Sept. 29, 1959 E. H. CLARK, JR 2,906,344

RETRIEVABLE WELL APPARATUS

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FIG. 1.

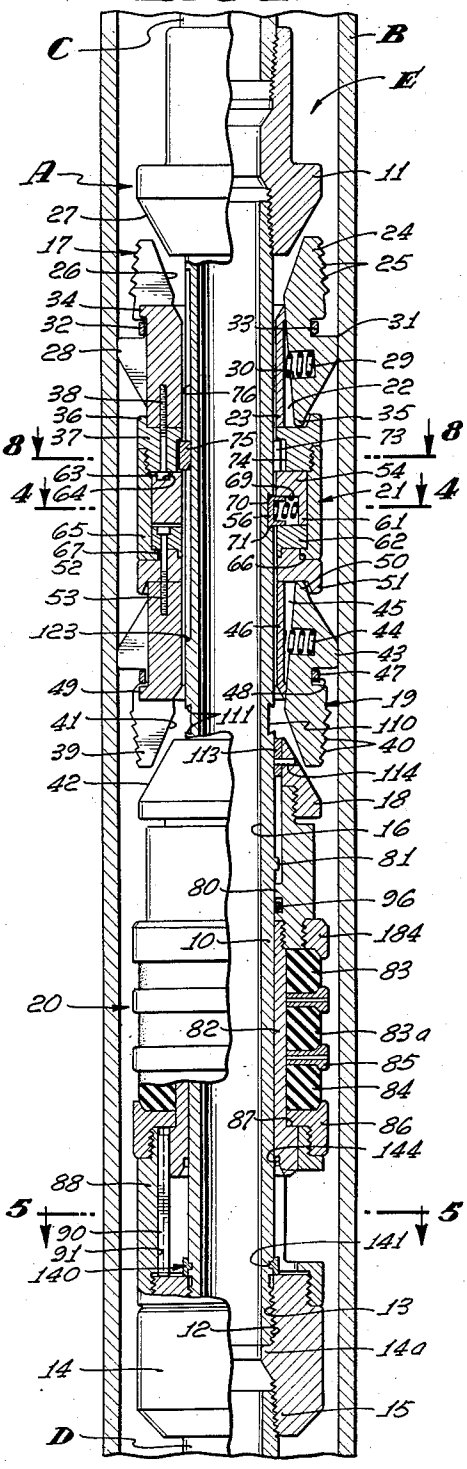
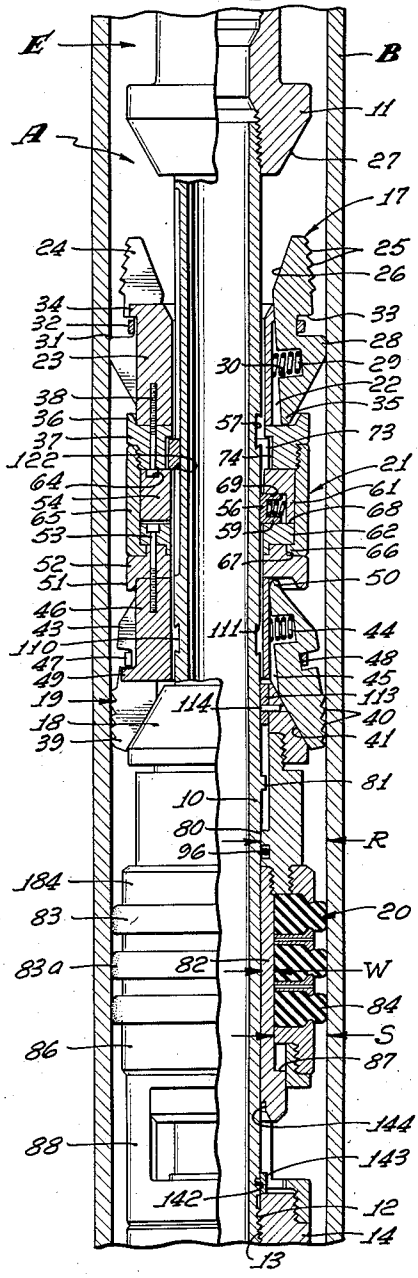


FIG. 2.



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FIG. 3.

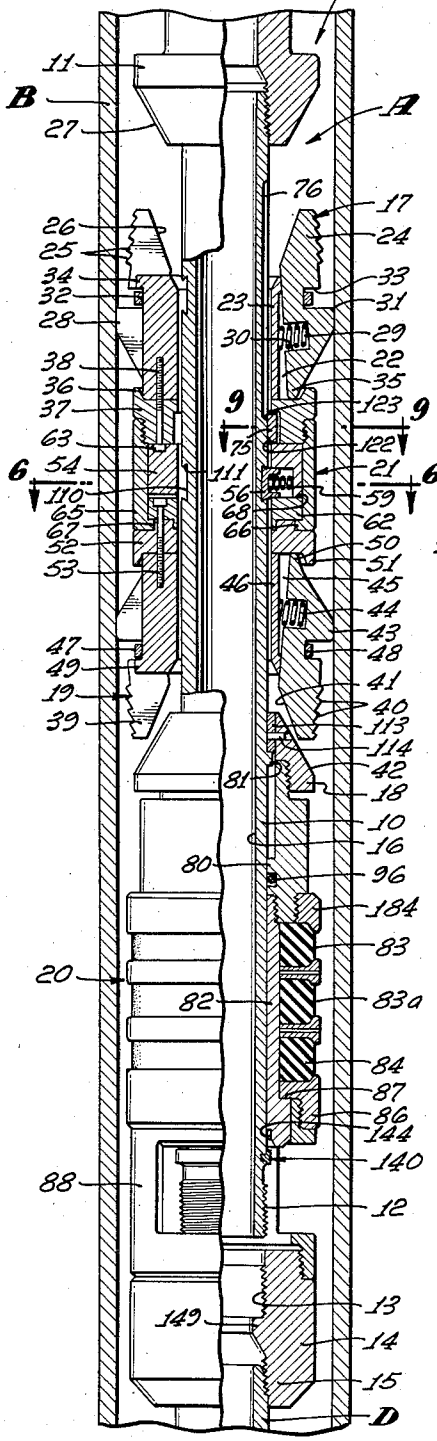


FIG. 4.

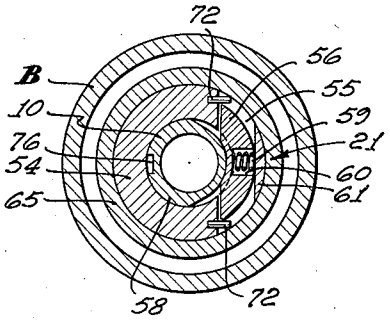


FIG. 5.

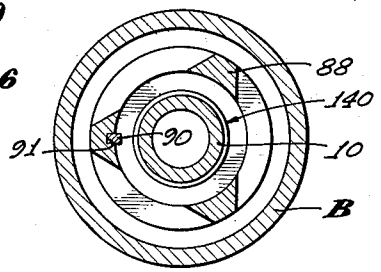
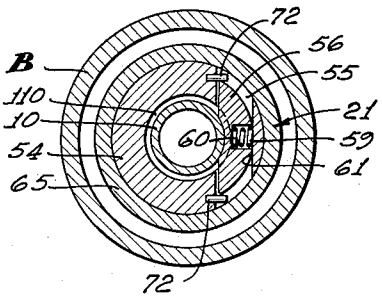


FIG. 6.



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RETRIEVABLE WELL APPARATUS

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FIG. 7.

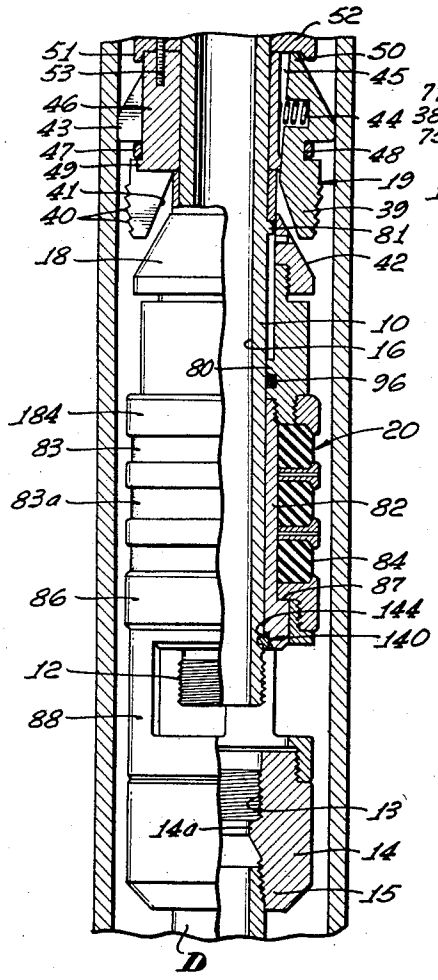


FIG. 8.

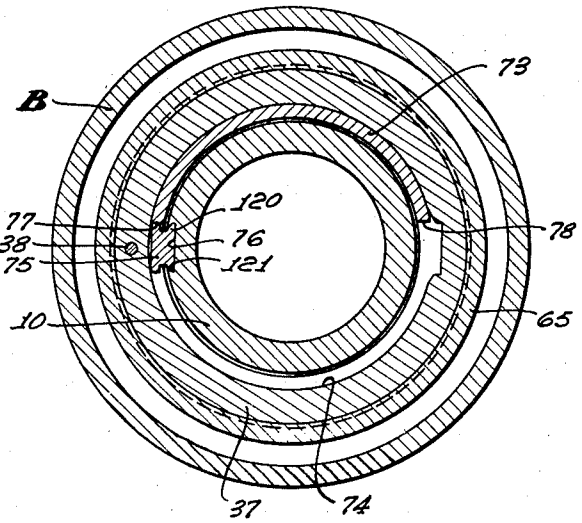
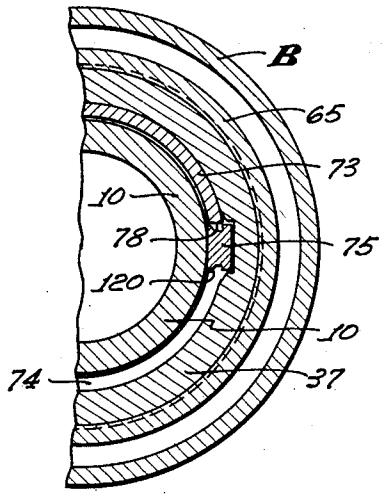


FIG. 9.



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2,906,344

RETRIEVABLE WELL APPARATUS

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Application April 20, 1956, Serial No. 579,619

20 Claims. (Cl. 166—140)

The present invention relates to subsurface well apparatus, and more particularly to apparatus capable of being anchored in a well bore and of being released therefrom for withdrawal to the top of the well bore.

An object of the present invention is to provide an improved retrievable subsurface well apparatus capable of being anchored in a well bore against longitudinal movement and of being locked in a position permitting the apparatus to be withdrawn from the well bore, without danger of inadvertently anchoring it in the well bore during its longitudinal movement therewithin.

Another object of the invention is to provide a retrievable well tool adapted to be anchored in a well bore by means of slips, in which the slips are capable of being irreleasably locked in a retracted position to preclude their inadvertent expansion during elevation of the tool in the well bore.

A further object of the invention is to provide a retrievable well tool capable of being anchored in a well bore by means of an expander movable within slips whose longitudinal movement is resisted by a drag device, in which the tubular string connected to the tool, as well as certain portions of the tool itself, are rotatable without rotating the drag device and other parts around the well bore, which action might damage them.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal section, with portions shown in side elevation, of an apparatus disposed in a well casing, with the parts in retracted position;

Fig. 2 is a view similar to Fig. 1 of the apparatus anchored in packed-off condition in the well casing against upward movement therewithin;

Fig. 3 is a view similar to Fig. 1, illustrating the apparatus with the slips permanently locked in a neutral or retracted position within the well casing;

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

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

Fig. 6 is a cross-section taken along the line 6—6 on Fig. 3;

Fig. 7 is a longitudinal section, partly in side elevation, of the lower portion of the tool disclosed in Fig. 1, with the parts occupying another relative position;

Fig. 8 is an enlarged cross-section taken along the line 8—8 on Fig. 1;

Fig. 9 is an enlarged cross-section taken along the line 9—9 on Fig. 3.

In the specific form of apparatus illustrated in the drawings, a well packer A can be anchored in packed-off condition in a well casing B against substantial longitudinal movement in both directions. The well packer is lowered through the well casing to the desired setting point by means of a tubular string C, such as drill pipe or tubing extending to the top of the hole, and through which fluent material under pressure can be pumped for movement through the well packer and for discharge into the well bore below the well packer. The well packer is capable of being anchored in packed-off condition in the well casing against upward movement therein. It is also capable of being anchored in packed-off condition in the well casing against downward movement therewithin, the packer unit being capable of withstanding extremely high pressure differentials imposed upon it both from below its packed-off location in the well casing, as well as from a region above its packed-off location in the well casing.

The well tool A can be positively locked, to hold its various elements in their retracted positions to permit its upward and downward movement in the well casing, and can be easily released to secure its anchoring in packed-off condition whenever desired. Following the performance of the desired operation or operations in the well bore, the well packer can be shifted, to place its several parts in their retracted position once again to enable the apparatus to be elevated in the well casing to a new setting location, to be entirely removed from the well casing, or to be lowered in the well casing to a new setting location. When the well packer is to be removed from the well casing, its anchoring devices can be locked in a retracted position to preclude their inadvertent expansion against the well casing. In addition, the parts can be placed in a condition permitting the tubular string C to be rotated in expediting threaded disconnection of the tubing joints at the top of the hole, without dragging any packer parts around the wall of the well casing. If difficulty is encountered in retrieving the tool, the major portions of the apparatus can still be removed from the well casing.

As specifically disclosed in the drawings, the well tool A includes an elongate body 10 of tubular form whose upper end is threadedly secured to an upper expander 11, which is, in turn, threadedly secured onto the lower portion of the tubular string C that extends to the top of the well bore. The upper expander could be secured to structural members that intervene between it and the tubular string, if desired. The lower end of the body 10 is provided with an external left-hand thread 12 threadedly secured within a companion internal left-hand thread 13 in a guide member 14 which may be considered as actually constituting part of the tubular body itself. The lower portion of the guide member may have a threaded box 15 to permit tubing D to be attached thereto, if desired, for extension to a lower portion in the well casing B.

The inside diameter of the passage 16 through the body 10 of the tool, as well as through the upper expander 11 and lower guide 14, is comparatively large, being at least equal to the inside diameter of the tubing string C extending to the top of the well bore, to facilitate the pumping of fluent materials, such as cement slurry, and oil mixtures used in fracturing operations, and the like, therethrough. The full bore 16 through the tool also enables other equipment, such as pressure and temperature recording instruments, and jet perforators, capable of being moved down through the tubular string C, to pass therethrough for disposition at any desired location below the well packer A. Such instruments and perforating tools can be removed through the well tool, when desired.

The upper expander **11** coacts with an upper set of circumferentially spaced slip members **17** to anchor the well tool to the well casing against downward movement therein. Slidably mounted on the body or mandrel **10** of the tool is a lower expander **18** that coacts with a lower set of circumferentially spaced slip members **19** to anchor the well packer to the well casing against upward movement therein. Disposed below the lower expander is a packing structure **20** capable of effecting a fluid tight seal against the wall of the well casing B, to prevent passage of fluids under high pressure in both directions between the body **10** of the tool and the casing. The upper expander **11** and upper set of slips **17** operate jointly with the packing structure **20** to anchor the well tool in packed-off condition in the well casing against downward movement, or the lower expander **18** and lower set of slips **19** act jointly with the packing structure **20** to anchor the well tool in packed-off condition within the well casing against upward movement therein. The slips **17**, **19** and packing structure **20** can be prevented from being expanded outwardly into engagement with the well casing by means of a clutch or latch device **21**, which is operable from the top of the well bore. As specifically disclosed in the drawings, this clutch or latch device is located between the upper and lower sets of slips **17**, **19**.

The upper set of slip members **17** is mounted in circumferentially spaced, longitudinally extending slots **22** in an upper slip ring **23** slidable on the body **10** of the tool. Each upper slip member **17** includes an upper gripping portion **24** having external wickers or teeth **25** facing in a downward direction to anchor the tool against downward movement in the well casing, the inner surfaces **26** of such gripping portions being inclined in a downward and inward direction for cooperation with a companion externally tapered surface **27** on the upper expander **11**, in order that downward movement of the upper expander within the slips can expand the gripping portions **24** outwardly into anchoring engagement with the well casing B and hold such gripping portions in such anchoring engagement. Each slip member **17** also includes an intermediate drag block portion **28** adapted to frictionally engage the wall of the well casing. The drag block portions are normally urged into full lengthwise engagement with the wall of the well casing by laterally disposed, helical compression springs **29**, there being one spring disposed in each groove **22**, with its inner portion bearing against the base of the latter and its outer portion bearing against the base of a socket **30** formed within the drag block portion of each slip member. The axis of the spring **29** is below the upper end **31** of the drag block portion, and when forcing the drag block into lengthwise frictional engagement with the well casing B, the upper gripping portion **24** is disposed inwardly substantially out of contact with the wall of the well casing. When the upper expander **11** is moved downwardly within the slips **17**, they will shift the gripping portions **24** outwardly, pivoting the drag block portions **28** about the point or line of engagement of their upper ends **31** with the casing as a fulcrum and away from the well casing. In effect, each slip member **17** is a lever of the first class, in which the upper end **31** of the drag block portion acts as a fulcrum upon the casing, the spring **29** constantly tending to swing the lower portion of the slip member outwardly to engage the drag block portion **28** fully with the well casing and the gripping portion **24** inwardly out of engagement with the well casing. When the upper expander **11** is moved downwardly within the gripping portion **24**, it rocks the slip member **17** about its fulcrum point of engagement **31** with the casing, to shift the upper gripping portion **24** into anchoring engagement with the wall of the well casing and to tilt the lower portion of the slip member in a direction inwardly of the wall of the well casing.

When the expander **11** is out of engagement with the gripping portions **24**, the inner surfaces **26** of the gripping portions are inclined with respect to the expander surface **11**. However, when the expander **11** moves into engagement with such inner surfaces **26**, to tilt the gripping portions **24** outwardly against the well casing, then a full surface contact is made between the expander and the gripping portions.

To insure joint longitudinal movement of the upper slip members **17** within the well casing, and to hold them in transverse alignment with respect to each other, a retaining ring **32** circumscribes the slip members immediately above their drag block portions **28**. This ring is located in external grooves **33** in the slip members, being adapted to engage the upper and lower sides of the slip grooves. The ring **32** also serves to limit outward expansion of the slip members **17** under the influence of the springs **29** prior to insertion of the tool in the well casing, by virtue of the engagement of the base of the slip grooves **33** with the retainer ring. This retainer ring **32** bears against an outwardly directed interrupted flange **34** at the upper end of the upper slip ring **23**, in order that downward movement of the slip ring will cause the flange **34** to engage the retainer ring **32**, which, in turn, engages the bottom of the slip grooves **33** to cause the slips **17** to move jointly with the retainer ring.

Below the drag block portions **28**, the upper slip members **17** incline in a downward and inward direction, terminating in lower foot portions **35** that are adapted to engage an upwardly projecting flange **36** of a stop ring **37** suitably secured to the upper slip ring **23**, as through use of longitudinally extending cap screws **38**. The flange also limits the extent of outward expansion of the slip members **17** under the influence of the springs **29** while the well tool A is out of the well casing B.

The lower set of slips **19** is the same as the upper set of slips, being reversely arranged. Accordingly, it is unnecessary to an understanding of the invention for a complete description of the lower set of slips and its holding arrangement to be given. It is sufficient to state that the lower set of slips **19** has a lower gripping portion **39** with teeth or wickers **40** facing in an upward direction to anchor the tool against upward movement in the well casing. It also has inner surfaces **41** inclined in an upward and inward direction for coaction with a companion tapered surface **42** on the lower expander. It has the drag portion **43** and the springs **44** for urging the drag portion into engagement with the wall of the well casing, the slips being held in appropriate position in circumferentially spaced, longitudinal slots **45** in a lower slip ring **46** by means of a retaining ring **47** disposed in the slip grooves **48** that are engageable with the lower slip ring flange **49**. The upper ends **50** of the lower slips are formed as stop portions engageable with a downwardly extending flange **51** of a lower stop ring **52**, to limit outward expansion of the lower slip members **19** under the influence of the springs **44**. This lower stop ring **52** is suitably secured to the lower slip ring **46**, as by longitudinally extending cap screws **53**.

The clutch device **21** is interposed between the upper and lower sets of slips **17**, **19**. More particularly, it is located between the upper and lower stop rings **37**, **52**. The lower end of the upper stop ring **37** bears upon a limit ring **54**, which has a space or guide groove **55** therein containing a laterally movable lock segment or clutch element **56**. This lock segment is of arcuate form and is urged inwardly into engagement with the mandrel **10** of the tool. It can be received within an arcuate groove **57** extending a substantial distance around the body or mandrel of the tool. Disposed between the ends of the body lock groove **57** is an arcuate bridge segment **58** which can cam or shift the lock segment **56** radially outward when the tubular string C and the body **10** are rotated, as hereinafter described.

The lock segment **56** is urged inwardly against the body

10 and into the arcuate groove 57 by a helical compression spring 59 received within and bearing against the base of a socket 60 formed in the outer portion of the segment, with the outer portion of the spring bearing against a seat 61 integral with the limit ring 54 and extending downwardly across the limit ring space 55. The lower surface of the limit ring 54 bears against a spacer ring 62, which is secured to the lower stop ring 52 by the same screws 53 that attach the lower stop ring to the lower slip sleeve 46. The limit ring 54 is prevented from rotating relative to the upper stop ring 37 and the upper slip structure by virtue of the reception of the heads 63 of the upper cap screws 38 within companion sockets 64 in the upper portion of the limit ring.

The entire slip and clutch structure externally of the body of the tool is held together against relative longitudinal movement by a swivel or coupling sleeve 65 threadedly secured to the upper stop ring 37, and which extends downwardly along the limit ring 54 and the spacer ring 62, there being a lower inwardly directed flange 66 on the swivel sleeve engaging within an external groove 67 defined between the spacer ring 62 and the lower stop ring 52.

By virtue of the fact that the sleeve 65 is connected to the upper stop ring, and because of the fact that relative rotation between the upper stop ring 37 and the limit ring 54 is prevented by the heads 63 of the upper cap screws 38, the sleeve 65, limit ring 54 and upper stop ring 37, as well as the upper slip ring 23 and upper slip structure, can rotate or turn relative to the spacer 62, lower stop ring 52, lower slip ring 46 and the lower slip structure. Such turning movement is only necessary under certain conditions that will be described hereinbelow. When it does occur, it is evident that the limit ring 54 is slidable arcuately upon the spacer ring 62. During such sliding movement, the lower side of the lock segment 56 can also slide along the upper surface of the spacer ring 62. In this connection, it is to be noted that actually the space or groove 55 in which the lock segment or clutch element 56 is laterally slidable is defined by the upper surface 68 of the spacer ring 62 and by the opposed wall 69 of the limit ring, the upper and lower sides of the lock segment 56 sliding along the upper side 68 and downwardly directed wall 69 of the spacer ring and limit ring, respectively.

The spring 59 urges the lock segment 56 inwardly. When the arcuate body groove 57 is in alignment therewith, the lock segment 56 can move into the groove 57 for the purpose of coupling the entire upper and lower slip structures to the body 10 in a particular position with respect to the upper and lower expanders 11, 18. Such position is a neutral one, in which neither the upper nor lower slips 17 or 19 can be anchored against the well casing. To insure the appropriate coupling action between the body 10 of the tool and the lock segment 56, the groove 57 is only slightly wider than the longitudinal extent of the segment, and the upper and lower sides 70 of the groove are inclined toward each other in an outward direction for coaction with companion inclined sides 71 on the portion of the lock segment 56 that enters the groove, in order that longitudinal movement in both directions of the body or mandrel 10 of the tool will tend to retain the lock segment 56 in the groove, and thereby insure the coupling of the body of the tool to the clutch structure surrounding it. When the body 10 of the tool is rotated to the proper extent, the arcuate bridge segment 58 on the body will engage the lock segment 56 and shift it outwardly from the groove 57, whereupon the body 10 of the tool can move longitudinally in both directions with respect to the lock segment, and with respect to the entire slip structure surrounding the body. During its movement into and out of the groove 57, the lock segment 56 is guided by pins 72 secured in parallel relation to the limit ring 54 and extending into the groove 55 containing the lock segment.

The relative location of the body 10 of the tool with respect to the lock segment 56, so as to permit the lock segment to move into the groove 57, or to be shifted and held out of the groove, is positively determined. Thus, the locating or limit sleeve 54 has an upwardly extending arcuate stop segment 73 therein that projects upwardly within a counterbore or space 74 in the upper stop ring 37. The space 74 is of a length corresponding to the length of a key 75 partially positioned therein and slidable within a longitudinally extending keyway or groove 76 in the body or mandrel 10 of the tool. The key 75 is movable arcuately with the body 10 of the tool to the extent limited by its engagement with the opposite ends 77, 78 of the stop segment 73. When the body 10 of the tool is turned in one direction, as in a counter-clockwise direction, or to the left, to place the key 75 in engagement with one end 77 of the stop segment, then the arcuate body groove 57 will have been moved into longitudinal alignment with the body lock segment 56, whereupon the spring 59 can shift the lock segment 56 into the groove 57, to clutch the body 10 to the clutch members surrounding it when the groove 57 is transversely aligned with the segment. On the other and, rotation of the tubular string C and the body 10 connected thereto in a clockwise direction, or to the right, will shift the body 10 with respect to the lock segment 56, the lock segment, if in the groove 57, not interfering with such relative rotation of the body because of the arcuate extent of the groove, until the body bridge segment 58 engages the lock segment 56 and shifts it laterally completely out of the groove 57. When the key 75 engages the opposite end 78 of the arcuate stop segment 73, the bridge or cam 58 will have shifted or cammed the lock segment completely out of the arcuate groove 57 and will be in alignment therewith to hold it laterally outward within the ring space 55 to prevent it from moving back into the groove. When in this position, the body 10 of the tool can be shifted longitudinally in both directions with respect to the slip structure, the clutch segment 56 merely sliding along the periphery of the body 10.

As described above, the lower expander 18 is slidably mounted on the tool body 10, its upward movement therealong being limited by engagement of an internal shoulder 80 of the expander with an external body flange 81. The packing structure 20 is also operatively connected to the lower expander. This structure includes a booster sleeve 82 threadedly secured to the lower portion of the expander 18 for slidable movement therewith with respect to the body. Surrounding the booster sleeve is an upper packing ring 83, an intermediate packing ring 83*a*, and a lower packing ring 84, made of rubber or rubber-like material, the upper packing sleeve or ring 83 engaging the lower end of the expander 18, which functions as an abutment, as well as an upper gauge ring 184 threaded on the lower expander to reduce the clearance space with the well casing B through which the rubber packing material may extrude when the packing ring 83 is expanded outwardly. The rings 83, 83*a*, 84 are separated by spacer rings 85, the lower packing ring or sleeve 84 engaging a lower gauge ring 86 which is relatively slidable along the exterior of the booster sleeve 82. Downward movement of the lower gauge ring 86 along the booster sleeve 82 is limited by engagement of the gauge ring 86 within a lower shoulder 87 on the sleeve.

The lower gauge ring 86 is, in effect, a lower abutment which is movable toward the upper abutment or expander 18 for the purpose of foreshortening the packing sleeves 83, 83*a*, 84 effecting their outward expansion into sealing engagement with the wall of the well casing B. The lower ring 86 is movable toward the lower expander 18 as a result of upward movement of the packer body 10. Thus, as described above, the packer body is threaded into the guide 14, the upper end of the guide being threaded onto the lower end of a skeletonized thrust tube 88 which is threadedly secured to the lower

gauge ring **86**. Assuming that the lower expander **18** is prevented from moving upwardly, upward movement of the body **10** will cause the lower gauge ring **86** to move along the booster sleeve **82** toward the lower expander **18** to foreshorten the packing elements **83**, **83***a*, **84** and expand them outwardly into engagement with the well casing. Relative rotation between the booster sleeve **82** and the thrust tube **88** is prevented by securing a key **90** to the lower portion of the booster sleeve below the lower gauge ring **86**, which is slidable in a longitudinal keyway **91** in the thrust tube. Although the key and keyway connection **90**, **91** prevents relative rotation between the booster sleeve **82** and the thrust tube **88**, it permits relative longitudinal movement between these parts to take place.

In the operation of the apparatus disclosed in Figs. 1 to 8, inclusive, and so far described, the body **10** of the tool is turned until the key **75** engages the end **77** of the stop segment **73**, which will place the body in the position to permit the lock segment **56** to enter the clutch groove **57** in the body. The body **10** is then moved longitudinally within the slip and packing structure in the proper direction until the lock segment snaps into the groove. When this occurs, the slips **17**, **19** are locked in a neutral position between the upper and lower expanders **11**, **18**, which will preclude relative longitudinal movement between the expanders and the slips, and thereby prevent expansion of the upper and lower slips into anchoring engagement with the wall of the well casing. In addition, the retention of the packing structure **20** in its retracted position, such as disclosed in Fig. 1, is assured. The lower expander **18** is prevented from moving upwardly along the body **10** to expand the lower slips **19** into engagement with the casing by engagement of the expander shoulder **80** with the body flange **81**. The left-hand body threads **12** are threaded completely into the guide **14** until the lower end of the body engages a shoulder **14***a* in the guide, which will couple the guide **14**, thrust tube **88** and lower gauge ring **86** for movement with the body. Since the lower gauge ring **86** engages the shoulder **87** on the booster sleeve **82**, and since the latter is threadedly connected to the lower expander **18**, the lower expander will move downwardly with the body.

The apparatus A is attached to the tubular string C and is inserted in the well casing B. The drag block portions **28**, **43** of the upper and lower sets of slips **17**, **19** offer resistance to downward movement of the slip structures in the well casing. However, in view of the fact that the slip structures are coupled to the body **10** of the tool, by virtue of the lock segment **56** being disposed in the body groove **57**, downward movement of the tubular string and body through the well casing forces the slip structures downwardly in the well casing, the drag block portions **28**, **43** frictionally sliding along the wall of the well casing. However, during such downward movement, the clutch **21** prevents the upper expander **11** from moving downwardly within the upper set of slips **17** to expand the latter outwardly.

When the location in the well bore is reached at which it is desired to anchor the tool in packed-off condition against upward movement in the well casing, it is only necessary to rotate the tubing string C and the body **10** to the right. Since the friction drag block portions **28**, **43** are resisting turning of the slip structures, the body **10** and the key **75** are turned, to rotate the bridge segment **58** with the body in a clockwise direction and place it behind the lock segment **56**, urging the latter out of the groove **57**. The fact that the lock segment is completely out of the groove is positively determined by engagement of the key **75** with the other end **78** of the arcuate stop segment **73**. The tubing string C and body **10** are now elevated, which will permit the body to move upwardly through the slip structures, in view of the unclutching of the latter with respect to the body. The periphery of the body **10** merely slides along the lock segment **56**. As upward movement of the body takes place, the guide **14**, thrust tube **88**, packing structure **20** and lower expander **18** are moved upwardly with it, until the lower expander moves into the lower slips **19**, shifting their gripping portions **39** outwardly into anchoring engagement with the wall of the well casing. Upon the occurrence of such anchoring engagement, the lower expander **18** is prevented from moving upwardly to any further extent. Accordingly, a continuation of the upward movement of the tubing string C and the body **10** of the tool will then move the lower gauge ring **86** toward the upper gauge ring **184** and expander **18**, foreshortening the rubber packing rings or sleeves **83**, **84** and expanding them outwardly into sealing engagement with the wall of the well casing.

The well packer A is now anchored in packed-off condition within the well casing against upward movement therewithin. The packing rings **83**, **84** firmly seal against the wall of the well casing, as well as against the periphery of the booster sleeve **82**, whereas leakage of fluid between the booster sleeve **82** and expander **18**, on the one hand, and the body **10**, on the other hand, may be precluded by the provision of a rubber-like seal ring **96** in the lower expander **18**, slidably and sealingly engaging the periphery of the body.

Cement slurry, acid, formation fracturing material, or the like, may now be pumped down through the tubular string C and through the bore **16** in the body **10**, which is of a large internal diameter, for discharge into the formation at some point below the set position of the well tool A. The fluid under pressure is prevented from forcing the tool up the hole because of the anchoring of the lower slips **19** against the well casing B. It is also prevented from leaking by the tool, by virtue of the expanded packing structure **20**.

When it is desired to release the tool A, it is merely necessary to move the tubular string C and body **10** in a downward direction, which will remove the compressive force on the packing structure **20**, allowing it to retract, and which will also effect a movement of the lower expander **18** downwardly out of wedging engagement with the lower set of slips **19**. The relative downward movement of the body **10** through the slip structure is assured because of the frictional resistance to longitudinal movement offered by the drag block portions **28**, **43** of the slips **17**, **19**. If it is desired to place the slips **17**, **19** in a neutral position, in order to move the tool longitudinally to a new location in the well casing, or to remove the tool from the well casing, the tubing string C is merely turned to the left until the keyway **75** again engages the end **77** of the arcuate stop segment **73**, which will insure the movement of the lock segment **56** into the groove **57** when the body is moved downwardly to align the groove with the lock segment. When the lock or clutch segment **56** is moved into the groove **57**, assurance is had that the slips **17**, **19** are locked against being expanded outwardly upon movement of the tool A in both longitudinal directions in the well casing B.

Assuming that the tool has been anchored in packed-off condition against upward movement in the well casing, as disclosed in Fig. 2, and a pressure differential is then imposed on fluid in the annulus E above the tool between the tubular string C and the well casing B, as, for example, by swabbing the tubing string, the tool will resist downward movement within the well casing. As the pressure is built up on the fluid in the annulus, such pressure will act in a downward direction over the entire annular cross-sectional area R of the packing structure **20** extending from the periphery of the body **10** to the wall of the well casing B, to urge the packing structure **20**, thrust tube **82**, guide **14** and body **10** in a downward direction, the body **10** and tubing string C being placed in tension and actually being stretched in a downward direction. Such downward movement will carry the lower expander **18**

downwardly with it out of engagement with and away from the lower slips **19**, permitting the springs **44** to again rock the slips **19** and place their drag portions **43** in full frictional engagement with the wall of the well casing, tilting the gripping portions **39** inwardly out of engagement with the wall of the well casing. Downward stretching of the tubular string C and of the body **10** of the tool can occur until the upper expander **11** enters the upper set of slips **17**, rocking their gripping portions **24** outwardly to engage and wedge their wickers **25** into anchoring engagement with the wall of the well casing. Further downward movement of the body **10** of the tool cannot occur. The tool is now anchored against downward movement in the well casing and its packing structure **20** is also packed-off against the well casing B, to prevent fluid pressure above the tool from being imposed on the fluid in the well casing below the packing structure **20**.

The imposition of the fluid pressure differential in the tubing-casing annulus E above the packing structure **20** cannot effect release of the packing structure. The lower gauge ring **86** is resisting downward movement of the packing structure by virtue of the fact that the tubular string C and the body **10** are connected thereto through the guide **14** and thrust tube **88**. This lower gauge ring **86** is exerting an upward force on the packing structure **20** over the annular cross-sectional area S of the latter extending between the periphery of the booster sleeve **82** and the wall of the well casing B. On the other hand, the pressure differential above the packing structure **20** is tending to move it downwardly and is acting over the entire annular area R of the packing structure, running from the periphery of the body **10** of the tool to the wall of the well casing. This annular area R is substantially greater than the area S over which the gauge ring is acting on the packing structure, by an amount at least equal to the cross-sectional area W of the booster sleeve **82** itself. Accordingly, there is a predominating force tending to shift the upper expander **18** and its gauge ring **84** toward the lower gauge ring **86**, to maintain the packing structure **20** compressed against the casing, which will hold the packing structure sealed off against the well casing during the downward stretching of the tubular string C, the packing sleeves **83**, **84** sliding, while in such packed-off condition, along the wall of the casing to the extent permitted by engagement of the upper expander **11** with the upper slips **17** and the anchoring of the latter against the wall of the well casing. The area W of the booster sleeve **82** insures that the packing structure **20** will not retract during the transferring movement of the body **10** of the tool to engage the upper expander **11** with the upper set of slips **17**, which would permit the fluid pressure to by-pass the packing structure and equalize around the tool. During the downward transferring of the tool to engage the upper expander with the upper slips, the lock segment **56** is ineffective to move into the circumferential body groove **17**, since the arcuate bridge segment **58** of the body is then in alignment with the lock segment and will prevent such entry into the groove. Accordingly, the body **10** can slide through the clutch structure **21** in effecting the necessary transfer of the holding force.

As the pressure in the tubing-casing annulus E above the tool A is relieved, the tensile force on the tubular string C is also relieved, allowing the tubular string to contract towards its original position, the upper expander **11** moving out of the upper slips **17** and the lower expander **18** moving back into the lower slips **19**. During all this time, the packing structure **20** remains in packed-off condition, merely sliding along the wall of the well casing, while remaining in firm sealing engagement therewith. When the parts have returned to the position disclosed in Fig. 2, pressure can again be applied, if desired, down through the tubing string C and the body **10** of the tool, and on the hole formation below the tool, the lower set of slips **19** preventing upward movement of the tool within the casing B under the action of such pressure.

When it is desired to retrieve the tool A from the well bore, its body **10** is rotated to the left to place the key **75** against the end **78** of the arcuate stop segment **73**, which will then disalign the bridge segment **58** with respect to the lock segment **56**. The tubular string C and body **10** can now be moved longitudinally in the proper direction until the lock groove **57** is in alignment with the clutch segment **56**, permitting the spring **59** to move the latter inwardly into the groove **57** and clutch the segment to the body **10** of the tool. During such downward movement, the packing structure **20** is shifted to its retracted position, the engagement of the lock segment **56** in the groove **57** insuring the retention of the packing structure **20** in its retracted position and the sets of slips **17**, **19** in their retracted or neutral positions relative to the expanders **11**, **18**. When the expander moves out of engagement with the slips, the springs **29**, **44** are effective to rock the drag portions **28**, **43** into full engagement with the wall of the well casing B, and the gripping portions **24**, **39** inwardly away from the wall of the well casing, such gripping portions then being in retracted position.

The tool may now be elevated in the well casing and removed from the well bore. if desired.

While the apparatus is in the well bore, the full bore **16** through it permits testing equipment, such as pressure recorders, to be lowered completely through the tool, as well as other equipment, such as jet perforators, that are capable of being passed down through the tubing string C. The full bore **16** through the tool also insures the absence of any restriction to flow of fluent materials through the tool that are to be pumped into the formation, such as sand suspended in a liquid medium, cement slurry, and the like.

The apparatus can be operated in the manner described above, to be anchored in packed-off condition against longitudinal movement in either a downward or an upward direction. The slips **17**, **19** and packing **20** can be returned to their initial retracted positions and locked in such position by causing the lock segment **56** to enter the lock groove **57** in the mandrel or body **10** of the tool. However, there is the possibility of the tubular string C and the body **10** of the tool being inadvertently rotated during longitudinal movement of the tool in the well casing, as movement in an upward direction, which might cause the bridge portion or cam **58** to shift the lock segment **56** out of the groove **57**, which would then permit one of the expanders, such as the lower expander **18**, to move upwardly within the lower slips **19** and anchor them against the well casing. If this action were to occur while the tubular string C was moving at a rather rapid rate upwardly in the well casing, damage to the tool or to the tubular string itself might occur.

In the tool disclosed in the drawings, the slips **17**, **19** can be locked in their retracted position and prevented from being inadvertently released from such position, to prevent one of the expanders, such as the lower expander **18**, from shifting a set of slips into anchoring engagement with the well casing. To accomplish this purpose, a lower circumferentially continuous groove **110** is provided in the body **10** of the tool at a particular distance below the groove **57**. This lower groove **110** does not have any bridge piece or cam portion, but extends the full 360 degrees around the body of the tool. Dimensionally, it is substantially the same width as the upper groove **57** and is provided with opposed sides **111** which converge toward each other in a direction laterally outwardly of the body of the tool, in order to conform with the companion tapered sides **71** of the inner portion of the lock segment **56**.

When the left-hand threaded connection **12**, **13** between the lower end of the body **10** and the guide **14** is fully engaged, as disclosed in Fig. 1, the lower circumferential groove **110** cannot be moved upwardly

sufficiently to receive the lock segment **56**. In the event it is desired to lock both sets of slips in a position that will positively preclude their subsequent outward expansion into engagement with the well casing B, the well tool A is anchored in packed-off condition against upward movement in the manner disclosed in Fig. 2. Such setting action will cause the lower slips **19** and expander **18**, as well as the packing structure **20** therebelow, to resist rotation of the sleeve **88** and the guide **14**. This will permit the tubular string C to be turned to the right, the turning effort being transmitted through the upper expander **11** to the body **10**. By virtue of the left-hand threaded connection **12, 13** with the guide **14**, the body will unscrew in an upward direction with respect to the guide **14**. The lower portion of the body **10** is unscrewed completely from the guide **14**, which will then permit the body to be shifted upwardly sufficiently to place the lower circumferentially continuous groove **110** opposite the lock segment **56**, whereupon the latter can be shifted by its spring **59** into this groove, which will lock the entire slip structure to the body and prevent subsequent relative longitudinal movement therebetween.

During the right-hand rotation of the body **10**, the guide **14** may, in fact, be threaded downwardly relative to it, carrying the packing structure parts **20** downwardly with it to a retracted position, so that the lower expander **18** is substantially removed from behind the lower slips **19** when the lower circumferential groove **110** receives the lock segment **56**. Once the lock segment enters the lower circumferential groove, it cannot be removed therefrom, the upper and lower slips **17, 19** being then movable with the tubular string C and the body **10**. The upper expander **11** can no longer be shifted downwardly with respect to the upper slips **17**, while the lower expander **18** cannot be shifted upwardly within the lower slips **19** since the flange **81** on the body will engage a shear ring and expander support **113** releasably secured within the lower expander by one or more shear pins **114**. The apparatus can now be withdrawn from the well bore, with the anchoring portions **24, 39** of both the upper and lower sets of slips occupying their retracted positions, such as disclosed in Fig. 3.

In addition to the circumferentially continuous groove **110** irreleasably locking the sets of slips **17, 19** to the body **10** of the tool, it also permits the sections of tubing C to be unscrewed at the top of the well bore, by rotating the tubular string located within the well bore. Such rotation of the tubular string can take place without rotating the slips around the wall of the well casing, and particularly the drag block portions **28, 43** thereof.

In accomplishing the purpose just mentioned, the locating key **75**, which determines the position of the lock segment **56** in alignment with the lock groove **57** or the bridge and cam piece **58**, is shifted out of the longitudinal keyway **76** in the body. Actually, the inner portion of the key **75** has opposed flanges or dovetailed portions **120** sliding within companion grooves **121** in the side of the keyway **76**, which will rotationally connect the key **75** to the body **10** of the tool while permitting relative longitudinal movement between these parts to occur. However, it is to be noted that the lower inner end **122** of the key is tapered, being inclined in an outward and downward direction for engagement by a companion tapered surface **123** on the body at the lower portion of the keyway. This lower portion of the keyway does not have the dovetailed side grooves **121** therein, but, instead, is made of an arcuate width slightly greater than the width of the key **75** itself. Accordingly, when the body **10** of the tool has been unscrewed from the guide **14**, and the body has been elevated with respect to the lock segment **56**, the key **75** is cammed by the inclined surfaces **122, 123** laterally out of the keyway **76** and into the arcuate space **74** in the stop ring **37**. Actually, the body **10** of the tool will move upwardly along the inner surface of the key **75** when the lock segment **56** shifts into the circumferentially continuous lower groove **110**, which will remove all connection between the body **10** of the tool and the key. Thus, the lock segment **56** will be located in the circumferentially continuous lock groove **110**, and the key **75** will be held out of the keyway **76**, being capable of sliding freely on the periphery of the body **10**, the parts then occupying the positions disclosed in Fig. 3.

The tubular string C and the body **10** of the tool can now rotate freely within the slip structure, the lower expander **18**, and the packing structure **20** therearound, as well as relative to the lock segment **56**, there being no tendency for the body to turn the parts externally thereof with it. Accordingly, more rapid disconnection of the threaded joints of the tubular string C at the top of the hole can be made, to expedite the elevation of the apparatus A in the well casing and its complete removal therefrom at the top of the hole.

Under some conditions encountered in the well bore, the body **10** may be elevated within the slip structure sufficiently to permit the lock segment **56** to enter the circumferentially continuous groove **110**, but the lower slips **19** might not be freed from the well casing B. Should this occur, the body of the tool is permitted to move upwardly to a greater extent relative to the lower expander **18**. Thus, the body flange **81** will engage the ring **113** secured to the expander **18**. An adequate pull is taken on the body **10** to shear the screws **114** holding the shear ring **113** to the expander, which will then permit the slips **17, 19** to move upwardly relative to the lower expander **18** to a sufficient extent as to come free from their anchoring condition against the well casing. This position of parts is disclosed in Fig. 7, which might result in freeing of the tool and allow it to be removed from the well casing.

If, however, the shearing of the ring **113** from the lower expander still does not result in complete freeing of the tool within the well casing, then the body **10** of the tool and the slip structure therearound may be freed from the packing structure **20** and removed from the well casing B, leaving the packing structure behind.

It is to be noted that the body **10** of the tool immediately above its left-hand thread **12** is provided with a T shaped ring **140**, the leg portion **141** of which is received within a companion groove **142** in the body and the head portion **143** of which extends outwardly of the body periphery. Upon the shearing of the ring **113** from the expander **18**, the T shaped ring **140** will fit within a recess **144** in the booster sleeve **82** and engage the lower portion of the latter. A sufficient upward strain can now be taken on the body **10** of the tool, which will either free the packing structure **20** from the well casing, or will shear the leg portion **141** of the ring from the head portion **143**, completely freeing the body of the tool from the packing structure. The body **10** of the tool and the slip structure surrounding it can now be elevated in the well casing, leaving the lower expander **14**, packing structure **20**, thrust sleeve **88**, guide **14**, and depending tubing D behind.

The shear ring **113** not only provides a positive connection between the body **10** of the tool and the lower expander **18**, to assist in elevating the latter in the well casing, but it also supports the expander against inwardly directed forces imposed when the expander is wedged upwardly within the lower slips **19**. The shear ring **113** engages the periphery of the body, and provides a backing to the upper portion of the expander, resisting its inward deformation.

It is, accordingly, apparent that a retrievable well apparatus has been provided in which the slips can be irreleasably locked in a retracted position when the tool is to be withdrawn from the hole. In addition, the relationship between the parts allows the tubular string C to be rotated, to effect a speedy disconnection of its joints

at the top of the well bore without dragging any of the apparatus parts around the wall of the well casing. The body of the tool will positively move the lower expander 18 in an upward direction when coming out of the hole, or the positive connection between these parts can be disrupted if it is necessary to do so in connection with the freeing of the slips from the well casing. Finally, the body of the tool and the slip structure can be removed from the well bore completely, leaving the packing structure 20 therebehind in the event the latter cannot be moved within the well casing.

The inventor claims:

1. In a well tool adapted for operation in a well bore: a body member connectible to a tubular running-in string for moving the tool within the well bore; a clutch member slidable on said body member and rotatable relative thereto; one of said members having a first groove; a clutch element movable laterally on the other of said members into said first grove to couple said members for longitudinal movement together; cam means on said one member operable in response to relative rotation between said members to engage and shift said clutch element laterally from said first groove to uncouple said members from each other; said one of said members having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said members for longitudinal movement together and to permit said members to rotate more than one revolution with respect to each other.

2. In a well tool adapted for operation in a well bore: a body member connectible to a tubular running-in string for moving the tool within the well bore; a clutch member slidable on said body member and rotatable relative thereto; said body member having a first groove; a clutch element movable laterally on said clutch member into said first groove to couple said members for longitudinal movement together; cam means on said body member operable in response to relative rotation between said members to engage and shift said clutch element laterally from said first groove to uncouple said members from each other; said body member having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said members for longitudinal movement together and to permit said members to rotate more than one revolution with respect to each other.

3. In a well tool adapted for operation in a well bore: a body member connectible to a running-in string for moving the tool within the well bore; a clutch member slidable on said body member and rotatable relative thereto; said body member having a first groove; a clutch element movable laterally on said clutch member into said first groove to couple said members for longitudinal movement together; cam means on said body member between the ends of said first groove, said cam means being operable in response to relative rotation between said members to engage and shift said clutch element laterally from said first groove to uncouple said members from each other; said body member having a second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said members for longitudinal movement together.

4. In a well tool adapted for operation in a well bore: a body member connectible to a tubular running-in string for moving the tool within the well bore; a clutch member slidable on said body member and rotatable relative thereto; one of said members having a first groove; a clutch element movable laterally on the other of said members into said first groove to couple said members for longitudinal movement together; cam means on said one member operable in response to relative rotation between said members to engage and shift said clutch element laterally from said first groove to uncouple said members from each other; said one of said members having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said members for longitudinal movement together and to permit said members to rotate more than one revolution with respect to each other; and coengageable means on said members for selectively locating said clutch element in position for engagement by said cam means or in position for movement into said first groove.

5. In a well tool adapted for operation in a well bore: a body member connectible to a tubular running-in string for moving the tool within the well bore; a clutch member slidable on said body member and rotatable relative thereto; said body member having a first groove; a clutch element movable laterally on said clutch member into said first groove to couple said members for longitudinal movement together; cam means on said body member operable in response to relative rotation between said members to engage and shift said clutch element laterally from said first groove to uncouple said members from each other; said body member having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said members for longitudinal movement together and to permit said members to rotate more than one revolution with respect to each other; and coengageable means on said members for selectively locating said clutch element in position for engagement by said cam means or in position for movement into said first groove.

6. In a well tool adapted for operation in a well bore: a body member connectible to a running-in string for moving the tool within the well bore; a clutch member slidable on said body member and rotatable relative thereto; said body member having a first groove; a clutch element movable laterally on said clutch member into said first groove to couple said members for longitudinal movement together; cam means on said body member between the ends of said first groove, said cam means being operable in response to relative rotation between said members to engage and shift said clutch element laterally from said first groove to uncouple said members from each other; said body member having a second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said members for longitudinal movement together; and coengageable means on said members for selectively locating said clutch element in position for engagement by said cam means or in position for movement into said first groove.

7. In a well tool adapted for operation in a well bore: a body member connectible to a running-in string for moving the tool within the well bore; a clutch member slidable on said body member and rotatable relative thereto; one of said members having a first groove; a clutch element movable laterally on the other of said members into said first groove to couple said members for longitudinal movement together; cam means on said one member operable in response to relative rotation between said members to engage and shift said clutch element laterally from said first groove to uncouple said members from each other; said one of said members having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said members for longitudinal movement together and to permit said members to rotate more than one revolution with respect to each other; said one of said members having a keyway; a key slidable longitudinally in said keyway, said key being engageable with the other of said members for selectively locating said clutch element in position for engagement by said cam means or in position for movement into said first groove; and means on said one of said members for shifting said key from said keyway

when said members have been moved longitudinally to a position permitting said clutch element to enter said second groove.

8. In a well tool adapted for operation in a well bore: a body member connectible to a running-in string for moving the tool within the well bore; a clutch member slidable on said body member and rotatable relative thereto; said body member having a first groove; a clutch element movable laterally on said clutch member into said first groove to couple said members for longitudinal movement together; cam means on said body member operable in response to relative rotation between said members to engage and shift said clutch element laterally from said first groove to uncouple said members from each other; said body member having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said members for longitudinal movement together and to permit said members to rotate more than one revolution with respect to each other; said body member having a keyway; a key slidable longitudinally in said keyway, said key being engageable with said clutch element for selectively locating said clutch element in position for engagement by said cam means or in position for movement into said first groove; and means on said body member for shifting said key from said keyway when said members have been moved longitudinally to a position permitting said clutch element to enter said second groove.

9. In a well tool: a body adapted to be moved longitudinally in a well conduit; normally retracted means on said body rotatable relative thereto and expandible outwardly into engagement with the well conduit in response to longitudinal movement of said body; said body having a first groove; a clutch element movable laterally on said normally retracted means into said first groove to couple said body and normally retracted means for longitudinal movement together; cam means on said body operable in response to relative rotation between said body and normally retracted means to engage and shift said clutch element laterally from said first groove to uncouple said body and normally retracted means from each other; said body having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body and normally retracted means for longitudinal movement together and to permit said body and normally retracted means to rotate more than one revolution with respect to each other.

10. In a well tool: body means adapted to be moved longitudinally in a well conduit; normally retracted means on said body rotatable relative thereto and expandible outwardly into engagement with the well conduit in response to longitudinal movement of said body means; one of said means having a first groove; a clutch element movable laterally on the other of said means into said first groove to couple said body means and normally retracted means for longitudinal movement together; a cam on said one of said means operable in response to relative rotation between said body means and normally retracted means to engage and shift said clutch element laterally from said first groove to uncouple said body means and normally retracted means from each other; said one of said means having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body means and normally retracted means for longitudinal movement together and to permit said body means and normally retracted means to rotate more than one revolution with respect to each other.

11. In a well tool: body means adapted to be moved longitudinally in a well conduit; normally retracted means on said body rotatable relative thereto and expandible outwardly into engagement with the well conduit in response to longitudinal movement of said body means; one of said means having a first groove; a clutch element movable laterally on the other of said means into said first groove to couple said body means and normally retracted means for longitudinal movement together; a cam on said one of said means operable in response to relative rotation between said body means and normally retracted means to engage and shift said clutch element laterally from said first groove to uncouple said body means and normally retracted means from each other; said one of said means having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body means and normally retracted means for longitudinal movement together and to permit said body means and normally retracted means to rotate more than one revolution with respect to each other; said one of said means having a keyway; a key slidable longitudinally in said keyway, said key being engageable with the other of said means for selectively locating said clutch element in position for engagement by said cam or in position for movement into said first groove; and means on said one of said means for shifting said key from said keyway when said body means nad normally retracted means have been moved longitudinally to a position permitting said clutch element to enter said second groove.

12. In a well tool: a body adapted to be moved longitudinally in a well conduit; normally retracted means on said body rotatable relative thereto and expandible outwardly into engagement with the well conduit in response to longitudinal movement of said body; said body having a first groove; a clutch element movable laterally on said normally retracted means into said first groove to couple said body and normally retracted means for longitudinal movement together; cam means on said body operable in response to relative rotation between said body and normally retracted means to engage and shift said clutch element laterally from said first groove to uncouple said body and normally retracted means from each other; said body having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body and normally retracted means for longitudinal movement together and to permit said body and normally retracted means to rotate more than one revolution with respect to each other; said body having a keyway; a key slidable longitudinally in said keyway, said key being engageable with said normally retracted means for selectively locating said clutch element in position for engagement by said cam means or in position for movement into said first groove; and means on said body for shifting said key from said keyway when said body and normally retracted means have been moved longitudinally to a position permitting said clutch element to enter said second groove.

13. In a well tool: a body adapted to be moved longitudinally in a well conduit; expander means on said body; slip means slidable longitudinally, and rotatable with respect to said body and coacting with said expander means to anchor said body to the conduit against substantial longitudinal movement; said body having a first groove; a clutch element movable laterally on said slip means into said first groove to couple said body and slip means for longitudinal movement together; cam means on said body operable in response to relative rotation between said body and slip means to engage and shift said clutch element laterally from said first groove to uncouple said body and slip means from each other; said body having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body and slip means for longitudinal movement together and to permit said body and slip means to rotate more than one revolution with respect to each other.

14. In a well tool: body means adapted to be moved longitudinally in a well conduit; an expander on said body means; slip means slidable longitudinally and rotat-

able with respect to said body means and coacting with said expander to anchor said body means to the conduit against substantial longitudinal movement; one of said means having a first groove; a clutch element movable laterally on the other of said means into said first groove to couple said body means and slip means for longitudinal movement together; a cam on said one of said means operable in response to relative rotation between said body means and slip means to engage and shift said clutch element laterally from said first groove to uncouple said body means and slip means from each other; said one of said means having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body means and slip means for longitudinal movement together and to permit said body means and slip means to rotate more than one revolution with respect to each other.

15. In a well tool: body means adapted to be moved longitudinally in a well conduit; an expander on said body means; slip means slidable longitudinally and rotatable with respect to said body means and coacting with said expander to anchor said body means to the conduit against substantial longitudinal movement; one of said means having a first groove; a clutch element movable laterally on the other of said means into said first groove to couple said body means and slip means for longitudinal movement together; a cam on said one of said means operable in response to relative rotation between said body means and slip means to engage and shift said clutch element laterally from said first groove to uncouple said body means and slip means from each other; said one of said means having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body means and slip means for longitudinal movement together and to permit said body means and slip means to rotate more than one revolution with respect to each other; said one of said means having a keyway; a key slidable longitudinally in said keyway, said key being engageable with the other of said means for selectively locating said clutch element in position for engagement by said cam or in position for movement into said first groove; and means on said one of said means for shifting said key from said keyway when said body means and slip means have been moved longitudinally to a position permitting said clutch element to enter said second groove.

16. In a well tool: a body adapted to be moved longitudinally in a well conduit; expander means on said body; slip means slidable longitudinally and rotatable with respect to said body and coacting with said expander means to anchor said body to the conduit against substantial longitudinal movement; said body having a first groove; a clutch element movable laterally on said slip means into said first groove to couple said body and slip means for longitudinal movement together; cam means on said body operable in response to relative rotation between said body and slip means to engage and shift said clutch element laterally from said first groove to uncouple said body and slip means from each other; said body having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body and slip means for longitudinal movement together and to permit said body and slip means to rotate more than one revolution with respect to each other; said body having a keyway; a key slidable in said keyway, said key being engageable with said slip means for selectively locating said clutch element in position for engagement by said cam means or in position for movement into said first groove; and means on said body for shifting said key from said keyway when said body and slip means have been moved longitudinally to a position permitting said clutch element to enter said second groove.

17. In a well tool: a body adapted to be moved longitudinally in a well conduit; expander means on said body; slip means slidable longitudinally and rotatable with respect to said body and coacting with said expander means to anchor said body to the conduit against substantial longitudinal movement; said body having a first groove; a clutch element movable laterally on said slip means into said first groove to couple said body and slip means for longitudinal movement together; cam means on said body operable in response to relative rotation between said body and slip means to engage and shift said clutch element laterally from said first groove to uncouple said body and slip means from each other; said body having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body and slip means for longitudinal movement together and to permit said body and slip means to rotate more than one revolution with respect to each other; shearable stop means between said body and expander means to limit movement of said body within said expander means in one longitudinal direction, said stop means being disruptable to permit further movement of said body within said expander means in said one direction.

18. In a well tool: a body adapted to be moved longitudinally in a well conduit; normally retracted means on said body rotatable relative thereto and expandible outwardly into engagement with the well conduit in response to longitudinal movement of said body; said body having a first groove; a clutch element movable laterally on said normally retracted means into said first groove to couple said body and normally retracted means for longitudinal movement together; cam means on said body operable in response to relative rotation between said body and normally retracted means to engage and shift said clutch element laterally from said first groove to uncouple said body and normally retracted means from each other; said body having a circumferentially continuous second groove longitudinally spaced from said first groove and adapted to receive said clutch element to couple said body and normally retracted means for longitudinal movement together and to permit said body and normally retracted means to rotate more than one revolution with respect to each other; and a threaded connection between said body and normally retracted means enabling said body to be rotated with respect to said normally retracted means to feed said body longitudinally along said normally retracted means to a position permitting said second groove to be placed in lateral alignment with said clutch element.

19. In a well tool: a body adapted to be moved longitudinally in a well conduit; expander means on said body; slip means slidable longitudinally and rotatable with respect to said body and coacting with said expander means to anchor said body to the conduit against substantial longitudinal movement; said body having an upper groove; a clutch element movable laterally on said slip means into said upper groove to couple said body and slip means for longitudinal movement together; cam means on said body operable in response to relative rotation between said body and slip means to engage and shift said clutch element laterally from said upper groove to uncouple said body and slip means from each other; said body having a circumferentially continuous lower groove longitudinally spaced from said upper groove and adapted to receive said clutch element to couple said body and slip means for longitudinal movement together and to permit said body to rotate more than one revolution with respect to said slip means; and means including a threaded connection between said body and slip means permitting said body to be rotated and moved longitudinally upwardly with respect to said slip means

to a position permitting said lower groove to be placed in transverse alignment with said clutch element.

20. In a well tool: a body adapted to be moved longitudinally in a well conduit; expander means on said body; slip means slidable longitudinally and rotatable with respect to said body and coacting with said expander means to anchor said body to the conduit against substantial longitudinal movement; said body having an upper groove; a clutch element movable laterally on said slip means into said upper groove to couple said body and slip means for longitudinal movement together; cam means on said body operable in response to relative rotation between said body and slip means to engage and shift said clutch element laterally from said upper groove to uncouple said body and slip means from each other; said body having a circumferentially continuous lower groove longitudinally spaced from said upper groove and adapted to receive said clutch element to couple said body and slip means for longitudinal movement together and to permit said body to rotate more than one revolution with respect to said slip means; and means including a threaded connection between said body and slip means permitting said body to be rotated and moved longitudinally upwardly with respect to said slip means to a position permitting said lower groove to be placed in transverse alignment with said clutch element; said body having a keyway; a key slidable longitudinally in said keyway, said key being engageable with said slip means for selectively locating said clutch element in position for engagement by said cam means or in position for movement into said upper groove; and means on said body for shifting said key from said keyway when said body and slip means have been moved longitudinally to a position permitting said clutch element to enter said lower groove.

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