

Sept. 6, 1966

G. E. THRANE ET AL

3,270,819

APPARATUS FOR MECHANICALLY SETTING WELL TOOLS

Filed March 9, 1964

3 Sheets-Sheet 1

Fig. 1a

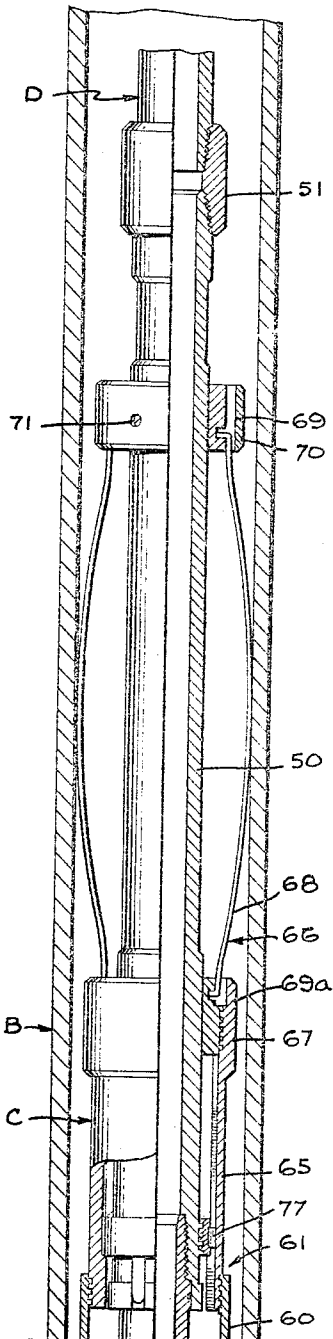


Fig. 1b

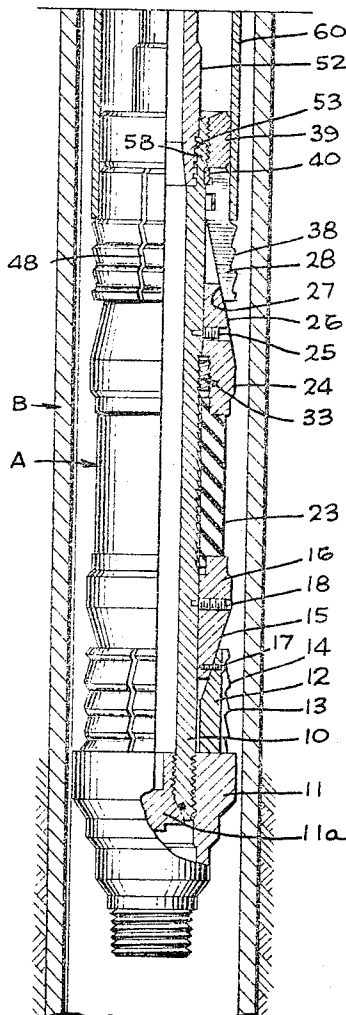
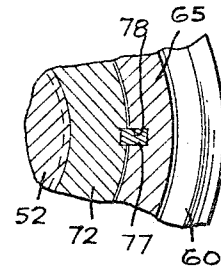


Fig. 3



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Fig. 2

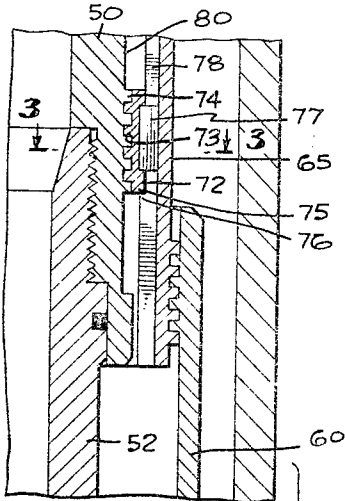
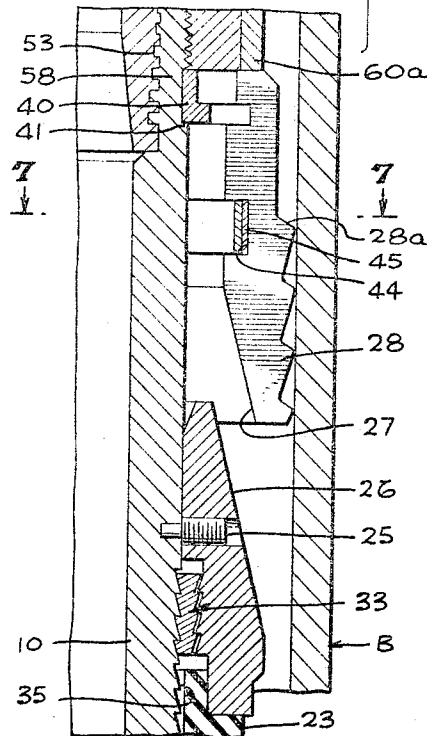
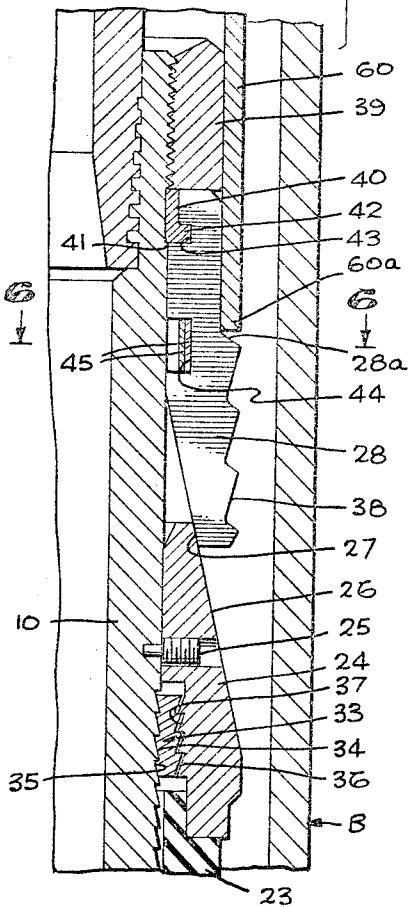
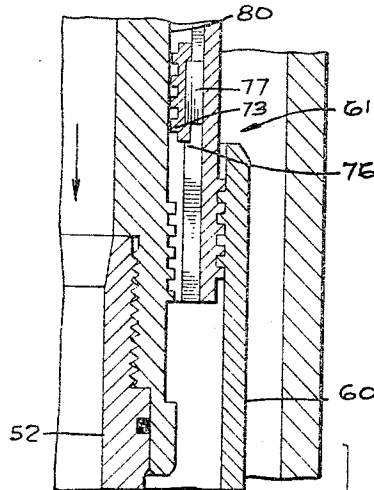


Fig. 4



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Fig. 5

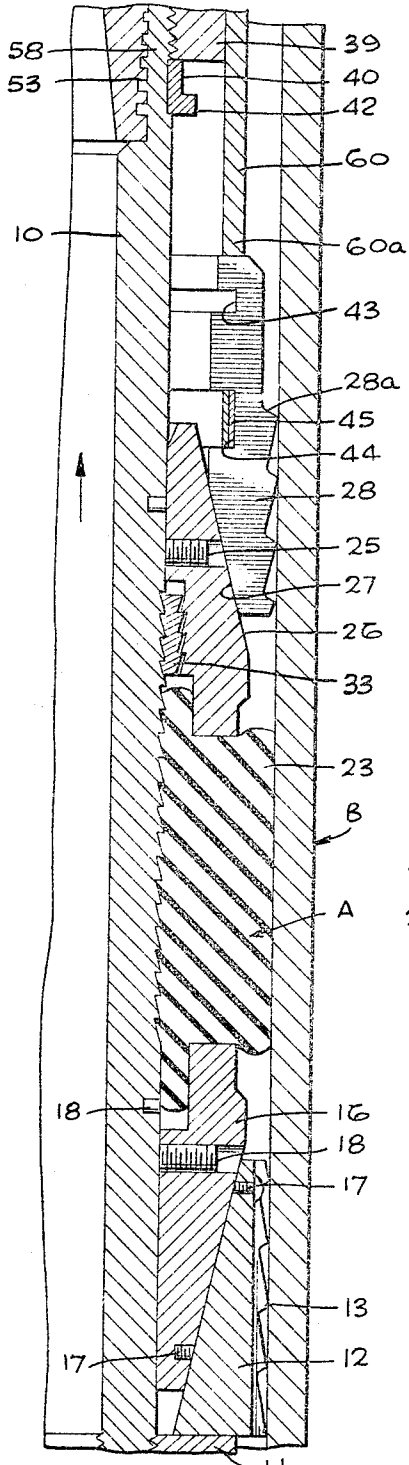


Fig. 6

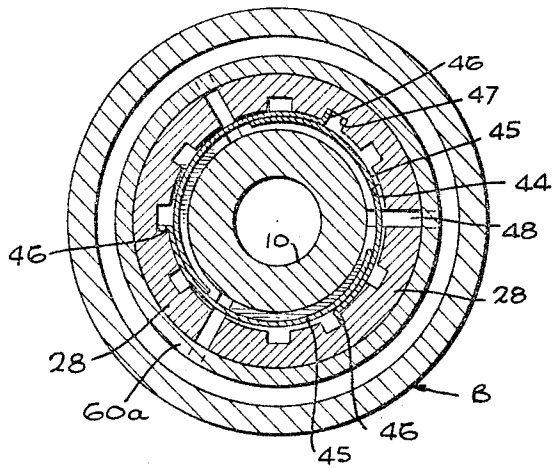
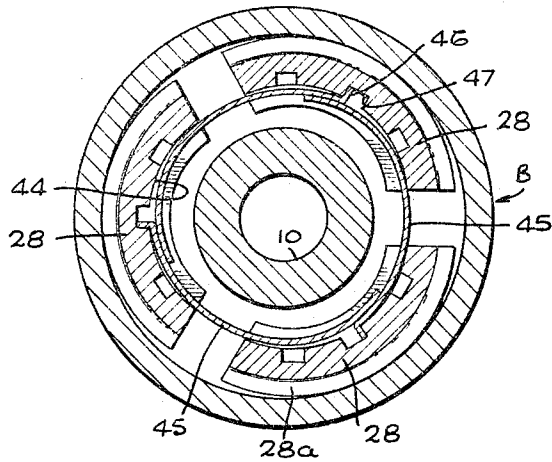


Fig. 7



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APPARATUS FOR MECHANICALLY SETTING
WELL TOOLS

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11 Claims. (Cl. 166—124)

The present invention relates to subsurface well bore apparatus, and more particularly to well packers, such as bridge plugs, production packers, cementing packers, and the like, adapted to be set in well bores for the performance of certain desirable operations or purposes there-within.

In the application of Gordon E. Thrane, Serial No. 192,822, filed May 7, 1962, now Patent No. 3,232,347, for "Mechanically Set Well Packer Apparatus," an apparatus is disclosed for positively holding slips, or the like, in retracted position until their outward expansion is desired. The apparatus prevents premature release and expansion of the slips. A portion of the apparatus for positively holding the slips in retracted position is also capable of subsequently assisting in anchoring them against the wall of the well casing, or other well conduit, in which the apparatus is run.

An object of the present invention is to provide apparatus for mechanically setting well tools, such as well packers, in a well bore of essentially the same type as described in the above-identified application, in which the apparatus has much fewer parts and, is, therefore, simpler in construction and easy to operate in performing the desirable results of initially holding the slips in retracted position, preventing their premature release and expansion, and in effecting purposeful release of the slips when their expansion is to be effected.

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:

FIGURES 1a and 1b together constitute a combined longitudinal section and side elevational view through an apparatus disposed in a well casing, with the parts in the initial position that they occupy during lowering of the apparatus in the well casing, FIG. 1b constituting a lower continuation of FIG. 1a;

FIG. 2 is a partial longitudinal section, on an enlarged scale, through a portion of the apparatus illustrated in FIGS. 1a and 1b;

FIG. 3 is an enlarged cross-section taken along the line 3—3 on FIG. 2;

FIG. 4 is a view similar to FIG. 2 illustrating parts in another relative position, and with the slips released and expanded against the well casing;

FIG. 5 is a partial longitudinal section, disclosing the well packer fully anchored in packed-off condition within the well casing;

FIG. 6 is a section taken along the line 6—6 on FIG. 2;

FIG. 7 is a section taken along the line 7—7 on FIG. 5.

As disclosed in the drawings, it is desired to run a subsurface well tool A, such as a well packer, in a well casing B on a suitable setting tool C through use of a

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tubular running-in string D, such as a string of tubing or drill pipe, extending to the top of the well bore containing the casing. Initially, portions of the well packer A are in retracted position. When the packer has been lowered to the desired setting point in the well casing, such portions are released and expanded outwardly toward the well casing.

The well packer apparatus A includes a body 10, which may be tubular, the lower portion of which may be constituted as a guide 11 threaded on the main portion of the body. The central passage through the tubular body may be open or may be closed by a plug 11a threadedly secured within its lower portion. A plurality of segmental lower slips 12, having wickers or teeth 13 facing in a downward direction, are capable of anchoring the well packer against downward movement in the well casing and rest upon the lower guide 11. These lower slips 12 have inner surfaces 14 inclined in a downward and inward direction, engaging a companion external surface 15 on a lower expander 16 mounted on the body. The lower slips are held initially in retracted position by shear screws 17 securing them to the lower expander 16, the latter being secured initially to the body 10 by shear screws 18.

The upper end of the lower expander 16 engages the lower portion of a packing structure 23, such as a rubber or rubber-like packing sleeve, surrounding the body 10, the upper end of which engages an upper expander 24 initially releasably secured to the body by one or more shear screws 25 and having an external expander surface 26 inclined upwardly and inwardly, which is companion to corresponding inclined internal surfaces 27 on a plurality of upper segmental slips 28 surrounding the upper portion of the body 10.

For the purpose of holding the slips 12, 28 and packing 23 anchored and in packed-off condition against the well casing, a split lock ring 33 is provided, which has internal ratchet teeth 34 facing in an upward direction and adapted to mesh with companion downwardly facing ratchet teeth 35 on the periphery of the body 10. The lock ring has external tapered cam surfaces 36 adapted to engage companion cam surfaces 37 in the expander 24, the cam surfaces tending to urge the ratchet teeth into mesh with one another. However, upward movement of the body 10 relative to the lock ring 33 can expand the ring outwardly, since there is sufficient lateral play between the cam surfaces 36, 37 when the lock ring is moved upwardly of the expander 28. The lock ring arrangement forms no part of the present invention and may be of any suitable construction. Its purpose is to allow upward movement of the body 10 relative to the upper expander 24, but to prevent downward movement of the body relative thereto.

The upper segmental slips 28 have teeth 38 facing in an upward direction, the slips coacting with the upper expander 24 and being engageable with the casing B to anchor the well packer A against upward movement there-within. These slips are held initially in a retracted position against the body 10, their upper ends initially engaging a body ring 39 threaded on the upper end of the body. A retainer ring 40 is mounted on the body between its upper ring 39 and an upwardly facing body shoulder 41, an external ring flange 42 being received within an internal groove 43 in the upper portion of the slips 28 to prevent them from dropping downwardly along the body 10 when the slips are in their fully retracted positions, such as disclosed in FIGS. 1b and 2. However, when the slips 28 are expanded outwardly, they are disconnected from the retainer ring flange 42, allowing the body 10 and the ring 40 to move upwardly relative to the slips.

Outward expansion of the slips 28 is produced by a spring device mounted within an internal circumferential groove 44 in the slips. As shown, the spring mechanism comprises several overlapping lengths 45 of spring band material, which normally tend to assume a straight condition, but which are assembled into the arcuate condition illustrated in FIGS. 6 and 7. An end 46 of each spring length is received in one of a plurality of longitudinal internal weakening grooves 47 in a slip segment 28, such spring extending along the internal groove in the same slip segment and across the gap 48 between adjacent slip segments and substantially along the entire length of the circumferential groove 44 of the adjacent segment. The spring band members 45 are arranged in overlapping relation, as shown, and by virtue of tending to straighten out, they are exerting a constant spring force urging the slips outwardly. Since they extend within the circumferential groove 44 from one slip segment 28 to an adjacent slip segment, they also collectively tend to hold the slips 28 in transverse alignment with respect to one another. The spring band elements 45 have a width corresponding to the longitudinal extent of the internal slip groove 44, having a working clearance with the sides of the groove to avoid interference with the freedom of the slips 28 to expand outwardly, when permitted to do so.

The setting tool C includes a tubular body, mandrel or inner tubular member 50 adapted to be threadedly secured at its upper end to a coupling 51 forming the lower end of the tubular running-in string D of drill pipe or tubing extending to the top of the hole. This body or mandrel has a lower section 52 threadedly secured to its upper section 50, being piloted within the upper portion of the packer body 10 with its threaded nut portion 53 adapted to be threaded into an upper threaded box 58 of the body member 10. Since the threaded interconnection between the setting tool body or mandrel 50, 52 and body 10 is preferably a left-hand one, right-hand rotation of the tubular string D and mandrel relative to the body 10 will effect disconnection of the mandrel 50 from the packer body 10.

Surrounding the mandrel 50 is a device which retains the upper slips 28 in their initially retracted position, but which can be actuated through appropriate manipulation of the tubular string D and mandrel 50 to release the slips 28 for outward expansion under the influence of the springs 45, and in which inadvertent release cannot occur readily. The mechanism surrounding the mandrel can also assist in securing the anchoring engagement of the upper slips 28 with the wall of the well casing B.

As disclosed in the drawings, the slip retaining and slip setting mechanism surrounding the mandrel includes a lower portion or section 60 of a setting and retaining sleeve structure 61, which surrounds the upper body ring 39 and which also surrounds the upper portion of the body slips 28, the lower end 60a of the lower sleeve portion 60 terminating adjacent to a slip shoulder 28a, which can be provided by one of the upwardly facing wickers or teeth 38 of the upper slips. By virtue of initially surrounding the upper portion of the slips 28, the lower sleeve portion 60 holds the latter inwardly against the body 10, and in a position in which the upper internal circumferential groove 43 receives the external holding flange 42 of the retainer ring 40.

The lower section 60 of the setting sleeve structure 61 has its upper portion threadedly secured to the lower end of an upper section 65 of the setting sleeve, which surrounds the mandrel 50. The upper end of this upper section is threadedly or otherwise suitably secured to the drag portion 66 of the apparatus. As specifically disclosed, the upper setting sleeve section 65 is threaded onto a lower drag collar 67 which is slidable on the mandrel 50, this collar receiving the lower ends of circumferentially spaced, longitudinally extending outwardly bowed leaf springs 68 adapted to frictionally engage the wall of the well casing B. The lower ends of these springs are

secured to the lower collar by an encompassing upper portion 69a of the upper sleeve section 65. The upper ends of the outwardly bowed springs 68 are secured to an upper drag collar 69 slidable on the mandrel by an encompassing retainer ring 70 secured to the upper collar by screws 71, or the like.

Initially, relative downward movement of the body member or mandrel 50, and of the entire well packer A with respect to the setting sleeve structure 61 is prevented by a lock device. As shown, this lock device includes a control nut 72 having internal right-hand threads 73 threadedly connected to companion external threads 74 on the mandrel. When fully threaded on the mandrel, the lower end 75 of the control nut 72 engages an upwardly facing shoulder 76 on the upper sleeve section 65, so that any downward movement of the mandrel 50 is transmitted directly through the control nut 72 to the sleeve shoulder 76 in order to carry the retaining sleeve structure 61 downwardly with the mandrel and frictionally drag the springs 68 along the wall of the well casing. The control nut 72 is prevented from rotating relative to the control sleeve 61, but can partake of longitudinal movement therealong by the provision of a slidable spline connection therebetween. As shown, the slidable spline connection is provided by a key 77 suitably attached to the control nut and slidable within a longitudinal keyway 78 formed in the interior of the upper sleeve section 65.

It is apparent that the control nut 72 cannot move downwardly of the sleeve 65 from the position illustrated in FIGS. 1a and 2, but that it can move upwardly along the sleeve. Because of the key and keyway connection 77, 78 between the control nut 72 and sleeve 65, rotation of the control nut is resisted by the frictional engagement of the drag springs 68 against the wall of the well casing B. Accordingly, right-hand rotation of the body or mandrel 50 results in a relative upward feeding of the control nut 72 along the mandrel and along the control sleeve 61, until the control nut is completely unthreaded from the mandrel. Such unthreading will result from the fact that the external diameter 80 of the mandrel 50 above its externally threaded portion 74 is less than the inside diameter of the control nut. After the control nut has been unthreaded from the mandrel 50, the latter is free to move downwardly relative to the setting sleeve structure 61.

Initially, the parts occupy the relative positions illustrated in FIGS. 1a, 1b, 2, 4 and 6, in which the lower slips 12 and packing structure 23 are in their initially retracted position and the upper slips are held retracted by being encompassed by the lower portion of the setting sleeve structure 61. As this time, the control nut 72 is in its lower position in full threaded mesh with the mandrel 50 and in engagement with the upwardly facing shoulder 76 in the upper setting sleeve section 65. The left-hand threaded portion 53 of the mandrel is in fully threaded engagement with the threaded box 58 of the packer body 10. The apparatus is run in the well casing, the friction drag springs 68 resisting downward movement of the drag device 66 and of the setting or control sleeve structure 61. However, such resistance is overcome by the direct transmission of the thrust from the mandrel 50 and control nut 72 to the setting sleeve shoulder 76. In the event that the tubing string D and mandrel 50 were to be moved upwardly, the entire apparatus will move upwardly with it, the upward motion of the mandrel being transmitted to the packer body 10 and from the body through the retainer ring 40 to the upper slips 28, the shoulder 28a of the latter engaging the lower end 60a of the lower setting sleeve section and urging the entire setting sleeve structure and drag device in an upward direction.

When the location of the well casing is reached at which the well packer A is to be anchored in packed-off condition, the tubular running-in string D and mandrel 50 are rotated to the right a sufficient number of

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turns, which, for example, may be about ten turns, which will produce corresponding rotation of the entire well packer apparatus within the setting sleeve 61, the latter being prevented from rotating by the friction drag device 66, which also prevents the control nut 72 from rotating. As a result of such rotation, the control nut 72 feeds upwardly out of threaded engagement with the mandrel threads 74, thereby allowing the mandrel 50 to move downwardly relative to the setting sleeve structure 61, since downward movement of the latter is resisted by the friction drag springs 68. Downward movement of the mandrel, which can be produced by moving the tubular running-in string D downwardly, will shift the packer A downwardly with it until the upper slips 28 are moved down below the lower end 60a of the setting sleeve structure, thereby freeing such slips and allowing the springs 45 to expand them outwardly against the wall of the well casing, as disclosed in FIG. 4, at which time the slips are free from the retainer ring 40 secured to the body 10. The slips are now located below the setting sleeve 60, which is in a position immediately above the slips and capable of engaging the latter to resist their upward movement in the well casing.

The tubular running-in string D and mandrel 50 are now moved upwardly, the packer body 10 moving upwardly with it, as well as the upper expander 24 and the well packer parts therebelow, the upper expander shifting upwardly behind the upper slips 28 and wedging them to a greater extent outwardly into firm anchoring engagement with the wall of the well casing B. If the upper slips tend to slide upwardly along the wall of the well casing B, they will move into engagement with the lower end 60a of the setting sleeve 60 (if they are not already in engagement with such lower end). Upward movement of this sleeve is resisted by the friction drag device 66, which results in resistance to upward movement of the upper slips 28. Accordingly, the upper expander 24 can wedge behind the slips and embed their wickers 38 into the wall of the well casing.

The taking of a sufficient upward strain on the mandrel 50 and the body 10 of the tool will then shear the screws 25 securing the upper expander 24 to the body, the body 10 then moving upwardly and carrying the lower expander 16 and lower slips 12 upwardly with it to shorten the packing sleeve 23 and effect its lateral expansion into sealing engagement with the wall of the well casing as well as with the periphery of the body. Upward movement of the body 10 relative to the upper expander 24 is permitted by the one-way ratchet lock ring device 33. After the packing sleeve 23 has been expanded against the wall of the well casing, a continuation of the upward strain on the mandrel 50 and the body 10 will effect a shearing of the screws 18, 17 attaching the lower expander 16 to the body and the lower slips 12 to the lower expander, the body 10 shifting the lower slips upwardly along the lower expander and outwardly into anchoring engagement with the wall of the well casing. As pointed out above, downward movement of the body 10 cannot occur since its downward force is transmitted through the ratchet ring 33 to the upper expander 24 and through the packing structure 23, lower expander 16 and lower slips 12 to the well casing B. Any tendency for the body 10 to move upwardly is transmitted through the lower slips 12, lower expander 16 and packing structure 23 to the upper expander 24 and through the latter to the upper slips 28 and to the well casing.

The well packer A has now been anchored in packed-off condition in the well casing B. The mandrel 50 can be released from the body by rotating the tubular running-in string D and the mandrel to the right, the lower threaded portion 53 of the mandrel unthreading completely from the threaded box 58 of the packer body 10. Following such disconnection of the mandrel from the packer body, the tubular running-in string D and

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mandrel are elevated, the upper thread turn 74 on the mandrel engaging the control nut 72 and moving the latter upwardly within the setting sleeve structure 61, until the nut 72 engages the lower drag collar 67, after which the entire drag device 66 and setting sleeve structure 61 move upwardly with the mandrel within the well casing. The tubular running-in string D and the setting tool C can now be elevated in the well casing B to the top of the well bore.

From the foregoing description, it is apparent that an apparatus has been provided which retains the upper slips 28 in retracted position, and precludes their inadvertent release and setting until the tool has been appropriately manipulated to secure their outward expansion. The setting sleeve structure 61 is prevented from being removed inadvertently from encompassing and holding relation to the upper slips 28 since the downward movement of the body or mandrel 50 is transmitted through the control nut 72 directly to the setting sleeve structure through its shoulder 76, upward movement being transmitted from the packer body 10, retaining ring 40 and the slips 28 to the setting sleeve structure 61. When expansion of the upper slips is desired, it is a simple matter to rotate the tubular running-in string D and mandrel 50 a sufficient number of turns to unthread and disconnect the control nut 72 from the mandrel, after which the tubular running-in string D and mandrel can be moved downwardly a relatively short distance to remove the upper slips 28 from its position within the setting sleeve 60, the springs 45, or the like, then readily expanding the upper slips outwardly against the well casing. Setting of the well packer A can then be completed by the simple act of taking an adequate upward strain on the tubular running-in string D, mandrel 50 and body 10 of the well packer.

We claim:

1. In well apparatus adapted to be set in a well bore: body means adapted to be secured to a running-in string for lowering the apparatus in the well bore; normally retracted means on said body means expandible laterally outwardly of said body means; spring means for shifting said normally retracted means laterally outwardly of said body means; a retainer engaging said normally retracted means to prevent expansion of said normally retracted means by said spring means; means releasably connecting said retainer to said body means to prevent relative shifting of said retainer from engagement with said normally retracted means, including a device threaded on said body means and movable upwardly on said body means and along said retainer in response to rotation of said body means to permit said body means to shift said normally retracted means longitudinally of said retainer to released position from said retainer.

2. In well apparatus adapted to be set in a well bore: body means adapted to be secured to a running-in string for lowering the apparatus in the well bore; normally retracted means on said body means expandible laterally outwardly of said body means; spring means for shifting said normally retracted means laterally outwardly of said body means; a retainer engaging said normally retracted means to prevent expansion of said normally retracted means by said spring means; means releasably connecting said retainer to said body means to prevent relative shifting of said retainer from engagement with said normally retracted means, including a device threaded on said body means and slidably splined to said retainer, said device being movable upwardly on said body means along said retainer in response to rotation of said body means to permit said body means to shift said normally retracted means longitudinally of said retainer to released position from said retainer.

3. In well apparatus adapted to be set in a well bore: a body member adapted to be secured to a running-in string for lowering the apparatus in the well bore; normally retracted means on said body member expandible

laterally outwardly of said body member; means for shifting said normally retracted means laterally outwardly of said body member; a retainer member engaging said normally retracted means to prevent expansion of said normally retracted means by said shifting means; means releasably connecting said retainer member to said body member to prevent relative shifting of said retainer member from engagement with said normally retracted means, including a device threaded on one of said members and slidably splined to the other of said members, said device being movable longitudinally of said body member and retainer member in response to rotation of said body member to permit said body member to shift said normally retracted means longitudinally of said retainer member to released position from said retainer member.

4. In well apparatus adapted to be set in a well bore: body means adapted to be secured to a running-in string for lowering the apparatus in the well bore; normally retracted means on said body means expandable laterally outwardly of said body means; spring means for shifting said normally retracted means laterally outwardly of said body means; a retainer engaging said normally retracted means to prevent expansion of said normally retracted means by said spring means; means releasably connecting said retainer to said body means to prevent relative shifting of said retainer from engagement with said normally retracted means, including a device threaded on said body means and slidably splined to said retainer; coengageable means on said device and retainer for transmitting downward motion of said device to said retainer; said device being movable upwardly on said body means and along said retainer in response to rotation of said body means relative to said device to permit said body means to shift said normally retracted means downwardly of said retainer to released position from said retainer.

5. In well apparatus adapted to be set in a well bore: a body member adapted to be secured to a running-in string for lowering the apparatus in the well bore; normally retracted means on said body member expandable laterally outwardly of said body member; means for shifting said normally retracted means laterally outwardly of said body member; a retainer member engaging said normally retracted means to prevent expansion of said normally retracted means by said shifting means; means releasably connecting said retainer member to said body member to prevent relative shifting of said retainer member from engagement with said normally retracted means, including a device threaded on one of said members and slidably splined to the other of said members; coengageable means on said device and said other of said members for transmitting downward motion of said device to said other of said members; said device being movable upwardly on said body member and along said retainer member in response to rotation of said body member relative to said device to permit said body member to shift said normally retracted means downwardly of said retainer member to released position from said retainer member.

6. In well apparatus adapted to be set in a well bore: body means including a mandrel adapted to be secured to a running-in string for lowering the apparatus in the well bore and a body attached to said mandrel; an expander on said body; normally retracted slip means on said body engageable by said expander to anchor said body in the well bore; means for shifting said slip means laterally outwardly of said body; a retainer engaging said slip means to prevent expansion of said slip means by said shifting means; means releasably connecting said retainer to said mandrel to prevent relative shifting of said retainer from engagement with said slip means, including a device threaded on said mandrel and movable upwardly on said mandrel and along said retainer in response to rotation of said mandrel to permit said mandrel to shift said body and slip means longitudinally of said retainer to release said slip means from said retainer.

7. In well apparatus adapted to be set in a well bore: body means including a mandrel adapted to be secured to a running-in string for lowering the apparatus in the well bore and a body attached to said mandrel; an expander on said body; normally retracted slip means on said body engageable by said expander to anchor said body in the well bore; means for shifting said slip means laterally outwardly of said body; a retainer engaging said slip means to prevent expansion of said slip means by said shifting means; means releasably connecting said retainer to said mandrel to prevent relative shifting of said retainer from engagement with said slip means, including a device threaded on said mandrel and slidably splined to said retainer, said device being movable upwardly on said mandrel and along said retainer in response to rotation of said mandrel to permit said mandrel to shift said body and slip means longitudinally of said retainer to release said slip means from said retainer.

8. In well apparatus adapted to be set in a well bore: body means including a mandrel member adapted to be secured to a running-in string for lowering the apparatus in the well bore and a body attached to said mandrel member; an expander on said body; normally retracted slip means on said body engageable by said expander to anchor said body in the well bore; means for shifting said slip means laterally outwardly of said body; a retainer member engaging said slip means to prevent expansion of said slip means by said shifting means; means releasably connecting said retainer member to said mandrel member to prevent relative shifting of said retainer member from engagement with said slip means, including a device threaded on one of said members and slidably splined to the other of said members, said device being movable longitudinally of said mandrel member and retainer member in response to rotation of said mandrel to permit said mandrel member to shift said body and slip means longitudinally of said retainer member to release said slip means from said retainer member.

9. In well apparatus adapted to be set in a well bore: body means including a mandrel adapted to be secured to a running-in string for lowering the apparatus in the well bore and a body attached to said mandrel; an expander on said body; normally retracted slip means on said body engageable by said expander to anchor said body in the well bore; means for shifting said slip means laterally outwardly of said body; a retainer engaging said slip means to prevent expansion of said slip means by said shifting means; means releasably connecting said retainer to said mandrel to prevent relative shifting of said retainer from engagement with said slip means, including a device threaded on said mandrel and slidably splined to said retainer; coengageable means on said device and retainer for transmitting downward motion of said device to said retainer; said device being movable upwardly on said mandrel and along said retainer in response to rotation of said mandrel relative to said device to permit said mandrel to shift said body and slip means downwardly of said retainer to release said slip means from said retainer.

10. In well apparatus adapted to be set in a well bore: body means including a mandrel member adapted to be secured to a running-in string for lowering the apparatus in the well bore and a body attached to said mandrel member; an expander on said body; normally retracted slip means on said body engageable by said expander to anchor said body in the well bore; means for shifting said slip means laterally outwardly of said body; a retainer member engaging said slip means to prevent expansion of said slip means by said shifting means; means releasably connecting said retainer member to said mandrel member to prevent relative shifting of said retainer member from engagement with said slip means; a device threaded on one of said members and slidably splined to the other of said members; coengageable means on said device and said other of said members for transmitting downward

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motion of said device to said other of said members; said device being movable longitudinally of said mandrel member and retainer member in response to rotation of said mandrel member to permit said mandrel member to shift said body and slip means downwardly of said retainer member to release said slip means from said retainer member.

11. In well apparatus adapted to be set in a well bore: body means including a mandrel adapted to be secured to a running-in string for lowering the apparatus in the well bore and a body attached to said mandrel; an expander on said body; normally retracted slip means on said body engageable by said expander to anchor said body in the well bore; means for shifting said slip means laterally outwardly of said body; a retainer engaging said slip means to prevent expansion of said slip means by said shifting means; a control nut threadedly connected to said mandrel; means providing a slidable splined connection between said control nut and retainer; coengageable means

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on said control nut and retainer for transmitting downward motion of said control nut to said retainer; said control nut being movable upwardly on said mandrel and unthreaded therefrom in response to rotation of said mandrel relative to said control nut to permit said mandrel to shift said body and slip means downwardly to said retainer to release said slip means from said retainer.

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