Feb. 1, 1966 G. E. THRANE 3,232,347

MECHANICALLY SET WELL PACKER APPARATUS

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FIG. 1a.

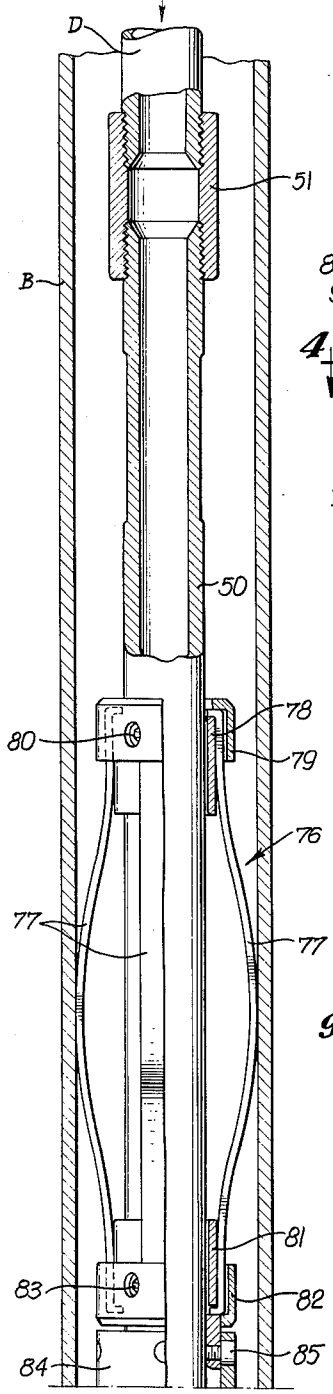


FIG. 1b.

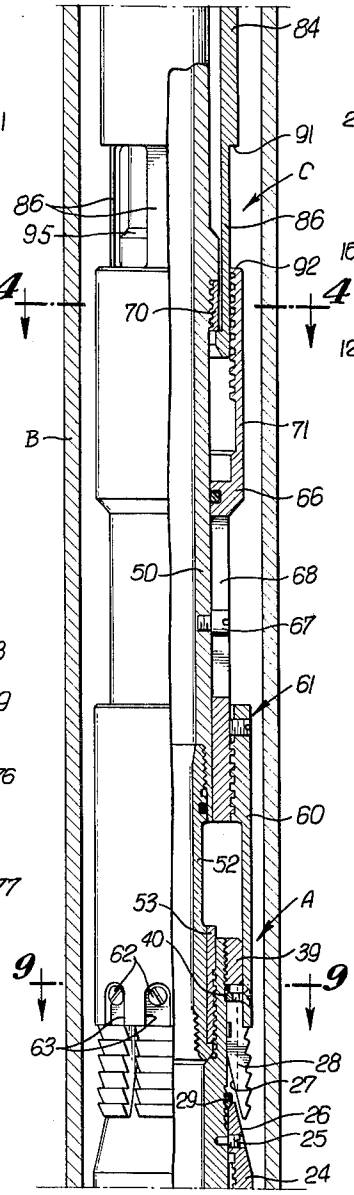
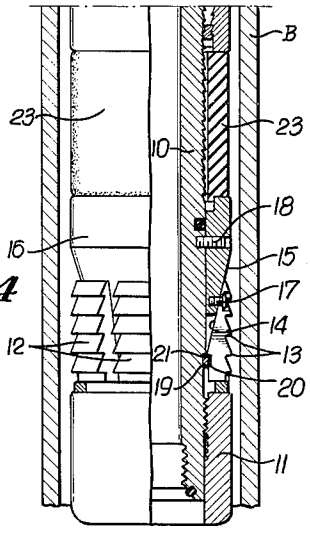


FIG. 1c.



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FIG. 2a.

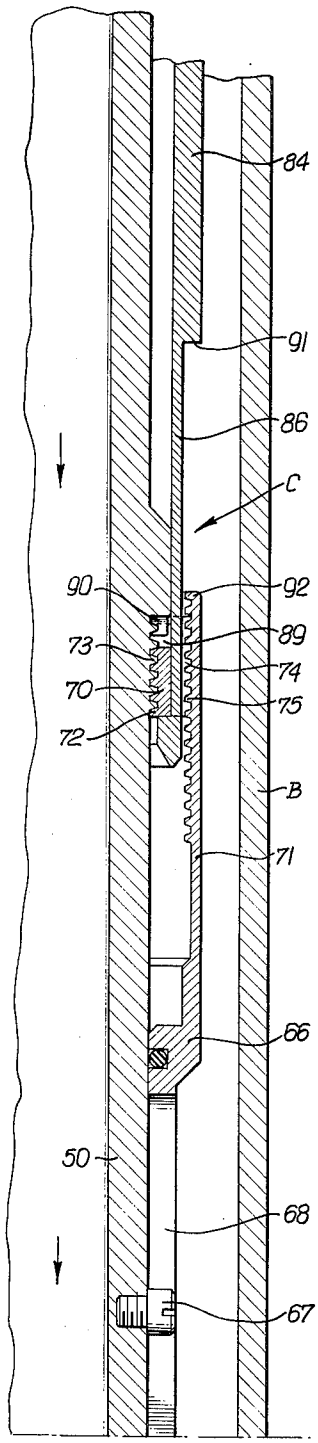
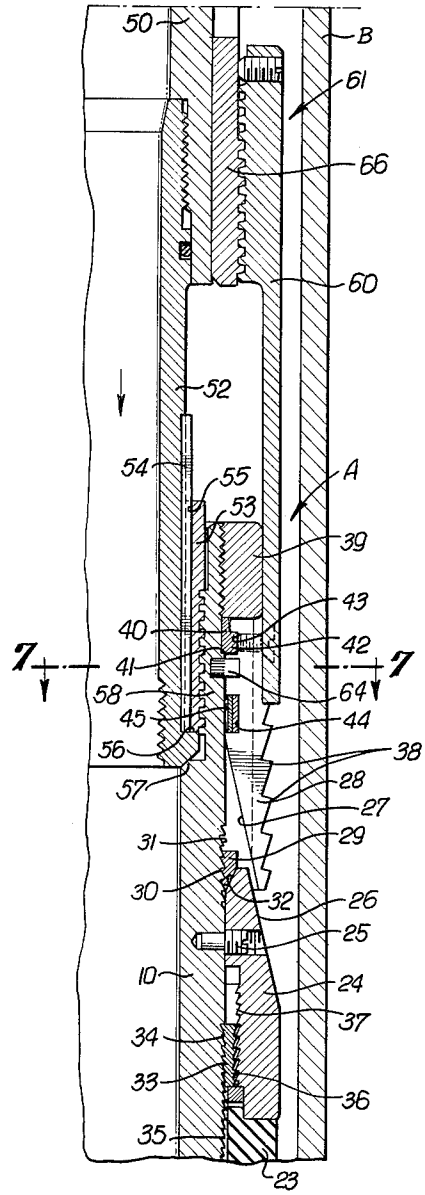


FIG. 2b.



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FIG. 3.

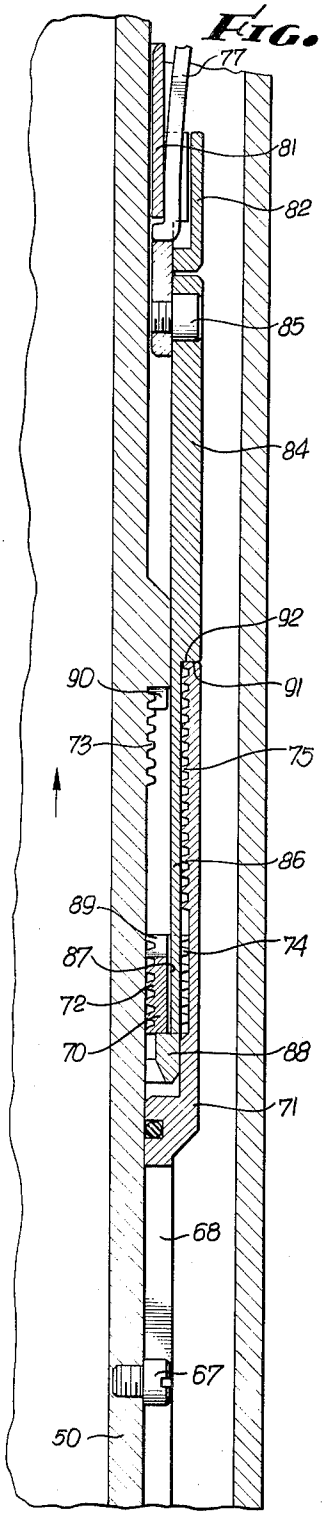


FIG. 4.

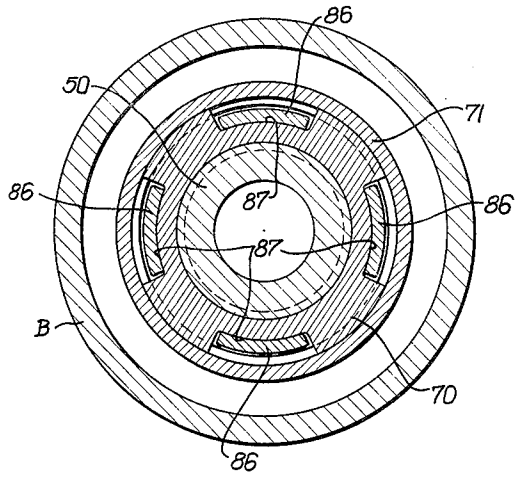
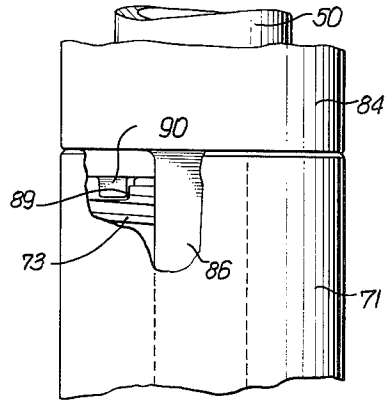


FIG. 5.



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FIG. 6.

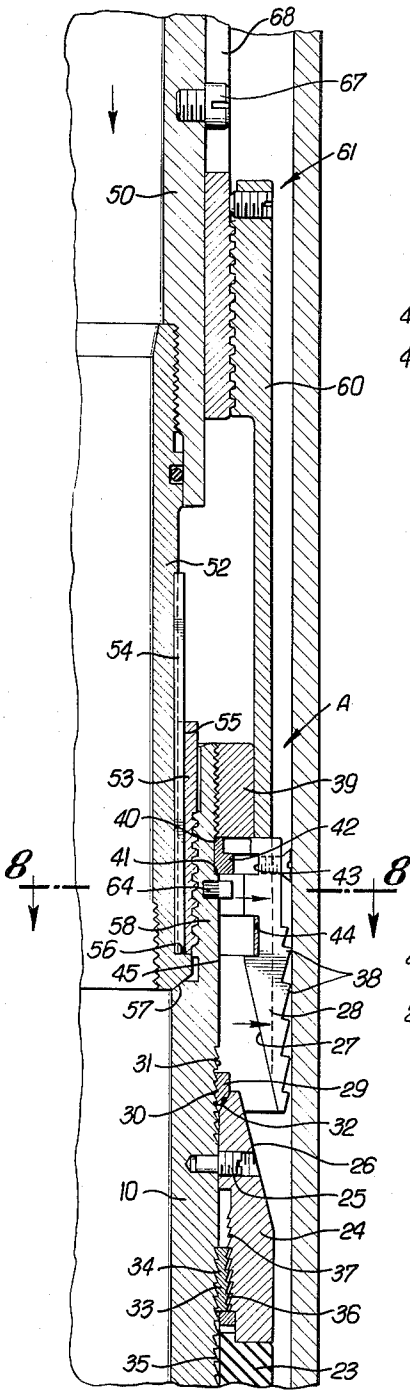


FIG. 7.

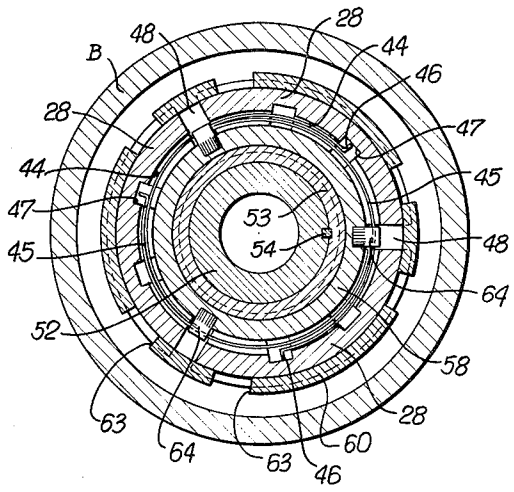
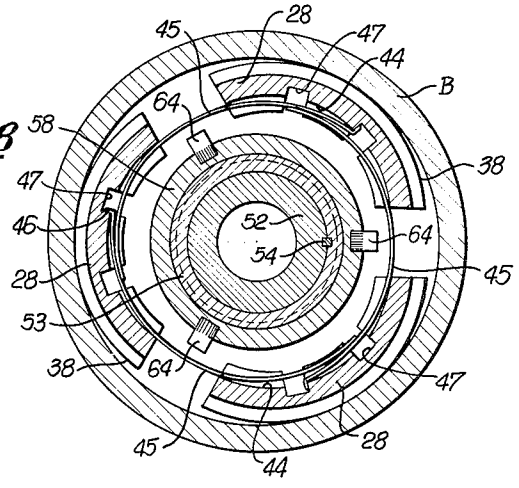


FIG. 8.



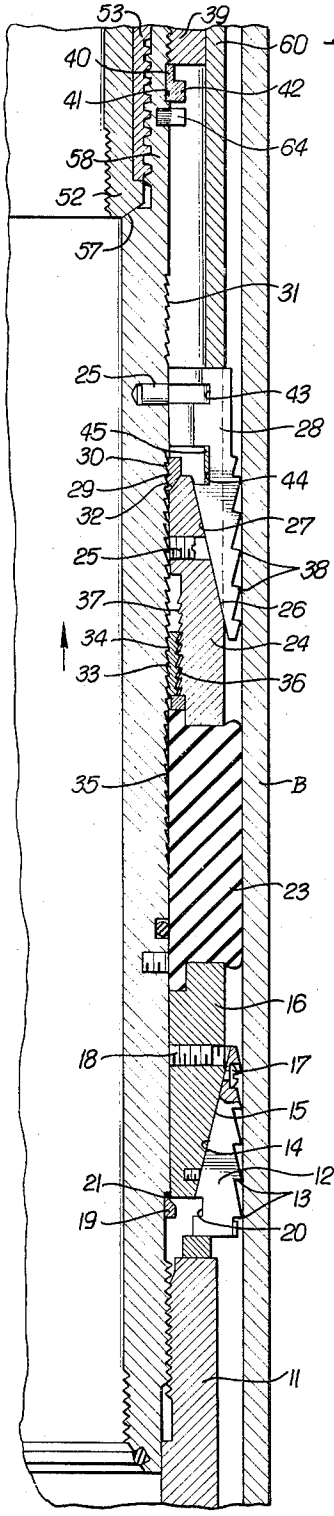
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FIG. 11.



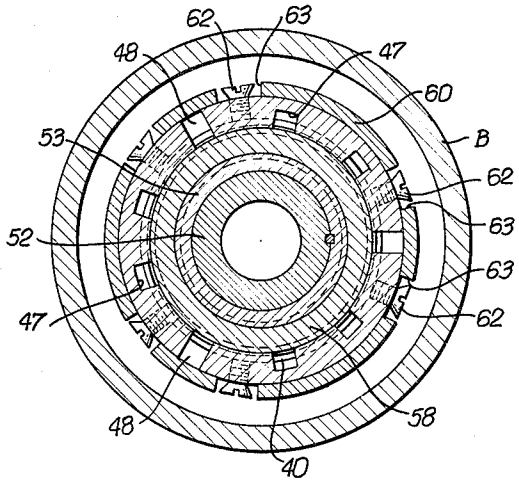


FIG. 9.

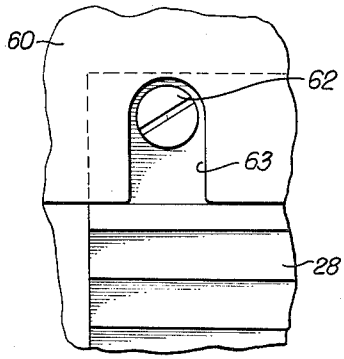


FIG. 10.

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United States Patent Office 3,232,347 Patented Feb. 1, 1966

3,232,347
MECHANICALLY SET WELL PACKER APPARATUS

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Filed May 7, 1962, Ser. No. 192,822
24 Claims. (Cl. 166—136)

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 to perform certain desirable operations or purposes therewithin.

An object of the present invention is to provide a well apparatus, such as well packer apparatus, having normally retracted slips, or the like, which are positively held in retracted position until their outward expansion is desired, and in which the slips cannot be released and expanded prematurely.

Another object of the invention is to provide a well apparatus, such as well packer apparatus, having normally retracted segmental slips positively held in retracted position until their outward expansion is desired, and in which the segmental slips are prevented from moving longitudinally with respect to each other when in retracted position.

A further object of the invention is to provide a well apparatus, such as well packer apparatus, having normally retracted slips, or the like, and embodying a mechanism for positively holding the slips in retracted position until their outward expansion is desired, in which the mechanism also assist in anchoring the slips against the wall of the well casing in which the apparatus is run.

An additional object of the invention is to provide well apparatus, such as well packer apparatus, having normally retracted slips and a tool for preventing and effecting outward expansion of the slips, which tool is made effective by rotating, through a substantial number of revolutions, a running-in string on which the apparatus is lowered in a well bore, wherein inadvertent rotation of the running-in string is still incapable of actuating the tool and releasing the slips for outward expansion, the tool being rotatable periodically in a reverse direction, if desired, to insure its return to its initial position preventing slip expansion.

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 1*a*, 1*b* and 1*c* 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 they occupy when lowering the apparatus in the well casing, FIG. 1*b* constituting a lower extension of FIG. 1*a*, and FIG. 1*c* constituting a lower extension of FIG. 1*b*;

FIGS. 2*a* and 2*b* together constitute partial longitudinal sections, on an enlarged scale, through a portion of the apparatus illustrated in FIGS. 1*b* and 1*c*, FIG. 2*b* being a lower extension of FIG. 2*a*;

FIG. 3 is a view similar to FIG. 2*a* illustrating the parts in another relative position;

FIG. 4 is an enlarged cross-section taken along the line 4—4 on FIG. 1*b*;

FIG. 5 is a side elevational view of a portion of the apparatus, part being broken away to show interior elements;

FIG. 6 is a view similar to FIG. 2*b* illustrating parts in another relative position and with the slips released and expanded against the well casing;

FIG. 7 is a cross-section taken along the line 7—7 on FIG. 2*b*;

FIG. 8 is a cross-section taken along the line 8—8 on FIG. 6;

FIG. 9 is an enlarged cross-section taken along the line 9—9 on FIG. 1*b*;

FIG. 10 is a fragmentary enlarged elevational view of a portion of the apparatus;

FIG. 11 is a partial longitudinal sectional view of the well packer fully anchored in packed-off condition within the well casing.

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 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 parts 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, and on which rest a plurality of segmental lower slips **12** having wickers or teeth **13** facing in a downward direction to anchor the well packer against downward movement in the well casing. 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 initially held in retracted position by shear screws **17** securing them to the lower expander **16**, the latter being initially secured to the body **10** by shear screws **18**. When the lower slips **12** are in retracted position, inadvertent shearing of the screws **17** holding them to the lower expander **16**, and their inadvertent outward expansion, are prevented by a split ring **19** disposed in an internal groove **20** in the slips, which ring engages a downwardly facing shoulder **21** on the body.

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 internal surfaces **27** on a plurality of upper segmental slips **28** surrounding the upper portion of the body **10**. Upward shifting of the upper expander **24** along the body is prevented by its engagement with a split ring **29** having internal upwardly facing ratchet teeth **30** meshing with companion downwardly facing external ratchet teeth **31** on the body. The stop ring **29** can be slipped downwardly on the body into snug engagement with the downwardly tapering portion **32** of the upper expander after the shear screws **25** have been assembled in place, to secure the upper expander to the packer body.

For the purpose of holding the slips **12**, **28** and packing **23** anchored 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 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. The lock ring arrangement forms no part of the present invention and may assume any suitable form. It is provided 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 engaging the casing B to anchor the well packer A against upward movement therewithin. These slips are held initially in a retracted position against the body 10, their upper ends initially engaging a 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 position, such as disclosed in FIGS. 1*b* and 2*b*. However, when the slips 28 expand 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. Such 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. 7 and 8. 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 circumferential 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 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, so as 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 mandrel or inner tubular member 50 adapted to be threadedly secured 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 mandrel has a lower section 52 threadedly secured to its upper section 50, which is piloted within the upper portion of the packer body 10 and which has a nut member 53 mounted thereon and rotationally coupled thereto, as by securing a longitudinal key 54 on the mandrel member received within a companion longitudinal groove or keyway 55 in the nut. The threaded nut 53 engages a flange 56 on the mandrel, the lower end of the mandrel engaging an upwardly facing shoulder 57 on the body 10. The nut 53 is adapted to be threaded into an upper threaded box 58 of the body member 10. When the nut is fully threaded within the body member, the lower end 56 of the mandrel engages the body shoulder 57, thereby securing the mandrel 50 to the body 10 against movement in both directions with respect thereto. However, the mandrel 50 can be rotated, after the well packer has been anchored in packed-off condition in the well casing B, the exertion of sufficient torque on the tubular string D and mandrel turning the threaded nut and effecting its upward threading and complete disconnection from the threaded box 58. Since the threaded interconnection between the nut and body is preferably a left-hand one, right-hand rotation of the tubular string and mandrel will disconnect the mandrel 50 from the packer body 10.

Surrounding the mandrel 50 is a device which retains the upper slips 28 in their initial retracted position, but which can be actuated through appropriate manipulation of the tubular string D and mandrel 50 to release the slips 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.

A disclosed, the slip retaining and slip setting mechanism surrounding the mandrel includes a lower portion 60 of a setting sleeve structure 61, which surronds the upper body ring 39 and which also surrounds the upper portion of the slips 28, holding the latter inwardly against the body 10 and in a position in which their upper internal circumferential groove 43 receives the external holding flange 42 of the retainer ring 40. Relative rotation between the slips 28 and the setting sleeve 60 cannot occur when the latter encompasses the slips by virtue of a substantially radial lock screw 62 threaded in the upper portion of each slip 28 and extending into a longitudinal slot 63 in the lower portion of the setting sleeve. For that matter, relative rotation between the slips 28 and the packer body 10 cannot occur when the slips are in retracted position because of the securing of generally radial pins 64 to the body which extend into the spaces between adjacent slips. Thus, any rotation of the body 10 will be transmitted through the pins 64 to the slips 28, and from the slips through the screws 62 to the setting sleeve structure 61.

The lower section 60 of the setting sleeve structure has its upper portion threadedly secured to the lower end of an upper section 66 of the setting sleeve, which surrounds the mandrel 50. Relative rotation between the upper section 66 of the setting sleeve and the mandrel is prevented by a screw or key 67 secured to the mandrel and extending in a longitudinal slot or keyway 68 in the upper sleeve section. Thus, rotation of the mandrel 50 can be transmitted to the setting sleeve structure 61, while longitudinal movement of the mandrel 50 with respect to the setting sleeve structure can occur when the parts have been conditioned to permit such relative longitudinal movement.

Initially, relative longitudinal movement between the setting sleeve structure 61 and the mandrel 50 is prevented by a lock structure, to prevent the mandrel 50 from shifting the well packer A downwardly with respect to the setting sleeve structure and thereby remove the upper slips 28 from under the setting sleeve section 60, under which condition the springs 45 would expand the upper slips outwardly. The lock structure, which is releasable when the upper slips 28 are to be expanded, includes a nut 70 received within an enlarged diameter portion 71 of the upper setting sleeve section 66, and which has an internal thread 72 meshing with an external thread 73 on the mandrel 50, the nut also having an external thread 74 meshing with an internal thread 75 in the upper enlarged portion 71 of the setting sleeve section 66. Since the nut 70 is threadedly connected initially to both the mandrel 50 and the setting sleeve structure 61, relative longitudinal movement therebetween cannot occur. However, the nut 70 can be threaded relatively along the mandrel and the setting sleeve, fully out of threaded mesh with their respective threaded portions when the upper slips 28 are to be released for expansion; by rotating the mandrel relative to nut.

Rotation of the nut 70 is resisted by a drag device 76. As shown, the drag device includes circumferentially

spaced outwardly bowed springs 77 adapted to frictionally engage the wall of the well casing B, the upper ends of the springs being secured to an upper collar 78 slidable on the mandrel 50, the springs being held in position on the upper collar by a retainer ring 79 and by screws 80 attaching the retainer ring to the upper collar. The lower ends of the outwardly bowed drag springs 77 are secured to a lower collar 81 slidable on the mandrel 50 by a lower retainer ring 82 secured to the lower collar by screws 83. This lower collar 81 is attached to a control sleeve 84 by a plurality of cap screws 85, the control sleeve extending downwardly toward the setting sleeve structure 61. The lower portion of the control sleeve is slotted to provide a plurality of longitudinal arms 86 extending through companion circumferentially spaced external longitudinal slots 87 in the control nut 70, the arms terminating in inwardly directed fingers 88 disposed under the nut. It is apparent that the engagement of the arms 86 with the sides of the nut slots 87 prevents relative rotary movement between the nut and the arms, although relative longitudinal movement therebetween can occur.

Initially, the nut 70 is in its upper position along the mandrel 50 in full threaded mesh therein, binding of the nut on the mandrel being prevented by a longitudinal face 89 at the upper end of the nut engaging a rotational stop element 90 secured to the mandrel 50. The length of internal thread 75 on the setting and holding sleeve structure 61 is substantially greater than the length of thread 73 on the mandrel, so that relative rotation of the mandrel 50 and setting sleeve 61 with respect to the nut 70 will effect an unthreading of the nut from the mandrel 50 before the nut is unthreaded from the internal threads 75 of the setting sleeve structure. When the nut 70 unthreads from the setting sleeve structure 61, it is disposed below its thread 75, as described hereinbelow, and when unthreaded from the mandrel 50, it is disposed below the threaded portion 73 of the latter, as described hereinbelow. The threaded connections 72, 73 and 74, 75 between the nut 70 and the mandrel 50 and between the nut and the setting sleeve 61 are left-hand threaded connections, so that right-hand rotation of the tubular running-in spring D and the mandrel 50, which will effect corresponding right-hand rotation of the setting sleeve 61, will cause the nut 70 to feed relatively downwardly along the mandrel and the setting sleeve, until the nut has become unthreaded from the mandrel 50 and then has become unthreaded from the setting sleeve structure 61.

Initially, the parts occupy the relative position illustrated in FIGS. 1*a* through 2*b*, in which the lower slips 12 and packing structure 23 are in their retracted position, and the upper slips 28 are held retracted by being encompassed by the lower portion of the setting sleeve structure 61. It is to be noted that the nut 70 is then in its upper position in full threaded mesh with the mandrel 50 and also in full threaded mesh with the upper portion of the internal threads 75 of the setting sleeve 61. The mandrel nut 53 has been threaded fully within the packer box 58, the lower end 56 of the mandrel engaging the body shoulder 57 adjacent to its threaded box. The apparatus is run in the well casing, the friction drag springs 77 resisting downward movement of the drag device 76 and of the control sleeve 84 along the casing, so that the nut 70 engages the fingers 88 at the lower ends of the control arms 86 at which time a downwardly facing shoulder 91 on the control sleeve is disposed a substantial distance above the upper end 92 of the setting sleeve structure 61, the parts then being in the position illustrated in FIGS. 1*a*, 1*b* and 1*c*, and FIGS. 2*a* and 2*b*, the drag device being pulled downwardly through the well casing by virtue of engagement of the control nut 70 with the fingers 88. During lowering of the apparatus in the well casing, the mandrel 50 and setting sleeve 61 cannot move longitudinally with respect to each other, which is also true of the well packer A itself, since it is tightly threaded onto the mandrel nut 53. Accordingly, longitudinal movement between the mandrel 50 and setting sleeve 61, on the one hand, and the well packer A, on the other hand, in both longitudinal directions cannot occur, the lower portion of the setting sleeve 60 being retained in its encompassed position around the upper segmental slips 28, the latter being thereby retained in their retracted position.

During lowering of the apparatus in the well casing, any tendency of debris or foreign substances in the latter to engage the well packer A and tend to rotate it and thereby effect a disconnection of the packer body 10 from the mandrel nut 53 is prevented, since the mandrel and packer body are rotationally tied to one another through the radial pins 64 engaging the sides of the slips 28, and because of the fact that the slip screws 62 are disposed within the lower slots 63 of the setting sleeve 60, which is rotationally coupled to the mandrel 50 through the keyway and screw interconnection 68, 67. Thus, no relative movement between the packer A and the other parts can occur at this time, so that assurance is had that the well packer can be run to its desired setting location in the well casing without fear of being inadvertently detached from the mandrel 50.

When the location of the casing B is reached at which the well packer is to be anchored in packed-off condition, the tubular running-in string D and mandrel 50, as well as the well packer A and the setting sleeve mechanism 61, are elevated several inches. The friction drag springs 77 prevent corresponding elevation of the control sleeve 84, so that the control sleeve will then, in effect, move relatively downwardly of the remaining mechanism to the extent at which its shoulder 91 engages the upper end 92 of the setting sleeve 61, at which time the fingers 88 will be disposed a substantial distance below the control nut 70. The tubular running-in string D and mandrel 50 can now be rotated to the right. Such rotation will also effect a rotation of the setting structure 61 because of the key and keyway interconnection 67, 68, the nut 70 remaining stationary, because of the resistance to turning offered by the drag device 76, 84 coupled thereto. Since the threaded interconnections 72, 73 and 74, 75 between the nut 70 and mandrel 50 and between the nut and sleeve 71 are left hand, the nut 70 will be threaded relatively in a downward direction along the mandrel 50 and the sleeve 71, until the nut is completely unthreaded from the external mandrel threads 73. However, to secure a release of the slips 28 from the setting sleeve 60, it is necessary for the mandrel to shift downwardly relative to the latter. Accordingly, rotation of the mandrel 50 to the right is continued, such rotation continuing to turn the setting sleeve structure 61 and effecting a continued downward feeding of the nut 70 along the setting sleeve member 71 until it has become completely unthreaded therefrom and occupies the position illustrated in FIG. 3. At this time, it is to be noted that there is a substantial distance between the mandrel thread 73 and the upper end of the nut 70.

The parts have now been conditioned for release of the slips 28. Such release occurs simply by lowering the tubular string D and mandrel 50, which will shift the well packer A, including its upper slips 28, downwardly, the setting sleeve 60 being prevented from moving downwardly to any significant extent by engagement of the lower end of its internal thread 75 with the nut 70, which is prevented from moving downwardly by resting upon the control sleeve fingers 88, the control sleeve 84 being prevented from moving downwardly by the frictional engagement of the springs 77 against the wall of the well casing B. The downward shifting of the body 10 of the tool and of the upper slips 28 from the sleeve 60 allows the springs 45 to expand, shifting the upper slips 28 outwardly into engagement with the wall of the well casing, as disclosed in FIG. 6. At this

time, the slips 28 are free of the retainer ring 40, but they are located below the setting sleeve 60, which is in a position to engage the slips and 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 outwardly into firm anchoring engagement with the wall of the well casing B. If the upper slips tend to slide along the wall of the well casing, they will move into engagement with the lower end of the setting sleeve 60. Upward movement of this sleeve is resisted by the friction drag device 76, since the upper end 92 of the setting sleeve structure 61 is engaging the shoulder 91 of the control sleeve 84, which is coupled to the drag device. Accordingly, the upper expander 24 can wedge behind the slips 28 and embed their wickers 38 into the wall of the well casing.

The taking of a sufficient upward strain on the mandrel 50 and body 10 of the tool will then shear the screws 25 securing the upper expander to the body, the body 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 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 nut 53 threading upwardly along the body box 58 until it has been completely disconnected therefrom, whereupon the tubular running-in string D can be raised, which will pull the mandrel 50 upwardly with it. A mandrel shoulder 95 may engage the lower end of the lower drag collar 81 to move the drag device 76 upwardly with it, the control sleeve 84 also being shifted upwardly, its fingers 88 engaging the nut 70 and carrying the latter upwardly with it, the nut engaging the lower end of the internal threads 75 of the setting sleeve structure 61 to carry the latter upwardly with it. At that, the parts may be so proportioned that the screw 67 engages the setting sleeve structure 61 at the upper end of the keyway or slot 68, carrying the setting sleeve structure 61, as well as the control sleeve 84 and drag device 71 upwardly with the mandrel. The mandrel 50 and the parts surrounding it can now be removed from the well casing, if desired.

From the foregoing description, it is apparent that an apparatus has been provided which positively precludes inadvertent release and setting of the upper slips 28 until the tool has been appropriately manipulated to secure their outward expansion. In the event of inadvertent twisting or turning of the tubular string D in a right-hand direction, there may be some downward threading of the control nut 70 along the mandrel 50 and the setting sleeve structure 61. However, at periodic intervals during lowering of the apparatus in the well bore, the tubular running-in string may be turned reversely, or to the left, which will effect a return feeding of the nut 70 to its initial position. With the exercise of the precaution noted, assurance is had that the control nut 70 is always in a position coupling the mandrel 50 to the setting sleeve 61 against any substantial relative longitudinal movement, so that the setting sleeve remains in its position encompassing the slips 28, precluding their outward expansion. Moreover, the securing of the slips 28 to the packer body against rotation because of the pins 64, and the further interconnecting of the slips with the lower section 60 of the setting sleeve 61 against rotation, as through use of the screws 62, effectively couples the mandrel 50 to the body 10 against relative rotation through the mandrel screw 67, setting sleeve structure 61, slip stop screws 62, and pins 64, thereby preventing relative turning between the mandrel and the body of the tool, which might otherwise effect a release of the coupling nut 53 from the body box 58, as during lowering of the apparatus in the well casing. The setting sleeve structure 61 not only insures retention of the upper slips 28 in their retracted position until their release is purposely desired, but the setting sleeve structure also aids in insuring the anchoring of the slips against the well casing by offering resistance to their upward movement after they have been released, insuring the firm upward wedging of the upper expander 24 into and behind the upper slips. The entire combination is strong and sturdy in structure, and is yet comparatively economical to manufacture. Expansion of the slips 28 is effected by a spring device which is economical to produce and which is readily assemblable behind the slips, being retained in the slip grooves 44 to maintain the slip segments in transverse alignment during and after their outward expansion into engagement with the wall of the well casing.

I claim:

1. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; normally retracted means on said body and expandable laterally outwardly of said body; spring means for shifting said normally retracted means laterally outwardly of said body; retainer means movable longitudinally relative to said body and encompassing said normally retracted means to prevent lateral outward expansion of said normally retracted means, said retainer means being movable relatively upwardly of said body from encompassing relation to said normally retracted means; means interconnecting said retainer means and body to prevent relative longitudinal movement between said body and retainer means to hold said retainer means in position encompassing said normally retracted means; and means for releasing said interconnecting means to allow relative longitudinal movement between said retainer means and body and relative upward removal of said retainer means from encompassing relation to said normally retracted means to permit said spring means to shift said normally retracted means.

2. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; normally retracted means on said body and expandable laterally outwardly of said body; spring means for shifting said normally retracted means laterally outwardly of said body; retainer means movable longitudinally relative to said body and encompassing said normally retracted means to prevent lateral outward expansion of said normally retracted means, said retainer means being movable relatively upwardly of said body from encompassing relation to said normally retracted means; means interconnecting said retainer means and

body to prevent relative longitudinal movement between said body and retainer means to hold said retainer means in position encompassing said normally retracted means; and means responsive to rotation of body by the said running-in string for releasing said interconnecting means to allow relative longitudinal movement between said retainer means and body to relatively shift said retainer means upwardly of said normally retracted means from encompassing relation therewith to permit said spring means to shift said normally retracted means.

3. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; an expander on said body; expansible slip means engageable by said expander to anchor said body in the well bore; spring means for shifting said slip means laterally outwardly of said body; retainer means movable longitudinally relative to said body and encompassing said slip means to retain said slip means in retracted position, said retainer means being movable relatively upwardly of said body from encompassing relation to said slip means; means interconnecting said retainer means and body to prevent relative longitudinal movement between said body and retainer means to hold said retainer means in position encompassing said slip means; and means for releasing said interconnecting means to allow relative longitudinal movement between said retainer means and body and relative upward removal of said retainer means from encompassing relation to said slip means to permit said spring means to shift said slip means laterally outwardly of said body.

4. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; an expander on said body; expansible slip means engageable by said expander to anchor said body in the well bore; spring means for shifting said slip means laterally outwardly of said body; retainer means movable longitudinally relative to said body and encompassing said slip means to retain said slip means in retracted position, said retainer means being movable relatively upwardly of said body from encompassing relation to said slip means; means interconnecting said retainer means and body to prevent relative longitudinal movement between said body and retainer means to hold said retainer means in position encompassing said slip means; and means responsive to rotation of said body by the running-in string for releasing said interconnecting means and allow relative longitudinal movement between said interconnecting means and body to relatively shift said retainer means upwardly of said slip means from encompassing relation therewith to permit said spring means to shift said slip means.

5. In well apparatus adapted to be set in a well bore: body means adapted to be lowered in the well bore on a running-in string; normally retracted means on said body means and expandable laterally outwardly of said body means; spring means for shifting said normally retracted means laterally outwardly of said body means; retainer means encompassing said normally retracted means to prevent lateral outward expansion of said normally retracted means from its normally retracted position; said retainer means being movable relatively upwardly of said body from encompassing relation to said normally retracted means; means releasably connecting said retainer means to said body means to prevent relative upward removal of said retainer means from its position encompassing said normally retracted means; and means for releasing said releasable means to permit relative upward removal of said retainer means from encompassing relation to said normally retracted means to permit said spring means to shift said normally retracted means.

6. In well apparatus adapted to be set in a well bore: body means adapted to be lowered in the well bore on a running-in string; normally retracted means on said body means movable longitudinally therewith and expandable laterally outwardly of said body means; spring means for shifting said normally retracted means laterally outwardly of said body means; retainer means encompassing said normally retracted means to prevent lateral outward expansion of said normally retracted means; said body means and normally retracted means being movable relatively downwardly of said retainer means to remove said normally retracted means from said retainer means; means releasably connecting said retainer means to said body means to prevent said body means from moving said normally retracted means downwardly of said retainer means from its position encompassed by said retainer means; and means for releasing said releasable means to permit downward movement of said body means and normally retracted means with respect to said retainer means to shift said normally retracted means from its encompassed relation by said retainer means to permit said spring means to shift said normally retracted means.

7. In well apparatus adapted to be set in a well bore: body means adapted to be lowered in the well bore on a running-in string; normally retracted means on said body means movable longitudinally therewith and expandable laterally outwardly of said body means; spring means for shifting said normally retracted means laterally outwardly of said body means; retainer means engaging said normally retracted means to prevent lateral outward expansion of said normally retracted means; said body means and normally retracted means being movable relatively downwardly of said retainer means to remove said normally retracted means from engagement with said retainer means; means releasably connecting said retainer means to said body means to prevent said body means from moving said normally retracted means downwardly of said retainer means from its position engaged by said retainer means; and means for releasing said releasable means to permit downward movement of said body means and normally retracted means with respect to said retainer means to shift said normally retracted means from its engaged relation by said retainer means to permit said spring means to shift said normally retracted means.

8. In well apparatus adapted to be set in a well bore: body means adapted to be lowered in the well bore on a running-in string; an expander on said body means; expansible slip means on said body means engageable by said expander to anchor said body means in the well bore; spring means for shifting said slip means laterally outwardly of said body means; retainer means engaging said slip means to prevent said spring means from shifting said slip means laterally outwardly; said body and slip means being movable relatively downwardly of said retainer means to disengage said slip means from said retainer means; means releasably connecting said retainer means to said body means to prevent said body means from moving said slip means downwardly of said retainer means from its position engaged by said retainer means; and means for releasing said releasable means to permit downward movement of said body means and slip means with respect to said retainer means to shift said slip means from its engaged relation by said retainer means to permit said spring means to shift said slip means.

9. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; normally retracted means on said body and expandable laterally outwardly of said body; spring means for shifting said normally retracted means laterally outwardly of said body; retainer means movable longitudinally relative to said body and including a sleeve encompassing said normally retracted means to prevent lateral outward expansion of said normally retracted means; said sleeve being movable relatively upwardly of said body from encompassing relation to said normally retracted means; means interconnecting said retainer means and body to prevent relative longitudinal movement between said body and retainer means to hold said

retainer means in position encompassing said normally retracted means; and means for releasing said interconnecting means to allow relative longitudinal movement between said retainer means and body and relative upward removal of said sleeve from encompassing relation to said normally retracted means to permit said spring means to shift said normally retracted means.

10. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; an expander on said body; expansible slip means engageable by said expander to anchor said body in the well bore; spring means for shifting said slip means laterally outwardly of said body; retainer means movable longitudinally relative to said body and including a sleeve encompassing said slip means to retain said slip means in retracted position; said sleeve being movable relatively upwardly of said body from encompasing relation to said slip means; means interconnecting said retainer means and body to prevent relative longitudinal movement between said body and retainer means to hold said retainer means in position encompassing said slip means; and means for releasing said interconnecting means to allow relative longitudinal movement between said retainer means and body and relative upward removal of said sleeve from encompassing relation to said slip means to permit said spring means to shift said slip means laterally outwardly of said body.

11. In well apparatus adapted to be set in a well bore: body means adapted to be lowered in the well bore on a running-in string; normally retracted means on said body means movable longitudinally therewith and expandable laterally outwardly of said body means; spring means for shifting said normally retracted means laterally outwardly of said body means; retainer means including a sleeve encompassing said normally retracted means to prevent lateral outward expansion of said normally retracted means; said sleeve being movable relatively upwardly of said body from encompassing relation to said normally retracted means; means releasably connecting said retainer means to said body means to prevent said body means from moving said normally retracted means relatively downwardly of said sleeve from its position encompassed by said sleeve; and means for releasing said releasable means to permit downward movement of said body means and normally retracted means with respect to said sleeve to shift said normally retracted means from its encompassed relation by said sleeve to permit said spring means to shift said normally retracted means.

12. In well apparatus adapted to be set in a well bore: body means adapted to be lowered in the well bore on a running-in string; normally retracted means on said body means expandable laterally outwardly of said body means; means on said body means engaging said normally retracted means to hold said normally retracted means in expanded position in response to longitudinally directed force imposed by said body means; spring means for shifting said normally retracted means laterally outwardly of said body means; retainer means engaging said normally retracted means to prevent expansion of said normally retracted means by said spring means, said retainer means being movable relatively upwardly of said body means and said normally retracted means to permit expansion of said normally retracted means; means for shifting said retainer means relatively upwardly from said normally retracted means to permit said spring means to shift said normally retracted means laterally outwardly and in a position to be reengaged by said retainer means and prevent said normally retracted means from moving upwardly past said retainer means, whereby upwardly directed force imposed by said body means on said normally retracted means holds said normally retracted means laterally outwardly.

13. In well apparatus adapted to be set in a well bore: body means adapted to be lowered in the well bore on a running-in string; an expander on said body means; expandable slip means engageable by said expander to anchor said body means in the well bore in response to longitudinally directed force imposed by said body means; spring means for shifting said slip means laterally outwardly of said body means; retainer means including a sleeve encompassing said slip means to prevent expansion of said slip means by said spring means, said sleeve being movable relatively upwardly of said body and said slip means to permit expansion of said slip means; means for shifting said sleeve relatively upwardly of said body means and from said slip means to permit said spring means to shift said slip means laterally outwardly and to a position to be reengaged by said sleeve which prevents said slip means from moving upwardly past said sleeve, whereby longitudinally directed force imposed by said body means on said expander means and slip means holds said slip means laterally outwardly.

14. 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; normally retracted means on said body expandable laterally outwardly of said body; spring means for shifting said normally retracted means laterally outwardly of said body; 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 mandrel to prevent relative shifting of said retainer from engagement with said normally retracted means; said releasable means being releasable in response to rotation of said mandrel to permit said mandrel to shift said body and normally retracted means longitudinally of said retainer to release said normally retracted means from said retainer.

15. 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; normally retracted means on said body expandable laterally outwardly of said body; spring means for shifting said normally retracted means laterally outwardly of said body; a retainer engaging said normally retracted means to prevent expansion of said normally retracted means by said spring means; means threadedly connected to said mandrel and retainer to prevent relative longitudinal movement of said mandrel and retainer to hold said retainer engaged with said normally retracted means; said connected means being unthreaded from at least one of said mandrel and retainer in response to rotation of said mandrel to permit said mandrel to shift said body and normally retracted means longitudinally of said retainer to release said normally retracted means from said retainer.

16. 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; spring 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 spring means; means threadedly connected to said mandrel and retainer to prevent relative longitudinal movement of said mandrel and retainer to hold said retainer engaged with said slip means; said connected means being unthreaded from at least one of said mandrel and 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.

17. 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; spring 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 spring means; means threadedly connected to said mandrel and retainer to prevent relative longitudinal movement of said mandrel and retainer to hold said retainer engaged with said slip means; said connected means being unthreaded from at least one of said mandrel and 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; means on said body engaging said slip means to prevent relative rotation between said slip means and body when said slip means is in retracted position; and means connecting said slip means and retainer to prevent relative rotation therebetween.

18. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; an expander on said body; segmental slips engageable by said expander to anchor said body in the well bore, said slips having an internal circumferential groove; overlapping band spring elements in said groove extending between adjacent slip segments and constantly tending to shift said slip segments laterally outwardly of said body; retainer means engaging said slip segments to retain said slip segments in retracted position; and means for disengaging said retainer means from said slip segments to permit said band spring elements to shift said slip segments laterally outwardly of said body.

19. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; an expander on said body; slip segments engageable by said expander to anchor said body in the well bore, said slip segments having an internal circumferential groove and also having longitudinal grooves intersecting said circumferential groove; overlapping band spring elements in said circumferential groove extending between adjacent slip segments and constantly tending to shift said slip segments laterally outwardly of said body, each of said spring elements having an outwardly directed portion disposed in a longitudinal groove of a slip segment to prevent substantial relative circumferential movement between said element and said segments; retainer means engaging said segments to retain said segments in retracted position; and means for disengaging said retainer means from said slip segments to permit said band spring elements to shift said slip segments laterally outwardly of said body.

20. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; normally retracted means on said body and expandable laterally outwardly of said body; means for shifting said normally retracted means laterally outwardly of said body; retainer means movable longitudinally relative to said body and encompassing said normally retracted means to prevent lateral outward expansion of said normally retracted means, said retainer means being movable relatively upwardly of said body from encompassing relation to said normally retracted means; means interconnecting said retainer means and body to prevent relative longitudinal movement between said body and retainer means to hold said retainer means in position encompassing said normally retracted means; and means for releasing said interconnecting means to allow relative longitudinal movement between said retainer means and body and relative upward removal of said retaining means from encompassing relation to said normally retracted means to permit said shifting means to shift said normally retracted means.

21. In well apparatus adapted to be set in a well bore: a body adapted to be lowered in the well bore on a running-in string; normally retracted means on said body and expandable laterally outwardly of said body; means for shifting said normally retracted means laterally outwardly of said body; retainer means movable longitudinally relative to said body and including a sleeve encompassing said normally retracted means to prevent lateral outward expansion of said normally retracted means, said sleeve being movable relatively upwardly of said body from encompassing relation to said normally retracted means; means interconnecting said retainer means and body to prevent relative longitudinal movement between said body and retainer means to hold said retainer means in position encompassing said normally retracted means; and means for releasing said interconnecting means to allow relative longitudinal movement between said retainer means and body and relative upward removal of said sleeve from encompassing relation to said normally retracted means to permit said shifting means to shift said normally retracted means.

22. In well apparatus adapted to be set in a well bore 18 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; normally retracted means on said body expandable laterally outwardly of said body; spring means for shifting said normally retracted means laterally outwardly of said body; a retainer member engaging said normally retracted means to prevent expansion of said normally retarcted means by said spring means; means threadedly connected to one of said members and engaging said other member to prevent relative longitudinal movement of said mandrel member and retainer member to hold said retainer member engaged with said normally retracted means; said connected means being unthreaded from said one of said members in response to rotation of said mandrel member to permit said mandrel member to shift said body member and normally retracted means longitudinally of said retainer member to release said normally retracted means from said retainer member.

23. 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; spring 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 spring means; means threadedly connected to one of said members and engaging said other member to prevent realtive longitudinal movement of said mandrel member and retainer member to hold said retainer member engaged with said slip means; said connected means being unthreaded from said one of said members in response to rotation of said mandrel member to permit said mandrel member to shift said body member and slip means longitudinally of said retainer member to release said slip means from said retainer member.

24. 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; spring 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 spring means; means threadedly connected to one of said members and engaging said other member to prevent relative longitudinal movement of said mandrel member and retainer member to hold said retainer member engaged with said slip means; said connected means being unthreaded from said one of said members in response to rotation of said mandrel member to permit said mandrel mem-

ber to shift said body and slip means longitudinally of said retainer member to release said slip means from said retainer member; means on said body engaging said slip means to prevent relative rotation between said slip means and body when said slip means is in retracted position; and means connecting said slip means and retainer member to prevent relative rotation therebetween.

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