

Jan. 12, 1954

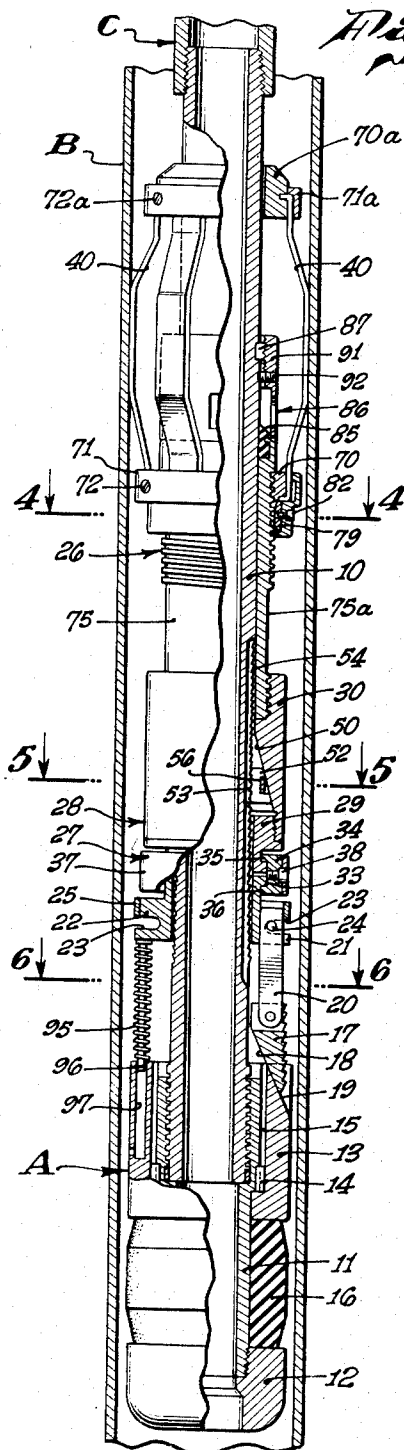
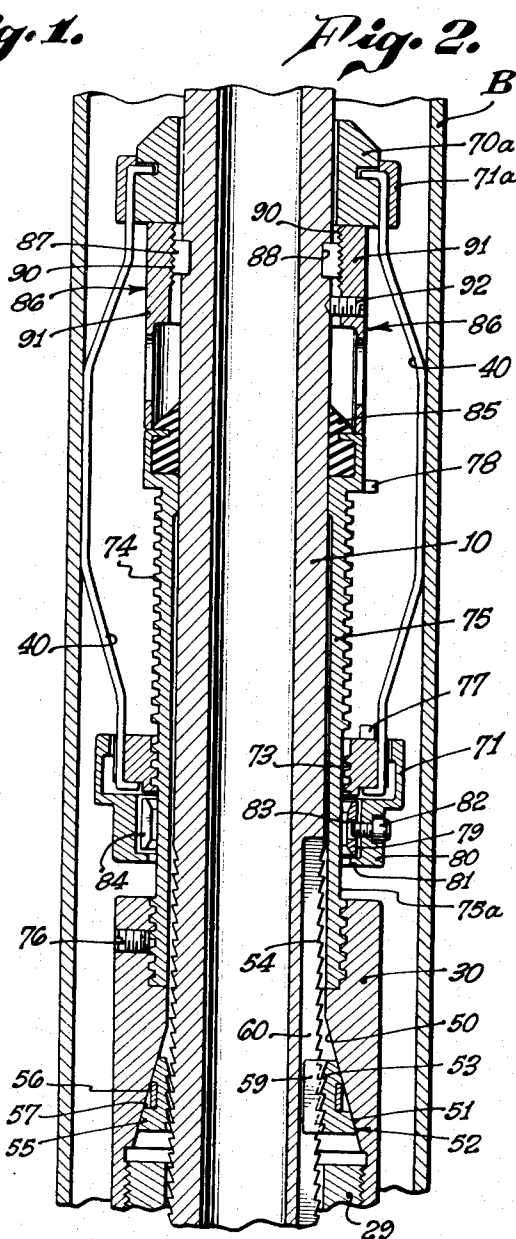
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2,665,764

RETRIEVABLE SUBSURFACE WELL TOOL

Filed Jan. 6, 1950

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

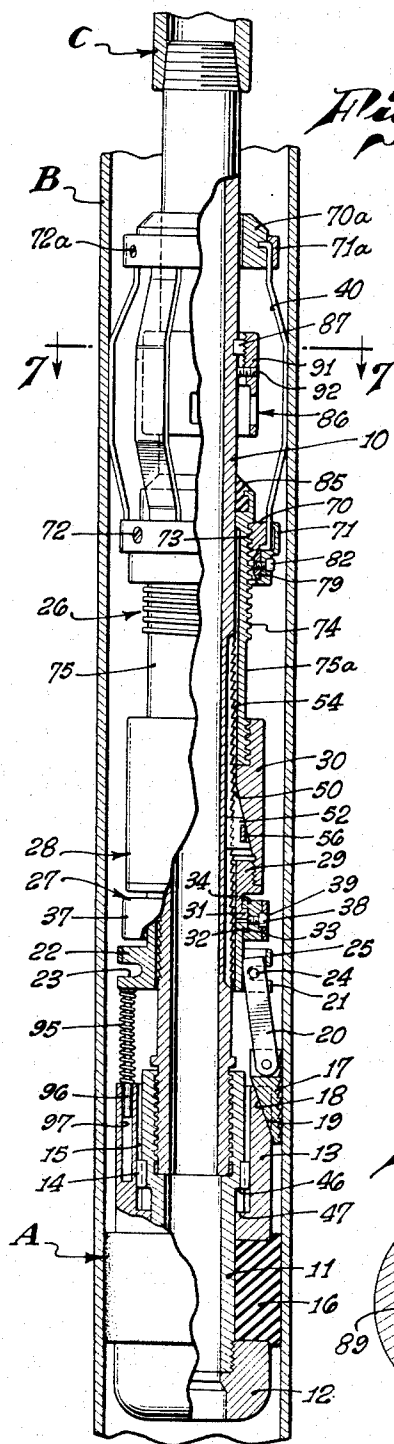


Fig. 3.

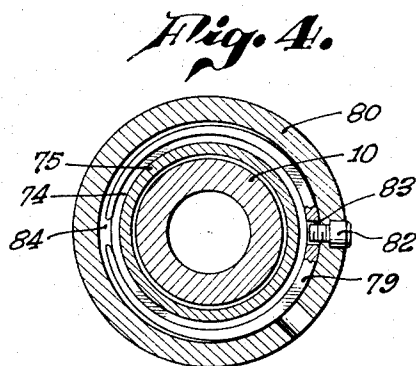


Fig. 4.

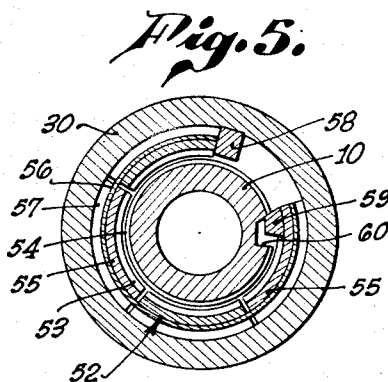


Fig. 5.

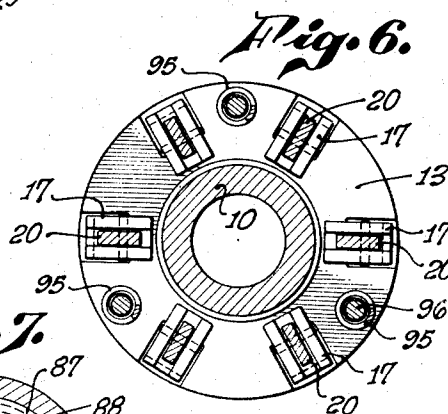
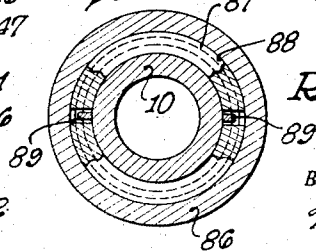


Fig. 6.

Fig. 7.



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RETRIEVABLE SUBSURFACE WELL TOOL

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18 Claims. (Cl. 166—12)

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The present invention relates to subsurface well tools, and more particularly to tools useful in the performance of cementing, acidizing, washing, testing, anchoring, production and other operations in well bores.

The operation of certain types of well tools is accomplished by moving their parts relatively to each other through the manipulation of tubular strings to which the tools are attachable. As an example, the tubular string may be manipulated for shifting casing engaging slips along a cooperable expander and outwardly against a well casing. The relative movement may be obtainable by resisting or preventing movement of one or more of the tool parts through the use of instrumentalities engaging the wall of the well conduit or formation. These instrumentalities may include friction springs and the like that are slidable along the conduit wall. Although resistance to movement is required during the performance of some of the operations in the well bore, such resistance is not always desirable. To illustrate, removal of the well tool from a casing is expedited if the tubing or drill joints are unscrewed by holding the section above the rotary table stationary and rotating the remainder of the tubular string and the well tool in the hole. This rotation also revolves the casing engaging instrumentalities, such as friction drag springs, sliding or dragging them around and along the casing wall, with potential damage to the instrumentalities and to other parts of the well tool.

An object of the invention is to provide a tool embodying a drag device for controlling operation of the tool, in which improved means are available for insuring the uncoupling of the drag device from the remainder of the tool, in order that the drag device need not be rotated during rotation of the tubular string secured to the tool.

Another object of the invention is to provide a well tool including casing engaging slips and a casing engaging drag device for controlling expansion and retraction of the slips against and from a well casing, in which improved means are provided for releasing the drag device, to permit rotation of the tool without rotating the drag device around the wall of the casing.

The aforementioned drag device may be threadedly connected to other portions of the tool when the drag device is in operative position. The drag device is unthreaded completely from such other portions to effect its uncoupling therefrom. The weight of certain parts of the tool may cause their engagement with the threaded portion of the drag device after the latter has been uncoupled, causing potential damage to the threads of the drag device during rotation of the tool in the well bore.

Accordingly, a further object of the invention is to prevent or minimize such engagement with the drag device threads after the latter has been uncoupled from the remainder of the tool.

Yet another object of the invention is to counterbalance the weight of slips and associated elements in a well tool to offset any tendency for the slips to shift inadvertently to expanded position.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It 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 longitudinal section, with parts in elevation, of a retrievable well packer disposed within a casing, with the packer parts in retracted position;

Fig. 2 is an enlarged longitudinal section through the drag and lock portion of the tool, with the drag device rotatably uncoupled from the remainder of the tool;

Fig. 3 is a view similar to Fig. 1 of the well packer anchored in packed-off condition within the well casing;

Fig. 4 is a cross-section taken along the line 4—4 on Fig. 1;

Fig. 5 is a cross-section taken along the line 5—5 on Fig. 1;

Fig. 6 is a cross-section taken along the line 6—6 on Fig. 1;

Fig. 7 is a cross-section taken along the line 7—7 on Fig. 3.

The invention is exemplified in the drawings as applied to a well packer A of the retrievable type. It is to be understood, however, that the invention is also applicable to other well tools, and for controlling elements other than slips and packings hereinafter referred to.

The packer A is adapted to be run in a well bore or casing B on the end of a tubular running-in string C threadedly, or otherwise attached, to the upper end of the tubular mandrel or body portion 10 of the packer. The lower end of this mandrel or body portion 10 is threaded into the upper end of a lower tubular packer body 11, to which is attached a packing actuator 12 in the form of a guide.

A tapered expander 13 is mounted on the body part 11. It is preferably prevented from turning with respect to the latter by a key 14 secured to the exterior of the body and received within

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a keyway 15 in the expander; so as to permit relative longitudinal movement between the body 11 and expander 13 while preventing rotation therebetween. When the tubular string C and body 10, 11 are elevated, the packing actuator 12 is moved toward the expander 13 to compress an intervening packing sleeve 16, surrounding the body, and force it outwardly into engagement with the wall of the casing B. Such actuation of the packing sleeve 16 only occurs when the tapered expander 13 is prevented from moving upwardly, which results from shifting of the expander within a plurality of slips 17, and outward expansion of the latter against the wall of the casing.

The slips 17 have tapered inner surfaces 18 cooperating with companion tapered surfaces 19 on the expander, the inclination of such surfaces being such as to move the slips 17 outwardly toward the casing when the expander 13 is elevated. Conversely, lowering of the expander 13 with respect to the slips 17 permits the latter to release from the casing wall and move inwardly to retracted position.

It is, accordingly, apparent that elevation of the tubular string C and packer body 10, 11 can effect anchoring of the tool, through engagement of the slips 17 with the casing B under the influence of the tapered expander 13. Such elevation can also effect compression or foreshortening of the rubber packing sleeve 16 between the expander 13 and guide 12, to produce its radial outward expansion into sealing engagement with the casing wall.

The slips 17 are held together for joint movement along the tapered expander 13 to and from engagement with the casing B by pin-connecting them to the lower ends of links 20, whose upper ends extend between the fingers 21 of a slip ring 22. This ring is also provided with a peripheral groove 23 into which pins 24, projecting in both directions from the sides of the links 20, may extend, in order to couple all of the links 20 and slips 17 for movement jointly with the slip ring 22. Outward movement of the upper ends of the links 20 is prevented by a stop ring 25 suitably secured to the slip ring 22.

The slip ring is connected to a drag and lock device 26 by a swivel mechanism 27, in order to permit rotation of the slips 17 and slip ring 22 without correspondingly rotating the drag device 26. The main purpose of the drag device 26 is to resist longitudinal movement of the slips 17 within the well casing B.

The drag device 26 includes an outer ratchet member 28, consisting of a lower ring 29 threaded into an upper ratchet sleeve 30. The ratchet ring 29 and slip ring 22 are adjacent one another, and are provided with outwardly directed flanges 31, 32 receivable within an interval circumferential groove 33 in a tie ring 34 having upper and lower inwardly directed flanges 35, 36 disposed above and below the ratchet ring and tie ring flanges 31, 32, respectively. For convenience of assembly, the tie ring 34 may be made in two halves that are moved radially inwardly to dispose the flanges 35, 36 above and below the ratchet ring and slip ring flanges 31, 32. This two-piece tie ring is prevented from coming apart by an encompassing circumferentially continuous sleeve 37, which is prevented from dropping off the ring by one or more screws 38 threaded into the ring and disposed within holes 39 in the sleeve. It is apparent that the tie ring 34 and the flanges 31, 32 on the ratchet ring 29 and slip ring 22

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form a swivel connection 27 between the drag device 26 and the slips 17.

The drag and lock device 26 comprises the outer ratchet members 30, 29, which may slide relatively along the mandrel 10, or be coupled thereto. The sleeve 30 of this member is coupled to the lower end of the drag device 26, which includes a plurality of circumferentially spaced outwardly bowed leaf springs 40, extending upwardly along the mandrel 10, and frictionally engaging the casing B.

The frictional engagement of the springs 40 with the casing B tends to resist longitudinal movement of the slips 17 through the well casing. Upon reaching the desired setting point in the casing, if the tubular mandrel 10 is permitted to move upwardly with respect to the drag device 26, such elevation would also elevate the lower packer body 11, and, through the guide 12 and packing sleeve 16, elevate the expander 13 within the slips 17, since the latter are prevented from moving upwardly by the drag device. Such elevation of the expander 13 forces the slips 17 radially outward into anchoring engagement with the casing wall. With the slips 17 anchored to the casing B, the expander 13 is prevented from moving upwardly. Accordingly, a continuation of the upward movement of the tubular string C and body 10, 11 moves the guide ring 12 toward the expander 13, in order to foreshorten the packing sleeve 16 and shift it into firm sealing engagement with the casing B and the packer body 11.

Lowering of the tubular string C and packer body 10, 11 with respect to the drag device 26 permits retraction of the packing sleeve 16 from the casing, and produces corresponding downward movement of the tapered expander 13, by virtue of engagement of the body shoulder 46 with an expander flange 47, so that the slips 17 are moved inwardly to retracted position. Such inward retraction will occur, since downward movement of the slips is prevented by the friction spring drag device 26.

It is to be noted that upward movement of the tubular body can effect anchoring of the packer A in packed-off condition within the well casing B, and that lowering of these members can effect release of the packer. In order to allow the tubular body 10, 11 to be elevated without anchoring the tool in the well casing, some means is provided for preventing the relative longitudinal movement between the slips 17 and tapered expander 13 upon elevation of the tubular body. In the present instance, such means is afforded by a ratchet or one-way clutch type of lock device disposed between the upper body or mandrel 10 and the ratchet sleeve 30.

The ratchet sleeve 30 has an inner surface 50 tapering upwardly and inwardly, that cooperates with a correspondingly tapered surface 51 on a segmented ring 52, to urge the ring inwardly, in order that the internal teeth 53 of the ring are disposed for clutching engagement with external ratchet teeth 54 formed on the periphery of the upper tubular body or mandrel 10. The segmented ring 52 includes a plurality of adjacent segments 55 (see Fig. 5) disposed a substantial distance around the periphery of the mandrel 10, such segments being urged inwardly by a split, contractile spring or snap ring 56 disposed within a peripheral groove 57 in the segments. This ring 56 tends to urge the segments 55 inwardly, to effect engagement of their ratchet teeth 53 with the companion teeth 54 on the mandrel.

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Such ratchet teeth may be constituted by an upwardly facing ratchet or buttress type of thread 54 on the mandrel 10, engaging with a companion downwardly directed ratchet thread 53 formed jointly within the segments 55.

A stop 58, in the form of a key, is secured to the ratchet sleeve 30, and engages one end of the segmented ring 52, to prevent rotation of the segmented ring relative to the ratchet sleeve. The other end of the ring 52 has an inwardly directed key or projection 59 disposed within a longitudinal keyway 60 in the mandrel 10.

Because of the ratchet or one-way clutch type of lock device described, the mandrel 10 can be moved downwardly without interference by the lock device, since the mandrel ratchet teeth 54 will merely ratchet freely over the companion teeth 53 on the segments 55. However, upward movement of the mandrel 10 will cause its teeth 54 to engage the segment teeth 53 and move the segments 55 upwardly with it, shifting them slightly toward the narrow portion of the tapered surface 50 in the ratchet sleeve 30, and wedging the segments firmly between the mandrel 10 and ratchet sleeve 30, which effectively couples the mandrel 10 and drag device 26 together against relative upward movement. In other words, the two parts 10, 26 are locked together for upward movement as a unit. Accordingly, the slips 17 are also locked to the mandrel 10 and will move upwardly with it.

When it is desired to shift the mandrel 10 upwardly within the drag device 26, and with respect to the slips 17, in order to anchor the slips to the casing B, the tubular string C and upper body or mandrel 10 connected thereto are rotated a partial revolution, preferably to the right. Such rotation causes the mandrel 10 to act upon the segment key 59 and expand the segments 55 outwardly to the extent in which their teeth 53 are completely out of engagement with the mandrel teeth 54. Such expansion will occur, since the other end of the segmented ring is prevented from moving by the stop 58 secured to the ratchet sleeve 30. When the mandrel is thus turned to free the segments 55 from its teeth 54, the mandrel 10 may be moved upwardly within the segments 55 and the ratchet sleeve 30, in order to shift the expander 13 upwardly within the slips 17 and urge the latter into anchoring engagement with the casing B. As above indicated, a continuation of this upward movement foreshortens the packing sleeve 16 and expands it outwardly against the casing.

When the slips 17 and packing 16 are to be retracted, it is merely necessary to lower the tubular string C and mandrel 10, which will lower the abutment 12 away from the expander 13, allowing the packing sleeve 16 to retract and also cause the body shoulder 46 to engage the expander shoulder 47, shifting the expander downwardly relative to the slips 17 and effecting retraction of the latter. Such downward movement can occur without regard to the imposing of turning effort on the tubular string C and packer body 10, 11 because of the one-way ratchet arrangement between the mandrel threads 54 and segmented ring threads 53.

With the segmented ring 52 released by reverse turning of the tubular string C and packer body 10, 11, upward movement of these latter members will again automatically couple the mandrel 10 to the ratchet sleeve 30 and drag device 26, in order that upward movement of the tubular string C and packer body 10, 11 will be

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ineffective to anchor the packer to the well casing. The well tool, therefore, can be removed to the top of the well bore.

As described above, the outwardly bowed leaf springs 40 engage the casing B to resist longitudinal movement of the slips 17 therewithin. These springs also resist rotation of the ratchet sleeve 30 and enable rotation of the tubing string C and mandrel 10 to effect unclutching of the segmented ring 52 from the mandrel teeth 54.

After the operation has been performed in the well bore, it is desired to remove the tool from the well casing. Such removal can be expedited by disconnecting the tubing string joints at the rotary table (not shown), through holding the stand of tubing above the table stationary, and through rotating the rotary table to rotate the tubing string C and the well tool A attached thereto. Such rotation ordinarily occurs to the right. If the drag device 26 shown in Figs. 1, 2, 3 were coupled directly to the ratchet sleeve 30, rotation of the tubing string C and mandrel 10 would revolve the drag springs 40 around the casing B, and might severely damage them. In the form of the invention disclosed in the drawings, provision is made for uncoupling the drag device 26 from the remainder of the tool, in order that it need not rotate with the remainder of the tool.

In achieving the objective just mentioned, the lower ends of the springs 40 are connected to a lower drag collar 70 by an encompassing retainer ring 71 and screws 72. The upper ends of the springs are similarly connected to an upper drag collar 70a, slidable on the mandrel 10, by an encompassing ring 71a and screws 72a. This lower drag collar has internal threads 73 adapted to engage and cooperate with external threads 74 formed on the upper portion of a coupling or drag sleeve 75 threadedly, or otherwise, secured to the ratchet sleeve 30. The threaded connection 73, 74 is preferably left hand. Inadvertent separation between the drag sleeve 75 and ratchet sleeve 30 is prevented by a suitable lock screw 76 threaded into the ratchet sleeve and bearing against the drag sleeve.

Originally, the lower drag collar 70 occupies a position at the upper end of the drag sleeve 75, the extent of the upward threading of the collar being determined by engagement of its lug or projection 77 with an outwardly directed lug or projection 78 on the drag sleeve. Rotation of the drag sleeve 75 to the right will effect downward feeding of the lower drag collar 70 along the sleeve 75, before the sleeve projection 78 can engage the collar projection 77, so as not to interfere with downward movement of the lower collar 70 along the sleeve. The projections 77, 78 will be engaged upon upward screwing of the lower collar 70 on the sleeve 75, to limit the extent of such upward movement and to prevent jamming of the threads 73, 74.

In order to prevent rotation of the ratchet sleeve 30 and drag sleeve 75 during manipulation of the segmented lock ring 52, a frictional restraint is imposed between the lower drag collar 70 and the drag sleeve 75. Such frictional restraint is obtained by causing a split, contractile brake shoe or ring 79 to bear frictionally against the outer ends of the external threads 74. This shoe is carried within the lower brake portion 80 depending from the lower retainer ring 71. The shoe 79 may rest upon a flange or shoulder 81 extending inwardly from the brake portion 80, and is prevented from rotating by a holding screw

82 threaded through the brake portion 80 of the ring 81, and received within a hole 83 in the shoe 79 diametrically opposite the open end or split portion 84 of the brake shoe.

The inherently contractile split brake shoe or band 79 provides enough frictional force against the sleeve threads 74 as to resist rotation of the ratchet sleeve 30 to an extent sufficient to insure expansion of the segmented ring 52 to its unclutched position, upon rotation of the tubing string C and mandrel 10 to the right, as described above. The brake band or ring 79, however, does not exert sufficient frictional force to transmit rotary motion of the coupling or drag sleeve 75 to the drag springs 40 and revolve the latter around the casing. Instead, the brake shoe 79 will slip before that occurs.

A rubber wiper ring 85 may be secured in the upper end of the drag sleeve 75 to prevent foreign substances from moving downwardly through the clearance space between the drag sleeve 75 and mandrel 10, and possibly clog the ratchet clutch mechanism 50—54.

A stop device 86 is also provided for insuring the pulling of the drag device 26 through the well casing B, irrespective of its upward or downward movement through the well casing. This stop device is adjustable and includes a two-part stop ring 87 disposed within a circumferential groove 88 in the mandrel. The two halves of this stop ring are separated by keys 89 welded or otherwise secured to the mandrel 10. The stop ring has external threads 90 which project beyond the mandrel keys 89 for cooperation with an internally threaded sleeve 91 extending downwardly toward the drag sleeve 75, with which it is engageable. The upper end of the stop sleeve 91 is also engageable with the upper drag collar 70a, that is freely slidable along the mandrel 10.

It is to be noted that the threads 74 on the drag sleeve 75 do not extend throughout its length, but terminate a substantial distance above the upper end of the ratchet sleeve 30. The unthreaded portion 75a of the sleeve has a diameter no greater than the root diameter of the threads 74, in order to permit the lower collar 70 to be disposed therealong. The unthreaded portion 75a of the sleeve is sufficient in length to permit complete unscrewing of the lower drag collar 70 from the threaded portion 74, and also to accommodate the brake ring 79.

The well tool A is run in the well casing with the parts disposed in the position shown in Fig. 1, except that the segmented ring 52 may be in its inward or clutching position. The stop sleeve 91 is adjusted by rotating it on the threaded stop ring 87 until its lower end engages the upper end of the drag sleeve 75. It is maintained in this adjusted position by a suitable screw 92 threaded through the sleeve 91 and bearing against the mandrel 10. The lower drag collar 70 is at the upper end of the drag sleeve 75, and the upper drag collar 70a is disposed a substantial distance above the stop sleeve 91.

When the position in the well bore has been reached at which the tool is to be anchored in packed-off condition, the tubing string C and mandrel 10 are rotated to the right to unlatch the ratchet ring 52 from the mandrel, which permits the tubing string C and mandrel 10 to be elevated and effect engagement of the slips 17 and the packing 16 with the wall of the well casing. Upward movement of the mandrel within the drag device 26 is permitted, because of the

space that has been allowed between the upper end of the stop sleeve 75 and the upper drag collar 70a (see Fig. 1). Moreover, rotation of the ratchet sleeve 30 during turning of the mandrel 10 is prevented by the frictional engagement of the brake shoe 79 upon the threads 74 of the drag sleeve 75, which is connected to the ratchet sleeve 30.

When the well tool A is to be removed from the well casing, the tubing string C and mandrel 10 are lowered to retract the slips 17 and the packing 16 to their initial positions shown in Fig. 1. The tubing string C is then rotated to rotate the mandrel 10. Such rotation will expand the ratchet ring 52, and, through the ratchet ring 52 and stop key 53, will rotate the ratchet sleeve 30 and the drag sleeve 75. Since the threaded interengagement 73, 74 between the drag sleeve 75 and lower drag collar 70 is left hand, and since the drag springs 40 engage the casing B to resist rotation of the lower drag collar, the rotation of the drag sleeve 75 to the right will thread the lower drag collar 70 downwardly along the sleeve 75, until the lower drag collar is completely unscrewed from the threaded portion of the drag sleeve. The friction force exerted by the brake shoe or band 79 against the drag sleeve threads 74 is only sufficient to insure unclutching of the ratchet ring 52, but it is far less than the frictional force exerted by the drag springs 40 against the casing wall. As a result, the brake shoe 79 is incapable of preventing rotation of the drag sleeve 75 within the drag collar 70.

When the lower drag collar has been unscrewed from the threaded portion of the lower drag sleeve, as shown in Fig. 2, the upper drag collar 70a has been lowered to a location adjacent the upper end of the stop sleeve 91.

It is evident that the lower drag collar 70 has been completely uncoupled from the drag sleeve 75, and that rotation of the drag sleeve 75 can occur freely within the lower drag collar 70 and the springs 40 without tending to rotate the latter. The tubing string C and mandrel 10 may now be rotated to the extent desired, in elevating the tool within the well bore for the purpose of uncoupling the sections above the rotary table, without fear of revolving the drag springs 40 frictionally along and around the walls of the well casing B.

In addition to its function of permitting rotation of the mandrel 10 without rotating the drag device 26, after having been unscrewed from the drag sleeve 75, the drag and lock device disclosed performs a further important function. It is to be noted that the unscrewing of the lower drag collar 70 from the drag sleeve 75 has located the upper drag collar 70a adjacent the stop sleeve 91. It is also to be noted that the lower end of the stop sleeve 91 is adjacent the upper end of the drag sleeve 75, this latter position having occurred upon lowering of the mandrel 10 to effect retraction of the slips 17 and packing 16 from the well casing. Accordingly, regardless of the coupling or uncoupling position of the ratchet ring 52, it is impossible to reset the slips 17 and packing 16 against the casing B, since the mandrel 10 cannot be moved upwardly substantially with the respect to the slips 17. This action is prevented, because such upward movement is transmitted through the stop ring 87 and stop sleeve 91 to the upper drag collar 70a, through the drag springs 40 to the lower drag collar 70, and from the lower drag collar to the drag sleeve 75, because of the engagement of the uppermost

thread 73 on the lower collar 70 with the lowermost thread 74 on the threaded portion of the drag sleeve 75. Since the drag sleeve 75 is coupled to the slips 17 through the ratchet sleeve 30, swivel 27 and linkage 20, it is apparent that upward movement of the mandrel 10 will also move the slips 17 upwardly with it, despite the unclutched position that the ratchet ring 52 might assume. The tool can be moved out of the hole as rapidly as possible without fear of inadvertently setting the slips 17, which might cause the tubing string on the tool to be pulled apart.

The stop sleeve 91 and drag device 28 arrangement accomplishes yet a further function. During lowering of the tool in the well casing, the lower end of the stop sleeve 91 engages the drag sleeve 75, and, through the threaded interconnection 74, 73, moves the lower drag collar 70 downwardly in order to pull the drag springs 40 through the casing. Similarly, during upward movement of the mandrel 10 in removing the tool from the well casing, the stop sleeve 91 engages the upper collar 70a and again exerts a pulling action on the drag springs 40. This pulling action insures against buckling of the springs 40, that might accompany a pushing action, and avoids damage to or breakage of the leaf springs.

After the lower drag collar 70 has become completely unthreaded from the coupling or drag sleeve 75, the only portions that can support the latter, together with its associated ratchet sleeve 30 and slips 17, in an elevated position with respect to the mandrel 10 is the segmented ring 52. However, during rotation of the mandrel to the right, in uncoupling the tubing joints at the top of the well bore, the segmented ring 52 is expanded and no longer remains in coupled position. In view of this condition, there is then substantially nothing sustaining the weight of the drag sleeve 75, ratchet sleeve 30, links 20 and slips 17, the latter dropping downwardly a slight amount, as determined by engagement of the lowermost external thread on the coupling sleeve 75 with the uppermost internal thread in the lower drag collar 70. Due to the inclination of the threads, the result is an intermittent sliding and banging of the lowermost external thread 74 on the uppermost internal thread 73, with resultant damage to the parts as the tubular mandrel 10 and coupling sleeve 75 are being rotated.

The present invention offsets the tendency for the threads 74, 73 to engage after the lower drag collar 70 has been uncoupled from the coupling sleeve 75. This is done by sustaining the weight of the slips 17, links 20, swivel 27, ratchet sleeve 30 and drag sleeve 75, and all of the other parts connected to it. In the present instance, the weight is sustained by means of a plurality of helical springs 95 disposed around the lower portion of the mandrel 10. Each spring is mounted on a guide pin 96 received within a bore 97 in the expander 13. The lower end of each spring 95 rests upon the upper end of the expander 13 and its upper end bears upon the underside of the slip ring 22.

The springs 95 exert sufficient force to tend to hold the slips 17, links 20, slip ring 22, swivel 27, ratchet ring 30 and drag sleeve 75 in an upward position. The springs 95, however, do not exert sufficient force as to overcome the frictional force of the drag springs 40 against the wall of the well casing B. So long as the drag device is coupled to the sleeve 75, the springs are comparatively ineffective, and merely tend to shift the slips 17 upwardly with respect to the

expander 13 to retracted position. However, the springs 95 do not exert sufficient force to preclude shifting of the slips 17 to expanded position when the segmented lock ring 52 has been released and the expander 13 elevated upon upward movement of the mandrel 10, body 11 and packing 16.

After the packing 16 and slips 17 have been returned to retracted position, the mandrel 10 may be rotated to the right to unthread the lower drag collar 70 along the coupling sleeve 75, until the internal and external threads 73, 74 disengage, as shown in Fig. 2. When the parts are in this position, the helical springs 95 are effective to hold the coupling sleeve 75 in an upward position, to insure that the lowermost thread on the coupling sleeve is elevated above the uppermost thread in the lower drag collar 70. Accordingly, when the mandrel 10 is rotated to the right, in effecting uncoupling of the tubing joints at the top of the well bore, the lower thread on the coupling sleeve 75 cannot engage and ride upon the upper thread in the drag collar 70, thus precluding damage to these threaded members.

Since the springs 95 counterbalance or offset the weight of the slips 17, and the parts above the slips connected to them, they tend to hold the slips in their fully retracted position, after the lower drag collar 70 has been unthreaded from the drag sleeve 75, as limited by engagement of the drag sleeve 75 with the stop device 91.

The inventor claims:

1. In a well tool for use in a well conduit: a first member adapted for connection to a tubular string; a second member telescopically arranged with respect to said first member; means for transmitting the turning effort of said first member to said second member; conduit engageable means cooperable with said second member for resisting movement of said second member in said well conduit; means comprising a threaded connection between said conduit engageable means and second member for moving at least part of said conduit engageable means longitudinally of said members upon rotation of said first member and second member; friction brake means between said second member and conduit engageable means for resisting movement of said second member relative to said conduit engageable means, said friction brake means comprising a brake ring engaging a thread of said threaded connection.

2. In a well tool for use in a well conduit: a first member adapted for connection to a tubular string; a second member telescopically arranged with respect to said first member; means for transmitting the turning effort of said first member to said second member; conduit engageable means cooperable with said second member for resisting movement of said second member in said well conduit; means comprising a threaded connection between said conduit engageable means and second member for moving at least part of said conduit engageable means longitudinally of said members upon rotation of said first member and second member; friction brake means between said second member and conduit engageable means for resisting movement of said second member relative to said conduit engageable means, said friction brake means comprising an inherently contractile split ring engaging a thread of said threaded connection.

3. In a well tool for use in a well conduit: a first member adapted for connection to a tubular

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running-in string; a second member telescopically arranged with respect to said first member; means for transmitting the turning effort of said first member to said second member; longitudinally spaced collars disposed around said members; conduit engageable drag springs secured to said collars; means comprising a threaded connection between one of said collars and said second member for moving said one collar longitudinally of said second member in response to rotation of said second member; and friction brake means between said one collar and said second member, said friction brake means comprising an inherently contractile split brake ring carried by said one collar and engaging said second member.

4. In a well tool for use in a well conduit: a first member adapted for connection to a tubular running-in string; a second member telescopically arranged with respect to said first member; means for transmitting the turning effort of said first member to said second member; longitudinally spaced collars disposed around said members; conduit engageable drag springs secured to said collars; means comprising a threaded connection between one of said collars and said second member for moving said one collar longitudinally of said second member in response to rotation of said second member; friction brake means between said one collar and said second member, said friction brake means comprising an inherently contractile split brake ring carried by said one collar and engaging a thread on said second member, and means for preventing substantial rotation of said brake ring relative to said one collar.

5. In a well tool adapted to be lowered in a well conduit: normally retracted means; means for moving said normally retracted means into engagement with the well conduit; tubular means operatively connected to said moving means; releasable lock means operatively connected to said tubular means and normally retracted means for preventing substantial relative longitudinal movement between said normally retracted means and tubular means; a threaded sleeve secured to said lock means; friction means threaded on said sleeve and frictionally engageable with said conduit; and slippable brake means resisting relative rotation between said sleeve and friction means, said brake means comprising an inherently contractile split ring carried by said friction means and engaging said sleeve.

6. In a well tool adapted to be lowered in a well conduit: normally retracted means; means for moving said normally retracted means into engagement with the well conduit; tubular means operatively connected to said moving means; releasable lock means operatively connected to said tubular means and normally retracted means for preventing substantial relative longitudinal movement between said normally retracted means and tubular means; a threaded sleeve secured to said lock means; friction means threaded on said sleeve and frictionally engageable with said conduit; slippable brake means resisting relative rotation between said sleeve and friction means, said brake means comprising an inherently contractile split ring carried by said friction means and engaging the threaded portion of said sleeve, and means for preventing substantial relative rotation between said ring and friction means.

7. In a well tool adapted to be lowered in a well conduit: normally retracted means; means for moving said normally retracted means into engagement with the well conduit; tubular means

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operatively connected to said moving means; releasable lock means operatively connected to said tubular means and normally retracted means for preventing substantial relative longitudinal movement between said normally retracted means and tubular means; a sleeve secured to said lock means and having a threaded portion and an unthreaded portion; friction means threaded on said threaded portion and frictionally engageable with said conduit, said friction means being movable along said threaded portion onto said unthreaded portion in response to rotation of said tubular means and sleeve; and brake means on said friction means comprising an inherently contractile split ring engaging said sleeve.

8. In a well tool adapted to be lowered in a well conduit: normally retracted means; means for moving said normally retracted means into engagement with the well conduit; tubular means operatively connected to said moving means; releasable lock means operatively connected to said tubular means and normally retracted means for preventing substantial relative longitudinal movement between said normally retracted means and tubular means; a sleeve secured to said lock means and having a threaded portion and an unthreaded portion; longitudinally spaced collars disposed around said tubular means; conduit engageable springs secured to said collars; one of said collars being threaded on said threaded portion of said sleeve and movable from said threaded portion onto said unthreaded portion in response to rotation of said tubular means and sleeve; and an inherently contractile split ring carried by said one collar and engaging the threaded portion of said sleeve to resist relative rotation between said sleeve and said one collar.

9. In a well tool adapted to be lowered in a well conduit: normally retracted means; means for moving said normally retracted means into engagement with the well conduit; tubular means operatively connected to said moving means; releasable lock means operatively connected to said tubular means and normally retracted means for preventing substantial relative longitudinal movement between said normally retracted means and tubular means; a sleeve secured to said lock means and having a threaded portion and an unthreaded portion; friction means threaded on said threaded portion and frictionally engageable with said conduit, said friction means being movable along said threaded portion onto said unthreaded portion in response to rotation of said tubular means and sleeve; and means urging said sleeve in an upward direction when said friction means is disposed around said unthreaded portion of said sleeve.

10. In a well tool adapted to be lowered in a well conduit: normally retracted slips; an expander coacting with said slips for urging them into engagement with the well conduit; tubular means operatively connected to said expander; releasable lock means operatively connected to said tubular means and slips for preventing substantial relative longitudinal movement between said slips and tubular means; a sleeve secured to said lock means and having a threaded portion and an unthreaded portion; friction means threaded on said threaded portion and frictionally engageable with said conduit, said friction means being movable along said threaded portion onto said unthreaded portion in response to rotation of said tubular means and sleeve; and means urging said sleeve in an upward di-

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rection when said friction means is disposed around the unthreaded portion of said sleeve.

11. In a well tool adapted to be lowered in a well conduit: normally retracted slips; an expander coacting with said slips for urging them into engagement with the well conduit; tubular means operatively connected to said expander; releasable lock means operatively connected to said tubular means and slips for preventing substantial relative longitudinal movement between said slips and tubular means; a sleeve secured to said lock means and having a threaded portion and an unthreaded portion; friction means threaded on said threaded portion and frictionally engageable with said conduit, said friction means being movable along said threaded portion onto said unthreaded portion in response to rotation of said tubular means and sleeve; and means engaging said expander for urging said sleeve and slips in an upward direction when said friction means is disposed around the unthreaded portion of said sleeve.

12. In a well tool adapted to be lowered in a well conduit: normally retracted slips; an expander coacting with said slips for urging them into engagement with the well conduit; tubular means operatively connected to said expander; releasable lock means operatively connected to said tubular means and slips for preventing substantial relative longitudinal movement between said slips and tubular means; a sleeve secured to said lock means and having a threaded portion and an unthreaded portion; friction means threaded on said threaded portion and frictionally engageable with said conduit, said friction means being movable along said threaded portion onto said unthreaded portion in response to rotation of said tubular means and sleeve; at least one spring engaging said expander for urging said sleeve and slips in an upward direction, said spring exerting less elevating force on said sleeve and slips than the friction force of said friction means against the conduit.

13. In a well tool adapted to be lowered in a well conduit: normally retracted slips; an expander for moving said slips into engagement with the well conduit; tubular means operatively connected to said expander; releasable lock means operatively connected to said tubular means and slips for preventing substantial relative longitudinal movement between said normally retracted slips and tubular means; friction means secured to said lock means and frictionally engageable with the conduit; and means urging said friction means and slips in an upward direction relative to said expander.

14. In a well tool adapted to be lowered in a well conduit: normally retracted slips; an expander for moving said slips into engagement with the well conduit; tubular means operatively connected to said expander; releasable lock means operatively connected to said tubular means and slips for preventing substantial relative longitudinal movement between said normally retracted slips and tubular means; friction means secured to said lock means and frictionally engageable with the conduit; and at least one spring engaging said expander and lock means for urging said slips in an upward direction with respect to said expander, said spring exerting a lesser upward force than the force of friction of said friction means against the conduit.

15. In a well tool adapted to be lowered in a well conduit: normally retracted slips; an ex-

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pander for moving said slips into engagement with the well conduit; tubular means operatively connected to said expander; releasable lock means operatively connected to said tubular means and slips for preventing substantial relative longitudinal movement between said normally retracted slips and tubular means; friction means secured to said lock means and frictionally engageable with the conduit; at least one guide pin slidable in said expander; and at least one spring disposed around said pin and engaging said expander and lock means for urging said lock means and slips in an upward direction relative to said expander.

16. In a well tool for use in a well conduit: a first member adapted for connection to a tubular string; a second member telescopically arranged with respect to said first member; means for transmitting the turning effort of said first member to said second member; conduit engageable means cooperable with said second member for resisting movement of said second member in said well conduit; means comprising a threaded connection between said conduit engageable means and one of said members for moving at least part of said conduit engageable means longitudinally of said members upon rotation of said first member and second member; friction brake means between said one of said members and conduit engageable means for resisting movement of said one of said members relative to said conduit engageable means, said friction brake means comprising a brake ring for exerting a friction force between said one of said members and said conduit engageable means.

17. In a well tool adapted to be lowered in a well conduit: normally retracted slips; an expander for moving said slips into engagement with the well conduit; tubular means operatively connected to said expander; releasable lock means operatively connected to said tubular means and slips for preventing substantial relative longitudinal movement between said normally retracted slips and tubular means; friction means secured to said lock means and frictionally engageable with the conduit; and means urging said friction means and slips longitudinally with respect to said expander to enable said slips to shift inwardly toward retracted position.

18. In a well tool adapted to be lowered in a well conduit: normally retracted slips; an expander for moving said slips into engagement with the well conduit; tubular means operatively connected to said expander; releasable lock means operatively connected to said tubular means and slips for preventing substantial relative longitudinal movement between said normally retracted slips and tubular means; friction means secured to said lock means and frictionally engageable with the conduit; and at least one spring engaging said expander and lock means for urging said slips longitudinally with respect to said expander in a direction enabling said slips to shift inwardly toward retracted position.

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