool, means on said mandrel coacting with the slips for urging and holding the same in gripping position upon relative upward movement of the mandrel, a sleeve-like carrier from which the slips are suspended surrounding said mandrel and also surrounding a portion of the connecting element, a collar on said element within the carrier and spaced from the top thereof, means formed at the top of said carrier overhanging the collar, means detachably connecting the element to the mandrel whereby said element may be detached from said mandrel by an upward pull on the element when the slips are in a gripping position, such disconnection of said element permitting the same to undergo limited movement relative to the mandrel and carrier, whereby the element may be utilized to jar down on said mandrel to release the slips and may then be moved upwardly to engage its collar with the overhanging means of the carrier and effect removal of the entire device from the well bore, and means detachably connecting the collar to said element, whereby said collar may be detached to permit removal of the element separately from said mandrel and slips.

5. A well tool as set forth in claim 4 together with a coiled spring confined upon the mandrel between the collar and the carrier for urging said carrier downwardly relative to said mandrel so as to move the slips into engagement with the coacting means of the mandrel and into gripping position.

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