April 21, 1970 D. V. CHENOWETH 3,507,327

RETRIEVABLE SUBSURFACE WELL TOOLS

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FIG. 1.

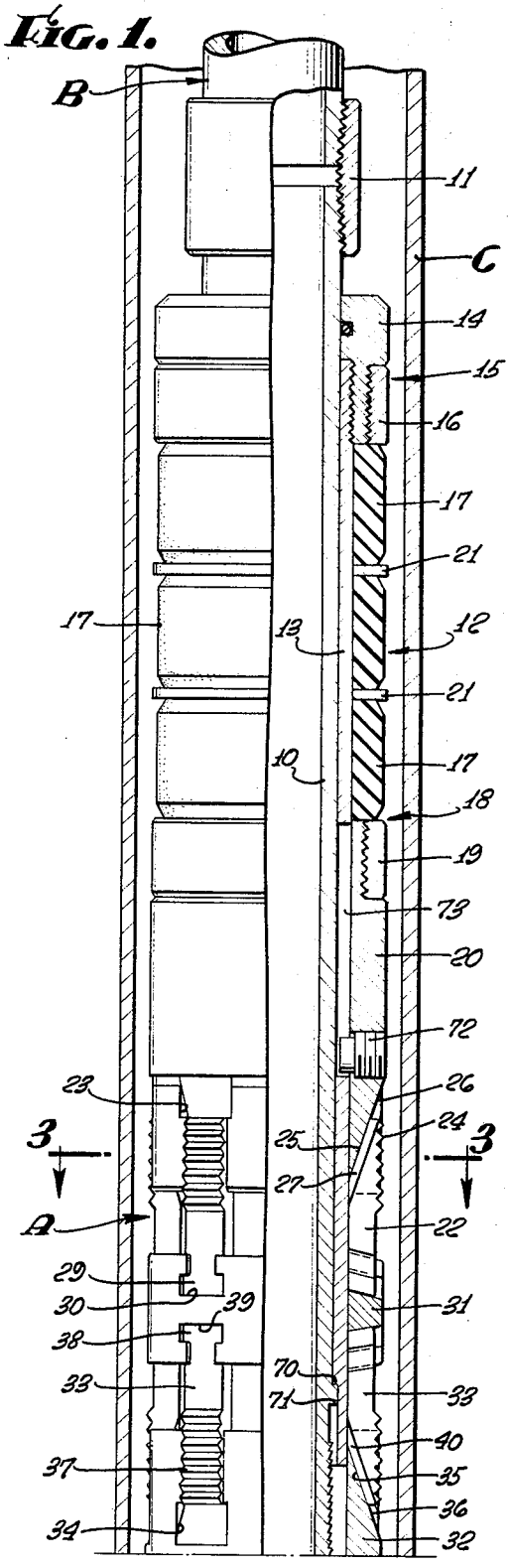

FIG. 1a.

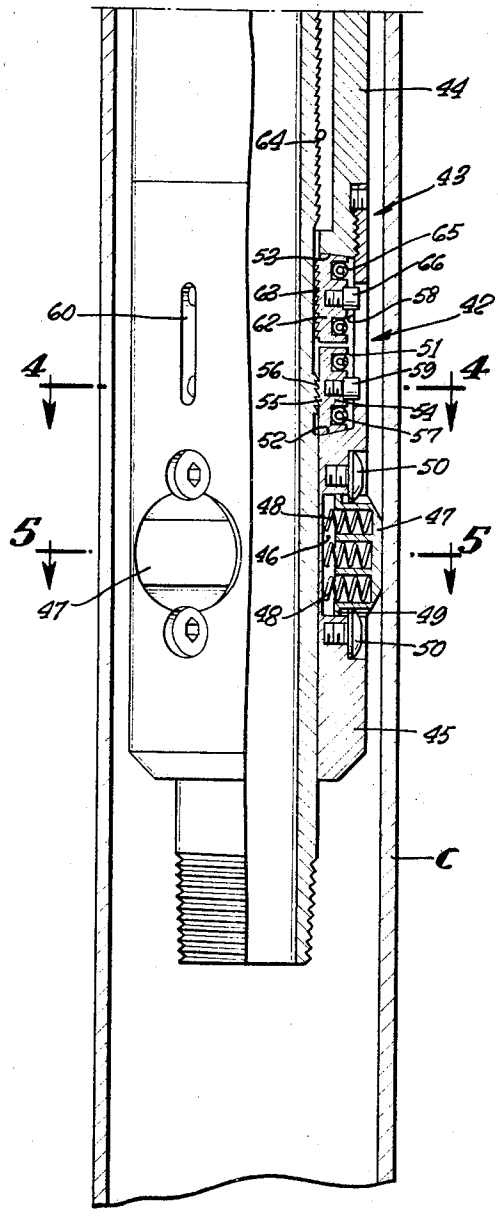

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FIG. 2.

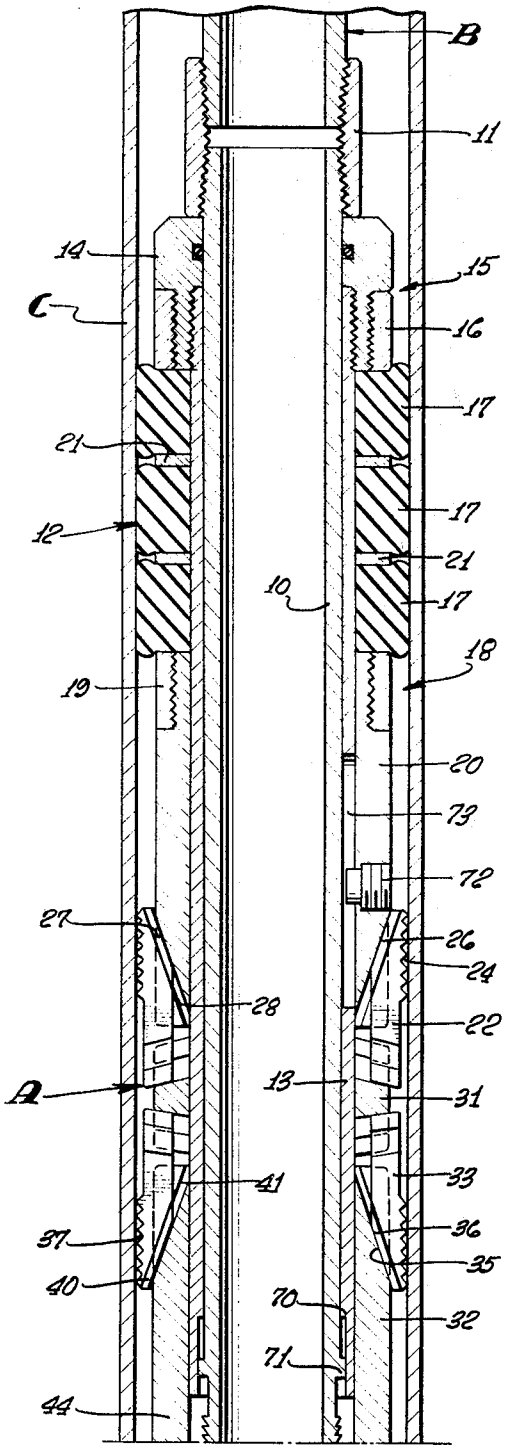

FIG. 2a.

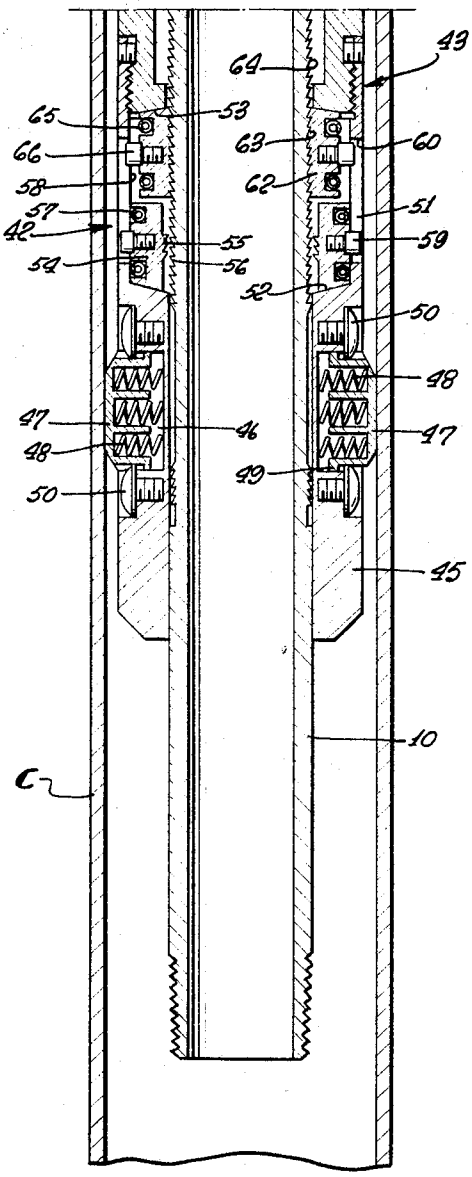

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FIG. 3.

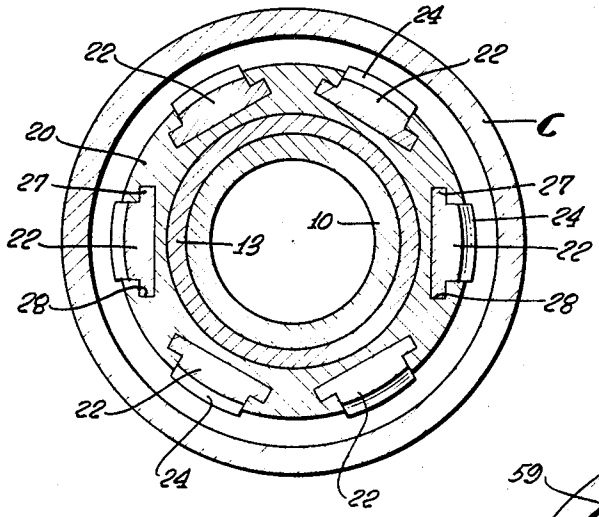


FIG. 4.

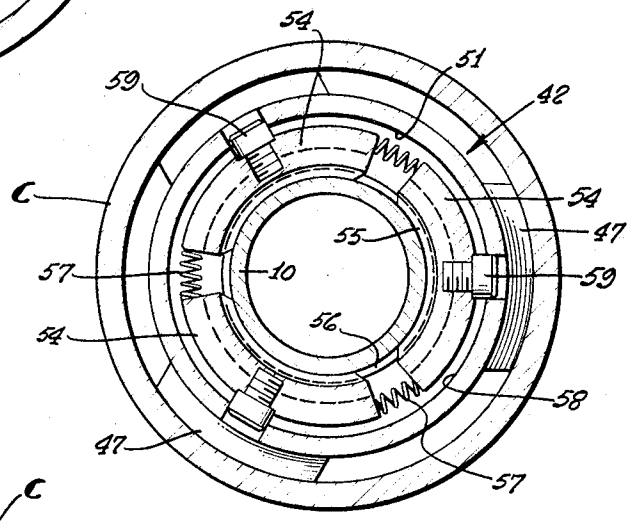
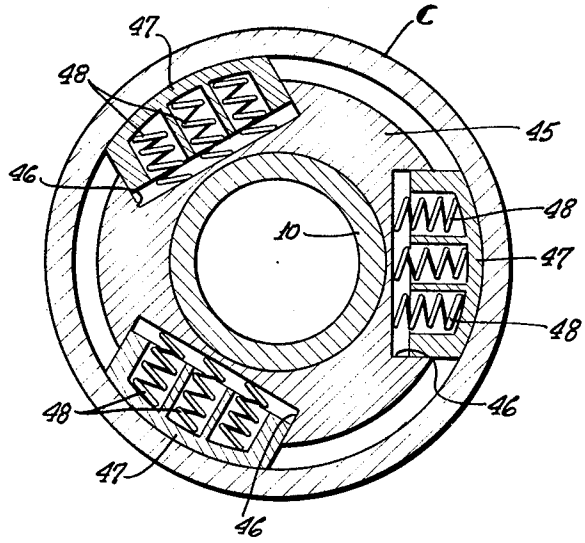


FIG. 5.



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RETRIEVABLE SUBSURFACE WELL TOOLS

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Int. Cl. E21b *33/12*

U.S. Cl. 166—134 23 Claims

ABSTRACT OF THE DISCLOSURE

Well apparatus for lowering in a well casing to be releasably anchored therewithin by moving upper and lower expanders toward each other to expand intervening slips against the well casing, the slips being releasably locked in both their retracted and expanded conditions and readily released from such conditions by rotating a body on which the expanders and slips are carried. A normaly retracted packing structure may also be carried on the body for expansion into sealing engagement with the well casing and retraction therefrom.

The present invention relates to subsurface well bore apparatus, and more particularly to tools, such as anchors and well packers, adapted to be set in well bores.

An object of the invention is to provide an improved retrievable subsurface well bore apparatus, such as a well packer or anchor, adapted to be lowered in a well bore on a tubular running-in string and capable of being anchored in a well casing, or the like, against movement in both longitudinal directions and of remaining in such anchored condition in the absence of applied tubular string weight or tension thereto, or in the presence of such weight or tension, the apparatus being readily releasable from the well casing whenever desired.

Another object of the invention is to provide a retrievable subsurface well bore apparatus, such as a well packer or anchor, adapted to be lowered in a well bore on a tubular running-in string and capable of being anchored in a well casing or the like against movement in both longitudinal directions through use of upwardly and downwardly holding slips coacting with upper and lower expanders, the apparatus remaining in such anchored or set condition with essentially no movement of its parts despite change in direction of longitudinal forces imposed thereon, the slips being readily releasable and retractable from the well casing when retrieval of the apparatus is desired.

A further object of the invention is to provide a retrievable well packer adapted to be lowered in a well casing or the like on a tubular running-in string and capable of being anchored in packed-off condition in the well casing against movement in both longitudinal directions by a packing structure and sets of upwardly holding and downwardly holding slips, the apparatus remaining anchored in such packed-off condition independently of fluid pressure imposed thereon from above or below and without movement of its parts, and yet being readily releasable and retrievable from the well casing whenever desired.

An additional object of the invention is to provide an improved retrievable well tool such as a packer or anchor adapted to be lowered in a well casing or the like, and capable of being anchored in the well casing against movement in both longitudinal directions, the well tool being comparatively simple and economical to produce, but yet of strong and sturdy construction and possessing great versatility.

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 and 1*a* together constitute a combined side elevational and longitudinal sectional view through an apparatus embodying the invention disposed in a well casing with the parts of the apparatus in their initial or retracted positions, FIG. 1*a* being a lower continuation of FIG. 1;

FIGS. 2 and 2*a* together constitute a longitudinal section through the apparatus disclosed in FIGS. 1 and 1*a* after the apparatus has been anchored in packed-off condition in the well casing, FIG. 2*a* being a lower continuation of FIG. 2;

FIG. 3 is an enlarged cross-section taken along the line 3—3 on FIG. 1;

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

FIG. 5 is an enlarged cross-section taken along the line 5—5 on FIG. 1*a*.

As illustrated in the drawings, the invention is embodied in a well packer or bridge plug A adapted to be connected to a tubular running-in string B for lowering in a well casing C to a desired setting point therein. The well packer is of the type capable of being anchored in packed-off condition in the well casing against longitudinal movement in both directions and of being released therefrom for the purpose of its relocation in the well casing or its entire removal therefrom.

The specific well packer illustrated includes a tubular mandrel or body **10**, the upper portion of which is threadedly secured to a body coupling **11** which is, in turn, threadedly attached to the lower end of the string of tubing B, or the like, extending to the top of the well bore, and by means of which the apparatus is moved longitudinally in the well casing, is set therewithin, and is released therefrom. The well packer includes an upper packing structure **12** consisting of an elongate sleeve or body **13** slidable on the inner body or mandrel **10**, with its upper end threadedly secured to the upper head **14** of an upper abutment structure **15**, this latter structure also including an upper gage ring **16** threadedly secured to the head. Surrounding the outer sleeve or body below the head are a plurality of initially and normally retracted packing elements **17**, the uppermost of which engages the upper abutment **15** and the lowermost of which engages a lower abutment **18**, constituted as a lower gage ring **19** threadedly mounted on the upper portion of an upper expander **20** which is adapted for relative sliding movement on the outer sleeve or body **13**. Spacer rings **21** are provided between adjacent packing elements **17**, the latter being made of a suitable pliant and elastic material, such as natural or synthetic rubber, capable of being expanded outwardly upon relative movement of the upper abutment **15** toward the lower abutment **18**, but also being capable of inherently retracting when the abutments are subsequently moved relatively away from each other.

The well packer A is adapted to be anchored against downward movement in the well casing C by the coaction between the upper expander **20** and a set of circumferentially spaced upper slips **22** disposed in slots **23** in the expander. These slips have outer teeth **24** and inner tapered surfaces **25** adapted to engage companion downwardly tapering and inclined surfaces **26** in the expander. Relative downward movement of the expander **20** within the slips **22** will shift the latter outwardly to embed their teeth **24** in the wall of the well casing, whereas relative

upward movement of the expander with respect to the slips will effect retraction of the latter from the casing. Such retraction will occur because of the provision of oppositely directed inclined tongues or flanges **27** on each slip which are disposed within companion grooves **28** in the sides of each slot (FIG. 3), forming a slidable spline connection therebetween. The slips themselves are movable longitudinally jointly, but can partake of independent lateral or radial movement, by virtue of the reception of lower T-shaped heads **29** of the slips in companion T-shaped slots **30** in a slip ring **31** encompassing and slidable relatively on the outer sleeve or body **13**.

The well packer apparatus A is adapted to be anchored to the well casing C against upward movement therewithin by the coengagement between a lower expander **32** and a set of circumferentially spaced lower slips **33** disposed within companion slots **34** in the lower expander. Tapered inner surfaces **35** of the lower slips engage companion tapered surfaces **36** in the base of the slots **34** which are inclined in an upward and inward direction so that relative upward movement of the lower expander **32** within the lower slips will expand the latter outwardly toward the casing to embed their exterior teeth **37** therewithin. As is true of the upper slips, the lower slips have upper T-shaped heads **38** slidable laterally within companion T-shaped slots **39** in the slip ring **31** to cause the lower slips to move jointly in a longitudinal direction while allowing them to shift independently laterally to and from the casing C. Relative downward movement of the lower expander **32** with respect to the slips **33** will effect retraction of the latter from the well casing because of the coaction between inclined oppositely directed tongues or flanges **40** of each slip in companion grooves **41** in the expander on opposite sides of the slot **34** in which the slip is disposed, forming a slidable spline connection therebetween.

A control mechanism **42** is provided between the inner mandrel or body **10** and the parts surrounding it, to releasably secure the several sets of slips **22, 33** and packing structure **12** initially in their retracted positions, to permit expansion of the packing structure and sets of slips against the wall of the well casing, and to releasably retain the packing and slips in such outwardly expanded condition. As specifically illustrated in the drawings, the control mechanism or unit includes a control unit and drag block housing **43** surrounding and slidable relative to the inner body or mandrel **10**. This housing includes an upper portion **44**, integral with and depending from the expander **32** and threadedly secured to a lower control housing portion **45**. The control housing portion **45** has a plurality of circumferentially spaced cavities **46** receiving drag blocks **47** urged outwardly into frictional engagement with the wall of the well casing by a plurality of helical compression springs **48** bearing against the base of the cavity and also against the blocks, outward movement of the drag blocks being limited by engagement of stop shoulders **49** thereon with stop screws **50** threadedly secured to the housing above and below each drag block. The drag blocks **47** resist longitudinal movement of the housing **43** and lower expander **32** in the well casing, as well as rotary movement therein. However, when sufficient force is exerted, the drag blocks **47** will slide frictionally along the wall of the well casing C.

The lower housing portion **45** and the lower end of the housing portion **44** depending from the lower expander **32** define an internal circumferential groove **51**, the lower side **52** of the groove tapering to a slight extent in a downward and inward direction and the upper side **53** of the groove tapering upwardly to a slight extent in an inward direction. Disposed within the groove are upper and lower clutch or lock structures. The lower lock structure includes a plurality of clutch segments or elements **54** having internal ratchet teeth **55** contituted by right-hand buttress threads adapted to mesh with companion righ-hand buttress threads **56** on the body or mandrel **10**. These segments are urged in an inward direction to releasably hold the buttress threads meshing with the body threads by a plurality of encircling helical tension springs **57**. The segments **54** can move radially outward so that their teeth **55** are free from engagement with the lower buttress threads **56** on the body, since there is adequate lateral clearance between the outer surfaces of the thread segments and the outer base portion **58** of the groove in which they are located. Rotation of the segments **54** relative to the housing **42** is prevented by a guide screw **59** threadedly secured to each segment and slidably received within a longitudinally extending slot **60** in the housing. The buttress threads **55, 56** face in the direction disclosed in the drawings, so that the mandrel or body **10** can ratchet upwardly and without rotation through the segments **54**, but cannot be moved downwardly except as a result of rotating the inner body or mandrel **10** relative to the segments, rotation of the segments being prevented or resisted by the frictional engagement of the drag blocks **47** against the wall of the well casing.

The right-hand buttress thread connection is preferably a multiple thread, with each thread having a comparatively large lead so that only a comparatively small number of turns of the body **10** within the segments **54** is required to effect full downward unthreading of the body from the segments, whereupon the body or mandrel **10** is free to continue its downward movement without rotation.

The control unit **42** of the mechanism also includes upper clutch segments or elements **62** having downwardly facing ratchet teeth in the form of multiple threads **63** which are preferably left-hand buttress threads and which are adapted to engage companion buttress left-hand threads **64** extending longitudinally along the body thereabove. Encompassing helical springs **65** engage the segments **62** and urge them inwardly, the segments being adapted to be shifted radially outwardly by the threads **64** upon downward movement of the body **10** and its left-hand buttress threads **64** therealong. Once the left-hand buttress threads **64** are engaged with the internal threads **63**, the body **10** cannot move upwardly relative to the segments **62** unless the body or mandrel **10** is rotated. Such rotation will not effect relation of the clutch segments **62** since the latter are prevented from rotating by guide screws **66** attached to the segments and received within the longitudinal slots **60** within the housing, the guide screws allowing radial inward and outward shifting of the segments **62** but preventing their rotation, in view of the resistance to rotation afforded by the drag blocks **47**.

The left-hand threads **63, 64** are preferably multiple threads having a relatively large lead so that upon rotation of the inner mandrel or body **10**, a lesser number of body turns is required to effect upward feeding of the body within the upper set of clutch segments **62**, as described hereinbelow.

It is to be noted that the outer sleeve or body **13** extends downwardly within the sets of slips **22, 33** and terminates within the lower expander **32**. Its downward position along the inner body or mandrel **10** is limited by engagement of a downwardly facing sleeve shoulder **70** with an external body flange **71** above its left-hand ratchet threads **64**. It is further to be noted that relative rotation between the upper expander **20** and outer sleeve or body **13** is prevented by a radial pin **72** threadedly secured in the upper expander and extending into a longitudinal slot **73** in the sleeve, such pin and slot interconnection, however, permitting downward movement of the sleeve or outer body **13** within the upper expander **20** for the purpose of shortening the packing elements **17** and expanding them outwardly into sealing engagement with the wall of the well casing. For the purpose of insuring against leakage of fluid between the inner and outer bodies, the upper head **14** may have a side seal ring **74** thereon sealingly engaging the periphery of the inner body **10**.

Initially, the parts of the apparatus occupy the relative positions illustrated in FIGS. 1 and 1*a*, in which the packing structure **12** is retracted as well as the upper and lower sets of slips **22**, **33**. The lowermost turn of the left-hand buttress thread **64** on the inner body or mandrel **10** is disposed above the upper clutch segments **62**, whereas the lower buttress thread **56** is in full mesh with the companion internal threads **55** of the lower clutch segments **54**, thereby locking the inner mandrel or body to the control unit housing **43** and the lower expander **32**, preventing downward movement of the inner body **10** with respect thereto. The apparatus is connected to the tubular string B and is inserted in and movable downwardly within the well casing. Downward movement of the tubular string B and body **10** is transferred through the lower clutch members **54** to the housing **42** and results in the drag blocks **47** sliding frictionally along the wall of the well casing. The sleeve or outer body **13** is engaging the body flange **71** and cannot move downwardly therealong so as to inadvertently expand the packing elements **17** against the wall of the well casing. The upper expander **20** cannot shift downwardly along the sleeve **13** in view of the engagement of its radial pin **72** with the sleeve at the lower end of the longitudinal slot **73**. As a result, the upper and lower sets of slips **22**, **33** are retained in their retracted positions by virtue of their tongue and groove interconnections **27**, **28** and **40**, **41** with their respective upper and lower expanders **20**, **32**. Thus, all of the parts externally of the body **10** are retained in their retracted positions allowing the tubular string and apparatus to be moved downwardly through the fluid in the well casing, the latter flowing upwardly through the tubular body into the tubing string and also relatively around the retracted parts.

When the setting location of the well packer A in the well casing C has been reached, the tubular string B and body **10** are rotated to the right to effect a downward unthreading of the lower buttress threads **56** on the mandrel from the lower clutch segments **54**, since the lower clutch segments are prevented from rotating by the frictional engagement of the drag blocks **47** against the wall of the well casing. Inasmuch as the coengaging buttress threads are preferably multiple pitch, only a single turn, for example, is sufficient to complete unscrewing of the mandrel threads **56** from the threads **55** of the lower clutch segments **54**, freeing the mandrel for downward movement with respect to the parts that surround it. The initial downward movement of the inner body or mandrel **10**, as a result of moving the tubular string B downwardly, will cause the body coupling **11** to engage the upper head or abutment **15**, shifting the packing structure **12** and upper expander **20** downwardly toward the lower expander **32**, since downward movement of the latter is resisted by the frictional engagement of the drag blocks **47** against the casing. Such movement of the upper expander toward the lower expander will effect an outward expansion of the upper and lower sets of slips **22**, **33** against the well casing, the left-hand buttress threads **64** shifting downwardly within the segments **62** and ratcheting freely through the latter. In this connection, it is to be noted that the inner mandrel **10** has moved downwardly without rotation within the upper clutch segments **62**, and upon moving within the lower clutch segments **54** will merely cam the latter outwardly, and, in fact, hold them outwardly inasmuch as the left-hand threads **64** are of a different hand from the internal threads **55** of the lower segments.

The tubular string B and body **10** can move downwardly in the manner described until the tool takes some of the weight of the tubular string, which will insure that the upper slips **22** have engaged the wall of the well casing C. Thereafter, the tubing string and body can be pulled upwardly, the left-hand mandrel threads **64** meshing and locking with the segments **62** so that such upward pull is transmitted directly through the lower expander **32**

to the lower slips **33** to insure embedding of their teeth **37** in the wall of the well casing. The tubular string B and body **10** can again be moved downwardly to apply an additional wedging force of the upper expander **22** within the upper slips **22** to insure their firm anchoring against the wall of the well casing.

The application of additional set down weight on the body coupling **11** and upper abutment **15** will shift the upper abutment toward the lower abutment **18** (which is prevented from moving downwardly by the upper slips), to shorten the packing elements **17** and effect their expansion outwardly into firm sealing engagement with the wall of the well casing. As an example, the application of about 10,000 pounds to a well packer adapted to be run and set in 7″ casing is sufficient to securely anchor the apparatus A in packed-off condition in the well casing.

The anchored and packed-off condition of the well packer in the well casing is illustrated in FIGS. 2 and 2*a*, in which it is to be noted that the tool is prevented from moving upwardly in the casing by the wedging action of the lower expander **32** in the lower slips **32**, the tool being prevented from moving in a downward direction by the wedging action of the upper expander **20** in the upper set of slips **22**. The body **10** cannot move downwardly to any further extent in view of the anchoring of the upper slips **22** against the casing, and the firm compression of the packing elements **17** between the outer body **13** and the well casing. The body **10** cannot move upwardly because of the coupling action of the left-hand threads **64** with the upper set of clutch segments **62**, which engage the housing extension **44** of the upper expander, the upper thrust being transmitted through the lower set of slips **33** to the well casing. Thus, the body **10** of the tool is prevented from moving in both longitudinal directions within the well casing irrespective of the application of a set-down force imposed on the body through the tubing string B, or of the taking of an upward or tensile pull on the body through the tubing string, or even in the absence of a set-down or up-strain force on the body imposed by the tubular string, that is, the tubular string B being in a neutral condition.

Similarly, the existence of a comparatively high pressure differential below the tool is incapable of releasing the tool and of leaking past the packing elements **17**, since such pressure differential will act in an upward direction against the expanded packing structure tending to urge the upper abutment **15** in an upward direction, such upper abutment engaging the body coupling **11** and tending to move the body **10** upwardly. Upward movement of the body, however, cannot occur in view of the locking engagement of the left-hand body threads **64** with the upper clutch segments **62**, the upper thrust being transmitted directly through the lower expander **32** to the lower sets of slips **33** and to the well casing C. Assuming a pressure differential to exist in the fluid in the casing above the apparatus, such pressure acts in a downward direction on the packing structure **12** to urge the upper expander **20** downwardly, such downward movement being resisted by the anchoring of the teeth **24** of the upper slips **22** in the well casing.

Thus, regardless of the direction in which a mechanical or hydraulic force is being imposed on the well packer, it remains immovably anchored in packed-off condition in the well casing in much the same manner as a permanent type of packer remains anchored in packed-off condition in the well casing.

In the event it is desired to release the apparatus from the well casing, the tubular string B and inner body or mandrel **10** are rotated to the right while an up-strain is taken thereon. Because of the left-hand threaded connection **64**, **63** between the inner mandrel **10** and the upper segments **62**, such right-hand rotation results in an upward feeding of the body **10** within the parts surrounding, the body coupling **11** moving upwardly away from the upper abutment **15**, and the body flange **71**

engaging the lower shoulder **70** of the outer sleeve or body **13** to shift this sleeve and the upper abutment upwardly with respect to the lower abutment **18** and expander **20**, until the sleeve **13** has moved upwardly to the extent at which it engages the pin **72** secured to the upper expander. At this time, the inherently retractable packing elements **17** will have retracted to their initial position. Continued rotation of the tubular string B and body **10**, with an upstrain taken thereon, will result in the upper expander **20** moving upwardly with respect to the lower expander **32**, such relative upward movement pulling the upper sets of slips **22** inwardly from the casing because of the tongue and groove interconnection **27**, **28**. When the upper slips have been fully retracted, the upward movement of the upper expander **20** will cause the upper slips **22** to pull the slip ring **31** upwardly, which will result in upward movement of the lower slips **33** relative to the lower expander **32** and inward retraction of the lower slips from the wall of the well casing.

Because of the multiple pitch left-hand threads **63**, **64**, in a typical tool approximately four turns of the inner body or mandrel **10** are required to effect a full retraction of the packing elements **17** and upper and lower sets of slips **22**, **23** from the well casing. If desired, the tubular string and inner body can be rotated several additional turns while moving upwardly in the well casing to be assured that the slips and packing elements are fully retracted. In fact, rotation can continue until the left-hand body threads **64** have completely unthreaded from the threads **63** of the upper segments **62**, whereupon continued upward movement of the tubular string B and body **10** will pull the lower right-hand body threads **56** back into engagement with the companion internal threads **55** of the lower clutch segments **54**. Such right-hand threads **56** will ratchet upwardly relatively freely through the lower segments until the well packer parts have returned to the condition illustrated in FIGS. 1 and 1*a*.

The apparatus can now be moved to a new setting location, either upwardly or downwardly, in the well casing, and re-set in the manner described above, or it can be elevated in the well casing and removed entirely therefrom.

It is, accordingly, apparent that a well apparatus has been provided capable of being positively anchored in the well casing against movement in both longitudinal directions. Once the apparatus has been set in the well casing, it will remain in such set condition, regardless of reversal in the direction of forces imposed thereon, whether such forces be mechanically or hydraulically applied, or both. The apparatus will remain in its set condition without further relative movement between its parts, regardless of reversal in the direction of the applied forces, much in the nature of a permanent well packer. The apparatus is easy to run in the well casing and to retrieve. It is relatively simple in construction, and is yet strong and sturdy, possessing a comparatively small number of parts.

I claim:

1. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means on said body means for moving one of said expanders toward the other of said expanders to thereby shift said upper and lower slips laterally outwardly; and releasable lock means acting directly between said body means and said other of said expanders to prevent movement of said expanders away from each other, said lock means along said other of said expanders being released by movement of said body means to permit movement of said expanders away from each other and retraction of said upper and lower slips from the well conduit.

2. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outward thereby into achoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means movable in response to longitudinal movement of said body means in one direction for shifting one of said expanders toward the other of said expanders to thereby shift said upper and lower slips laterally outwardly; and one-way releasable lock means acting between said body means and said other of said expanders permitting movement of said body means in said one direction but preventing longitudinal movement of said body means in the opposite direction, said lock means being released by movement of said body means to permit longitudinal movement of said body means in said opposite direction.

3. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outward thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connections with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means movable in response to longitudinal movement of said body means in one direction for shifting one of said expanders toward the other of said expanders to thereby shift said upper and lower slips laterally outwardly; first releasable lock means acting between said body means and said other of said expanders preventing movement of said body means in said one direction; and second releasable lock means acting between said body means and said other of said expanders permitting movement of said body means in said one direction but preventing longitudinal movement of said body means in the opposite direction, said second lock means being released by movement of said body means to permit longitudinal movement of said body means in said opposite direction.

4. In a well tool adapted to be lowered in a well conduit disposed in a well bore; body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal direction; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means for transmitting longitudinal movement of said body means in one direction to one of said expanders to shift said one expander toward the other expander and shift said upper and lower slips laterally outwardly; first releasable lock means acting between said body means and said other of said expanders pre-

venting said body means from transmitting its movement in said one direction to said one expander; and second releasable lock means acting between said body means and said other of said expanders permitting movement of said body means in said one direction but preventing its movement in the opposite direction relative to said other of said expanders, said second lock means being released by manipulation of said body means to permit longitudinal movement of said body means in said opposite direction.

5. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means for transmitting longitudinal movement of said body means in one direction to one of said expanders to shift said one expander toward the other expander and shift said upper and lower slips laterally outwardly; first releasable ratchet lock means acting between said body means and said other of said expanders preventing said body means from moving in said one direction relative to said other of said expanders but permitting said body means to move longitudinally in the opposite direction relative to said other of said expanders; and second releasable ratchet lock means acting between said body means and said other of said expanders permitting said body means to move in said one direction relative to said other of said expanders but preventing its movement in said opposite direction.

6. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means movable in response to longitudinal movement of said body means in one direction for shifting one of said expanders towards the other of said expanders to thereby shift said upper and lower slips laterally outwardly; a clutch member slidable relatively on said body means and operatively connected to said other of said expanders; a first clutch element movable laterally on said clutch member into clutching engagement with said body means for preventing longitudinal movement of said body means in said one direction; and a second clutch element movable laterally on said clutch member into clutching engagement with said body means for preventing longitudinal movement of said body means relative to said other of said expanders in the opposite direction to lock said upper an lower slips in their outwardly expanded condition.

7. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means movable in response to longitudinal movement of said body means in one direction for shifting one of said expanders toward the other of said expanders to thereby shift said upper and lower slips laterally outwardly; said body means having first and second threaded portions; a clutch member slidable relatively longitudinally along said threaded portions and operatively connected to said other of said expanders; a first threaded clutch element movable laterally on said clutch member and being meshable with said first threaded portion for preventing longitudinal movement of said body means in said one direction with respect to said other of said expanders; a second threaded clutch element movable laterally on said clutch member into threaded mesh with said second portion for locking said upper and lower slips in their outwardly expanded condition; the threads of said first portion and first element being of opposite hand from the threads of said second portion and second element.

8. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means movable in response to longitudinal movement of said body means in one direction for shifting one of said expanders toward the other of said expanders to thereby shift said upper and lower slips laterally outwardly; said body means having first and second buttress thread portions of opposite hands; a clutch member slidable longitudinally along said threaded portions and operatively connected to said other of said expanders; a first clutch element movable laterally on said clutch member and having a buttress thread meshing with the first threaded portion to prevent said body means from moving in said one direction relative to said other of said expanders; and a second clutch element movable laterally on said clutch member and having a buttress thread adapted to mesh with said second threaded portion to lock said upper and lower slips in their outwardly expanded condition.

9. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of a slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means on said body means for moving said upper expander toward said lower expander to thereby shift said upper and lower slips laterally outwardly; and releasable lock means acting directly between said body means and said lower expander to prevent movement of said expanders away from each other, said lock means being released by movement of said body means along said lower expander to permit movement of said expanders away from each other and retraction of said upper and lower slips from the well conduit.

10. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between

and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means movable in response to downward movement of said body means for shifting said upper expander toward said lower expander to thereby shift said upper and lower slips laterally outwardly; and one-way releasable lock means acting between said body means and said lower expander permitting downward movement of said body means but preventing upward movement of said body means, said lock means being released by movement of said body means to permit upward movement of said body means.

11. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means for transmitting downward movement of said body to said upper expander to shift said upper expander toward said lower expander and shift said upper and lower slips laterally outwardly; first releasable lock means acting between said body means and said lower expander preventing said body means from transmitting its downward movement to said upper expander; and second releasable lock means acting between said body means and said lower expander permitting downward movement of said body means but preventing its upward movement relative to said lower expander, said second lock means being released by manipulation of said body means to permit upward movement of said body means.

12. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means movable in response to downward movement of said body means for shifting said upper expander toward said lower expander to thereby shift said upper and lower slips laterally outwardly; a clutch member slidable relatively on said body means and operatively connected to said lower expander; a first clutch element movable laterally on said clutch member into clutching engagement with said body means for preventing downward movement of said body means relative to said lower expander; a second clutch element movable laterally on said clutch member into clutching engagement with said body means for preventing upward movement of said body means relative to said lower expander to lock said upper and lower slips in their outwardly expanded condition.

13. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means for transmitting downward movement of said body means to said upper expander to shift said upper expander toward said lower expander and shift said upper and lower slips laterally outwardly; said body means having first and second threaded portions of opposite hand; a clutch member slidable longitudinally along said threaded portions and operatively connected to said lower expander; a first clutch element movable laterally on said clutch member and having a thread meshing with said first threaded portion to prevent said body means from moving downwardly relative to said lower expander; and a second clutch element movable laterally on said clutch member and having a thread adapted to mesh with said second threaded portion to prevent said body means from moving upwardly relative to said lower expander to lock said upper and lower slips in their outwardly expanded condition.

14. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; means for transmitting downward movement of said body means to said upper expander to shift said upper expander toward said lower expander and shift said upper and lower slips laterally outwardly; said body means having first and second buttress threaded portions of opposite hand; a clutch member slidable longitudinally along said threaded portions and operatively connected to said lower expander; a first clutch element movable laterally on said clutch member and having a buttress thread meshing with said first threaded portion to prevent said body means from moving downwardly relative to said lower expander; and a second clutch element movable laterally on said clutch member and having a buttress thread adapted to mesh with said second threaded portion to prevent said body means from moving upwardly relative to said lower expander to lock said upper and lower slips in their outwardly expanded condition.

15. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against longitudinal movement in both directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; normally retracted packing means on said body means; means on said body means for expanding said normally retracted packing means laterally outwardly and for moving one of said expanders toward the other of said expanders to thereby shift said upper and lower slips laterally outwardly; and releasable lock means acting directly between said body means and said other of said expanders to prevent movement of said expanders

away from each other and to retain said packing means and upper and lower slips in an outwardly expanded condition, said lock means being released by movement of said body means along said other of said expanders to permit retraction of said packing means and movement of said expanders away from each other and retraction of said upper and lower slips from the well conduit.

16. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against longitudinal movement in both directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a sildable spline connection between said lower set of slips and lower expander; normally retracted packing means on said body means longitudinally to one side of one of said expanders; means on said body means acting through said packing means for moving said one of said expanders toward the other of said expanders to shift said upper and lower slips laterally outwardly and to expand said packing means laterally outwardly; and releasable lock means acting directly between said body means and said other of said expanders to prevent retraction of said packing means and upper and lower slips from the well conduit.

17. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against longitudinal movement in both directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a sildable spline connection between said lower set of slips and lower expander; normally retracted packing means on said body means longitudinally to one side of one of said expanders; means for transmitting longitudinal movement of said body means in one direction to said packing means and through said packing means to said one expander for moving said one expander toward the other of said expanders to shift said upper and lower slips laterally outwardly and to expand said packing means laterally outwardly; first releasable lock means acting between said body means and said other of said expanders preventing said body means from transmitting its movement in said one direction to said packing means and said one expander; and second releasable lock means acting between said body means and said other of said expanders permitting movement of said body means in said one direction but preventing its movement in the opposite direction relative to said other of said expanders, said second lock means being released by manipulation of said body means to permit longitudinaly movement of said body means in said opposite direction.

18. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means having first and second threaded portions; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against longitudinal movement in both directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; normally retracted packing means on said body means disposed longitudinally to one side of said expander; means on said body means for transmitting longitudinal movement of said body means in one direction through said packing means to one of said expanders for moving said one expander toward the other of said expanders to shift said upper and lower slips laterally outwardly and to expand said packing means laterally outwardly; a clutch member slidable relatively longitudinally along said threaded portions and operatively connected to the other of said expanders; a first threaded clutch element movable laterally on said clutch member and being meshable with said first threaded portion for preventing longitudinal movement of said body means in said one direction; a second threaded clutch element movable laterally on said clutch member into threaded engagment with said second portion for preventing logitudinal movement of said body means in the opposite direction in order to retain said packing means and upper and lower slips expanded outwardly; the threads of said first portion and first element being of opposite hand from the threads of said second portion and second element.

19. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means having first and second buttress threaded portions; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against longitudinal movement in both directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; normally retracted packing means on said body means disposed longitudinally to one side of said expander; means on said body means for transmitting longitudinal movement of said body means in one direction through said packing means to one of said expanders for moving said one expander toward the other of said expanders to shift said upper and lower slips laterally outwardly and to expand said packing means laterally outwardly; a clutch member slidable relatively longitudinally along said threaded portions and operatively connected to the other of said expanders; a first threaded clutch element movable laterally on said clutch member and being meshable with said first threaded portion for preventing longitudinal movement of said body means in said one direction; a second threaded clutch element movable laterally on said clutch member into threaded engagement with said second portion for preventing longitudinal movement of said body means in the opposite direction in order to retain said packing means and upper and lower slips expanded outwardly; the threads of said first portion and first element being of opposite hand from the threads of said second portion and second element.

20. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means having first and second buttress thread portions of opposite hand; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against longitudinal movement in both directions; said slip means comprising an upper set of slips, a lower set of slips, and a slip ring between and coupled to both sets of slips and having a radially slidable connection with each set of slips; a slidable spline connection between said upper set of slips and upper expander; a slidable spline connection between said lower set of slips and lower expander; normally retracted packing means on said body means above said upper expander;

means for transmitting downward movement of said body means through said packing means to said upper expander to shift said upper expander toward said lower expander and shift said upper and lower slips laterally outwardly and to expand said packing means laterally outwardly; a clutch member slidable relatively longitudinally along said threaded portions and operatively connected to said lower expander; a first clutch element movable laterally on said clutch member and having a buttress thread meshing with said first threaded portion to prevent said upper and lower slips and packing means from being expanded outwardly; and a second clutch element movable laterally on said clutch member and having a buttress thread adapted to mesh with said second threaded portion to lock said packing means and upper and lower slips in their outwardly expanded condition.

21. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; means movable in response to longitudinal movement of said body means in one direction for shifting one of said expanders toward the other of said expanders to thereby shift said slip means laterally outwardly; said body means having first and second threaded portions; a clutch member slidable relatively longitudinally along said threaded portions and operatively connected to said other of said expanders; a first threaded clutch element movable laterally on said clutch member and being meshable with said first threaded portion for preventing longitudinal movement of said body means in said one direction with respect to said other of said expanders; a second threaded clutch element movable laterally on said clutch member into threaded mesh with said second portion for locking said slip means in its outwardly expanded condition; the threads of said first portion and first element being of opposite hand from the threads of said second portion and second element; wherein the threads of said second threaded clutch element and said second portion are a multiple thread.

22. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against movement in both longitudinal directions; means for transmitting downward movement of said body means to said upper expander to shift said upper expander toward said lower expander and shift said slip means laterally outwardly; said body means having first and second buttress threaded portions of oppoosite hand;

a clutch member slidable longitudinally along said threaded portions and operatively connected to said lower expander; a first clutch element movable laterally on said clutch member and having a buttress thread meshing with said first threaded portion to prevent said body means from moving downwardly relative to said lower expander; and a second clutch element movable laterally on said clutch member and having a buttress thread adapted to mesh with said second threaded portion to prevent said body means from moving upwardly relative to said lower expander to lock said slip means in its outwardly expanded condition; the buttress threads of said second clutch element and second threaded portion being a multiple thread.

23. In a well tool adapted to be lowered in a well conduit disposed in a well bore: body means having first and second buttress thread portions of opposite hand; upper and lower expanders on said body means; slip means between and coacting with said expanders and shiftable laterally outwardly thereby into anchoring engagement with the well conduit against longitudinal movement in both directions; normally retracted packing means on said body means above said upper expander; means for transmitting downward movement of said body means through said packing means to said upper expander to shift said upper expander toward said lower expander and shift said slip means laterally outwardly and to expand said packing means laterally outwardly; a clutch member slidable relatively longitudinally along said threaded portions and operatively connected to said lower expander; a first clutch element movable laterally on said clutch member and having a buttress thread meshing with said first threaded portion to prevent said slip means and packing means from being expanded outwardly; and a second clutch element movable laterally on said clutch member and having a buttress thread adapted to mesh with said second threaded portion to lock said packing means and slip means in their outwardly expanded condition; the buttress threads of said second clutch element and second threaded portion being a multiple thread.

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