July 12, 1960 R. C. BAKER 2,944,604

RETRIEVABLE WELL PACKER

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FIG. 1.

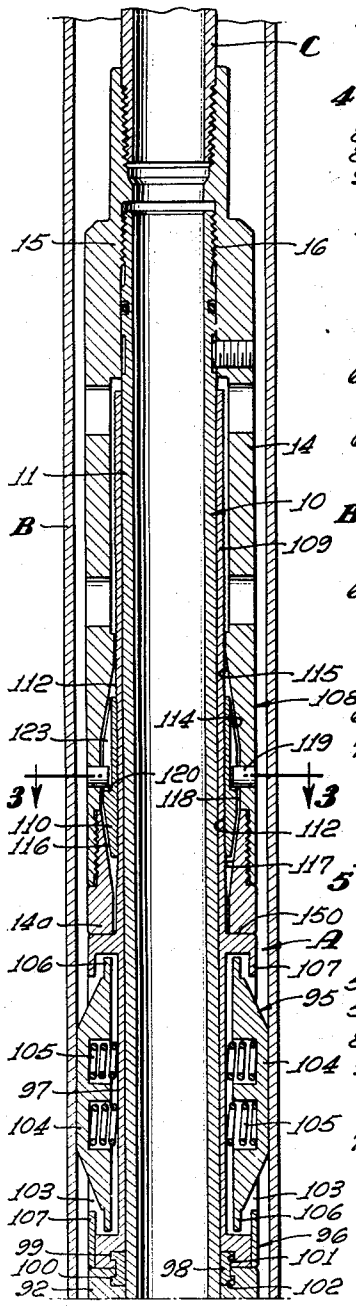


FIG. 1a.

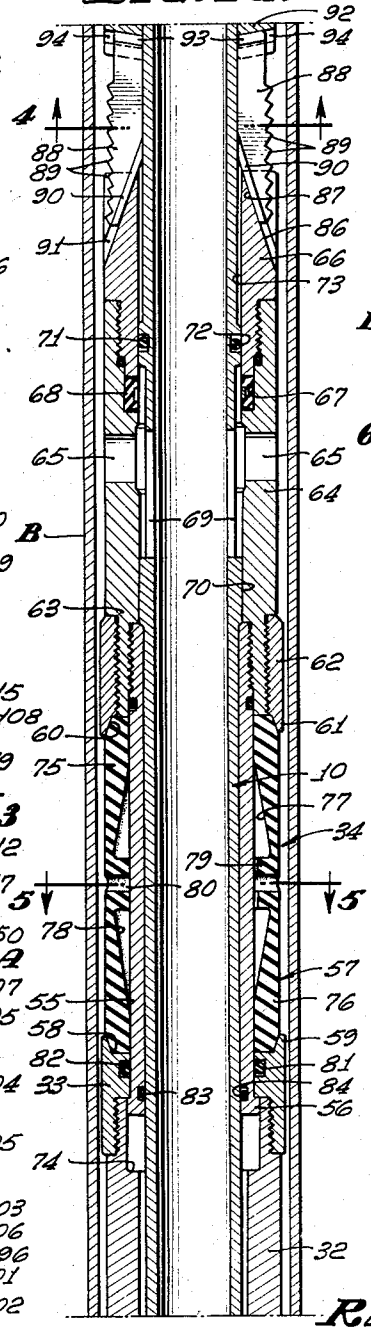
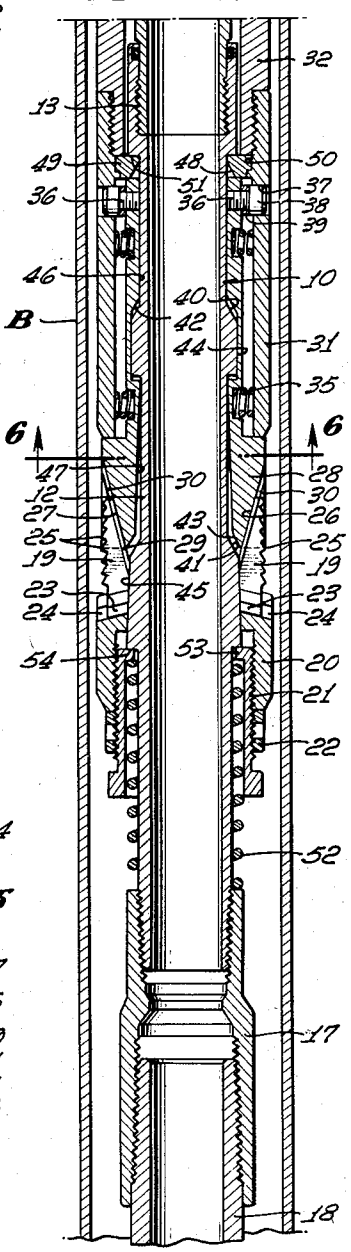


FIG. 1b.



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FIG. 2.

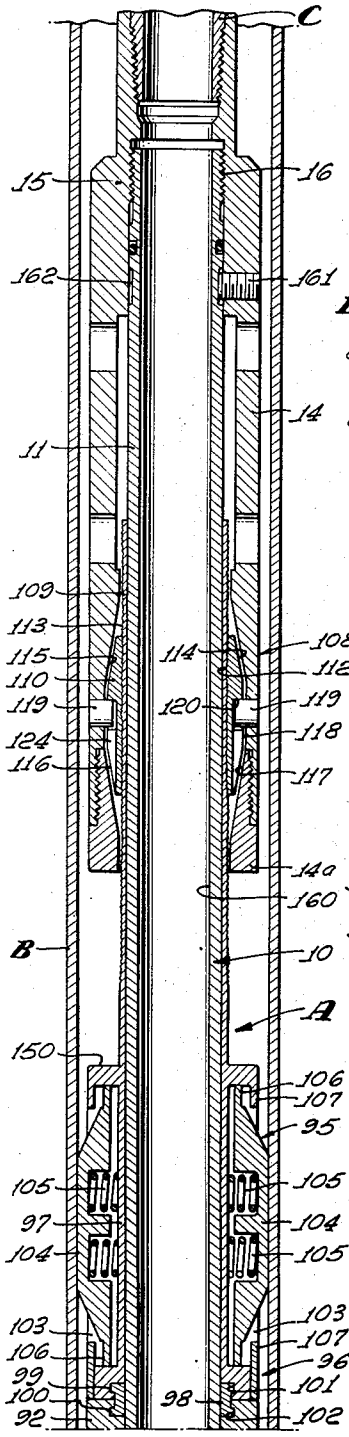


FIG. 2a.

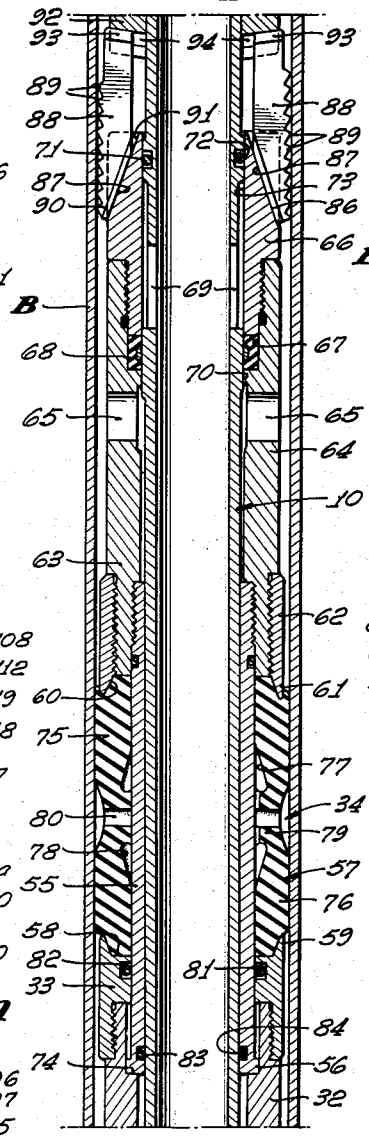
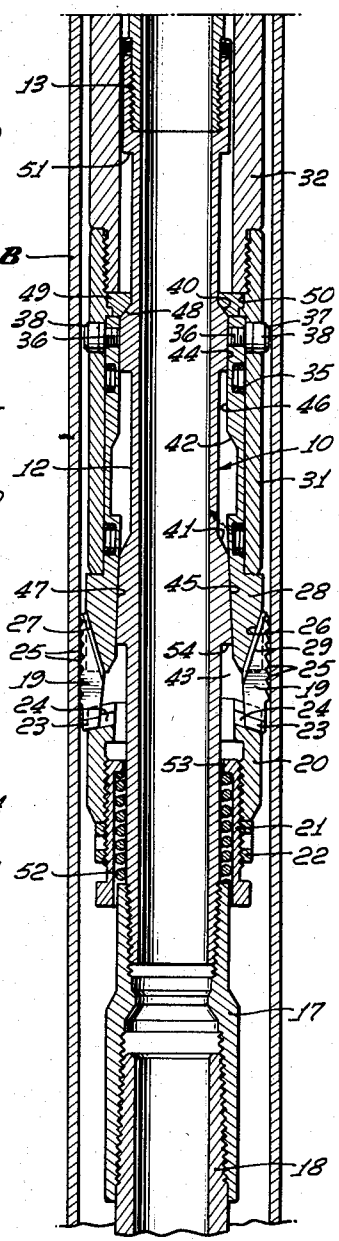


FIG. 2b.



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FIG. 4.

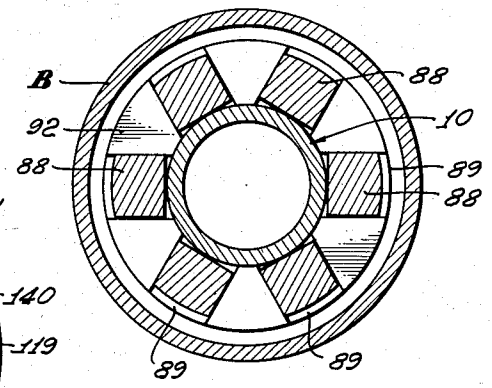


FIG. 3.

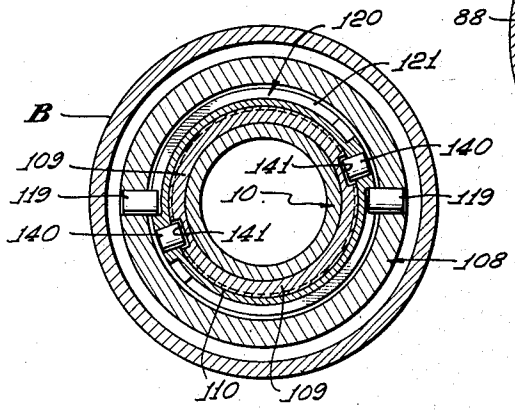


FIG. 6.

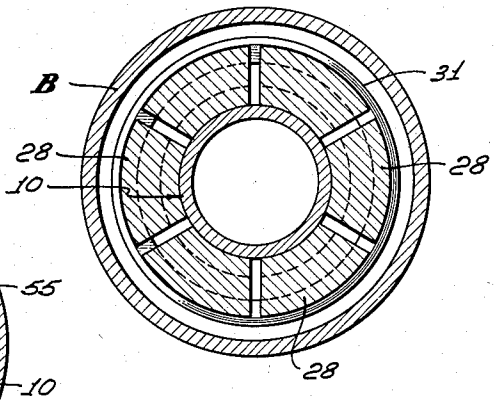
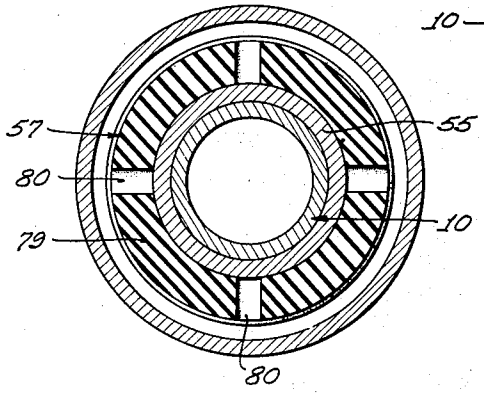


FIG. 5.



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FIG. 7.

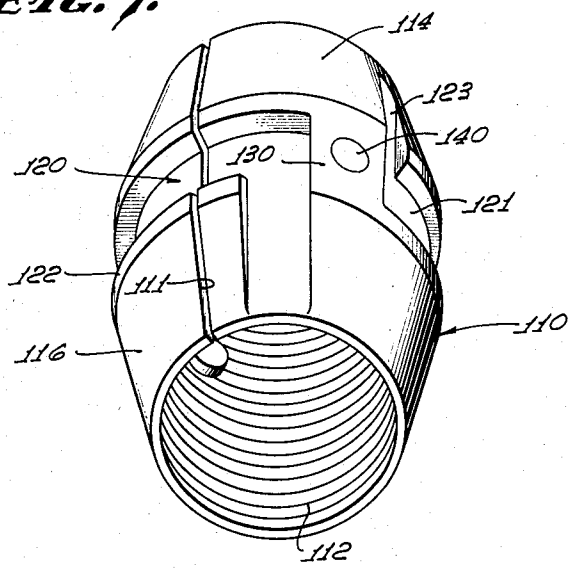
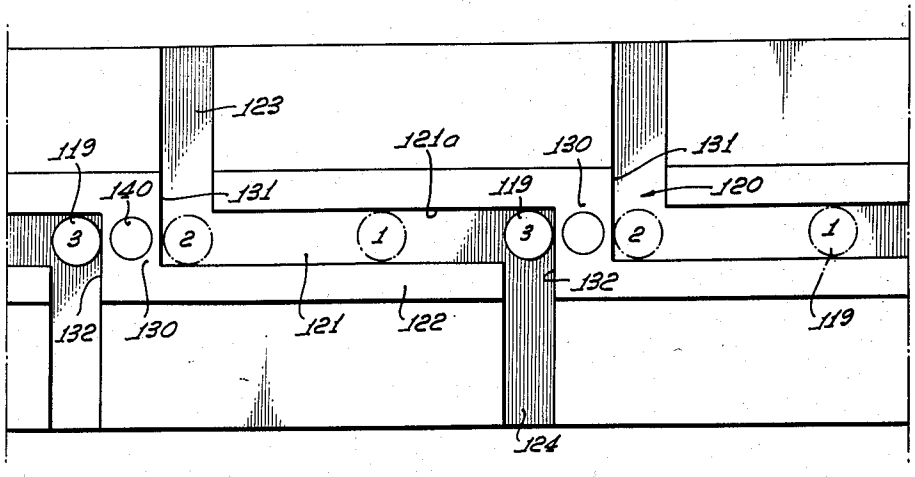


FIG. 8.



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United States Patent Office 2,944,604 Patented July 12, 1960

2,944,604

RETRIEVABLE WELL PACKER

Reuben C. Baker, Coalinga, Calif., assignor to Baker Oil Tools, Inc., Los Angeles, Calif., a corporation of California

Filed Oct. 30, 1956, Ser. No. 619,201

19 Claims. (Cl. 166—131)

The present invention relates to subsurface well devices, and more particularly to well packers, and the like, capable of performing diverse functions in well bores in which the packers are set.

An object of the present invention is to provide an improved well packer capable of being anchored in packed-off condition in a well bore against longitudinal movement in both directions, and of being released and completely retrieved from the well bore whenever desired.

Another object of the invention is to provide a retrievable well packer capable of being run in a well bore on a tubular string and anchored in packed-off condition in the well bore against longitudinal movement in both directions, the well packer being capable of supporting the tubular string in tension and also in compression while remaining in its packed-off condition.

A further object of the invention is to provide a retrievable well packer capable of being run in a well bore on a tubular string, and set mechanically in packed-off conditions in the well bore against longitudinal movement in both directions, the tubular string remaining in operative relation to the packer, which has a passage therethrough to permit well production to pass into the tubular string and be conducted to the top of the well bore. Thus, the tubular string serves the purposes of running the packer in the well bore, settling the packer against longitudinal movement in both directions, and conducting well production to the top of the hole, all without removing the tubular string from the well bore until the tubular string is to be availed of for retrieving the packer.

Yet another object of the invention is to provide a retrievable type of well packer capable of being run in a well bore on a tubular string and anchored in packed-off condition in the well bore against movement in both longitudinal directions, and embodying a valve device for controlling the passage of fluid between the interiors of the packer and tubular string, on the one hand, and the annulus around the tubular string, on the other hand.

An additional object of the invention is to provide a retrievable type of well packer capable of being anchored in packed-off condition in a well bore against movement in both longitudinal directions, the packer embodying safety provisions for facilitating the recovery of a substantial portion, and possibly all, of its parts, in the event difficulty is had in releasing the packer from its anchored condition.

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, 1*a* and 1*b* together constitute a longitudinal section through a well apparatus embodying the invention disposed in a well casing, with the parts occupying their retracted positions to enable a well packer to be moved longitudinally in the well packer, Fig. 1*a* constituting a lower continuation of Fig. 1, and Fig. 1*b* constituting a lower continuation of Fig. 1*a*;

Figs. 2, 2*a* and 2*b* are longitudinal sections similar to Figs. 1, 1*a* and 1*b*, disclosing the apparatus anchored in packed-off condition in the well bore, Fig. 2*a* constituting a lower continuation of Fig. 2, and Fig. 2*b* constituting a lower continuation of Fig. 2*a*;

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*;

Fig. 6 is an enlarged cross-section taken along the line 6—6 on Fig. 1*b*;

Fig. 7 is an isometric projection of the lock sleeve, which forms part of the apparatus;

Fig. 8 is a diagrammatic, plan view, illustrating the operation of the lock sleeve.

The invention is disclosed specifically in the drawings as being applied to a packer A designed to be run in a well casing B on a tubular string C, such as tubing, to a desired location, and to be anchored in packed-off condition therein against longitudinal movement in both upward and downward directions. More particularly, the packer is intended for production purposes to conduct the fluid in the well bore from below the setting point of the packer A through the tubing C to the top of the hole. Despite the fact that the packer is anchored against movement in both upward and downward directions when set in the well casing, it is readily retrievable whenever desired. Moreover, the same string of tubing used for running the well packer in the casing to its setting location is manipulated for effecting anchoring of the well packer in packed-off condition and for use as a production string. Thus, it is only necessary to make a single trip into the well bore with the tubing string to set the well packer and to conduct the production to the top of the hole.

The well packer A includes an elongate inner body or mandrel member **10** consisting of an upper body section **11** threadedly secured to a lower tubular body section **12** by means of a left-hand threaded connection **13**, which can function as a safety joint, for a purpose described hereinbelow. The upper end of the upper body section **11** is threadedly attached to an encompassing housing **14** that has an upper threaded box **15** for threadedly securing the well packer apparatus to the lower end of the tubular string C, which extends to the top of the hole. The threaded connection **16** between the upper body section and the housing is also preferably lefthand, to function as a safety joint, for a purpose described hereinbelow.

The lower end of the lower body section **12** is threadedly secured to a coupling or sub **17** which may, in turn, be threadedly attached to lower tubing **18** depending therefrom in the well casing B to any desired length. If desired, the depending tubing **18** need not be used at all, insofar as the present invention is concerned.

The well packer A can be anchored to the well casing B against downward movement therewithin by a set of circumferentially spaced lower slips **19** that are coupled for joint movement to a lower slip ring **20** circumscribing the lower body section **12** and threadedly mounted on an adjusting sleeve **21**, the lower slip ring **20** being held in threaded adjustment on the sleeve by a lock nut **22**

threaded on the sleeve and adapted to abut the lower end of the slip ring. The lower slips 19 can move laterally of the slip ring 20 and the body 10, but move longitudinally with the slip ring 20 by virtue of a tongue and groove connection between each slip and the slip ring. Thus, the lower end of each slip has tongues 23 extending transversely and outwardly therefrom for engagement within companion lateral grooves 24 in the upper portion of the slip ring 20. The tongue and groove arrangement 23, 24 preferably is inclined outwardly and downwardly to a slight extent to guide the lower slips in their movement to and from the wall of the well casing, the slips having wickers 25 adapted to engage the casing and prevent downward movement of the apparatus therewithin.

The slips 19 have upward and outwardly tapering expander surfaces 26 slidably engageable with companion surfaces on lower expander segments 28 encompassing the lower body section 12. Upward movement of the lower slips 19 with respect to the expander segments 28 will cause the slips to shift laterally outward into engagement with the casing B, whereas relative downward movement of the slips with respect to the expander will effect a retraction of the slips. Such retraction occurs in view of the slidable connection between the expanders 28 and slips afforded by providing tongues 29 on the sides of each slip adapted to slide within companion grooves 30 in each expander segment. The expander segments 28 extend upwardly into a limit sleeve 31 threadedly secured to a compression or thrust sleeve 32 that is, in turn, threadedly attached to a lower abutment member 33 of a packing structure 34 surrounding the upper body section 11. The limit sleeve 32 serves to determine the extent of lateral outward movement of the expander segments 28, these segments normally being urged inwardly by helical compression springs 35 engaging the inner wall of the limit sleeve 31 and the expander segments 28. The expander segments are guided in their radial movement by radial guide screws 36 threadedly secured to the upper portions of the expander segments 28 and slidable in radial guide holes 37 provided in the upper portion of the limit sleeve 31. To increase the effective guiding surface of the screws 36, their guide heads 38 may bear against washers 39 having the same diameter as the heads which clamp the washers against the exteriors of the expander segments 28.

The expander segments 28 are shifted outwardly by longitudinally spaced expander surfaces 40, 41 provided on the lower body section 12. Such upper and lower expander surfaces 40, 41 are inclined in an upward and inward direction, engaging companion upper and lower expander surfaces 42, 43 formed on the expander segments. When the body 10 is shifted upwardly relative to the expander segments 28, the expander surfaces 40, 41 will engage the companion inclined surfaces 42, 43 of the expander segments 28, shifting the latter outwardly to the extent determined by engagement of the upward extension of the expander segments with the inner wall of the limit sleeve 31. When the expander segments 28 have been shifted outwardly to such extent, the expander surfaces 40, 41, 42, 43 will ride off one another, and the peripheral upper and lower surfaces 44, 45 on the lower body section 12, depending from its expander surfaces 40, 41 will ride behind the inner surfaces 46, 47 of the expander segments, to hold the latter in their outward position. The holding surfaces 44, 45 on the body section 12 may be parallel to the axis of the body. However, it is preferred that the lower holding surface 45 be inclined slightly in an upward and inward direction, so as to allow the lower portions of the expander segments 28 to shift inwardly to a slight extent as a result of relative downward movement of the body 10 with respect to the expander segments 28, when the retraction of the lower slips 19 from engagement with the casing B is to be effected.

Upward movement of the body 10 within the expander segments 28 is limited by engagement of the upper expander surface 40 on the body with a companion tapered stop surface 48 on a split limit ring 49 which is secured between the thrust sleeve 32 and the limit sleeve 31 by being received within an internal groove 50 formed between the two sleeves. The limit ring 49 is split to permit it to be contracted and then allowed to expand outwardly into the groove 50. Not only will this limit ring determine the extent of upward movement of the body 10 with respect to the expander segments 28, but it also positively determines the extent of downward movement of the body 10 with respect to the expander surfaces 42, 43, because of the engagement of the downwardly facing shoulder 51 on the lower body section 12 with the upper surface of the limit ring 49.

The lower slips 19 are yieldably supported by the body 10 by means of a helical compression spring 52, the lower end of which bears upon the upper end of the coupling 17, this spring extending upwardly within the adjusting sleeve 21, with its upper end engaging an inwardly directed sleeve flange 53. Thus, the spring tends to urge the limit sleeve 21, lower slip ring 20 and the slips 19 upwardly with respect to the body 10 to the extent determined by engagement of the flange 53 with a downwardly facing shoulder 54 provided on the lower body section 12. By appropriately adjusting the limit sleeve 21 within the slip ring 20, the relative position of the lower slips 19 with respect to the expander segments 28, when the slips are in retracted position, can be positively determined.

The packing structure 34 includes the lower abutment member 33 previously referred to, which is threadedly attached to the upper end of the compression or thrust sleeve 32. This lower abutment member is slidable along the exterior of an inner sleeve 55 slidable on the upper body section 11, the downward movement of the lower abutment member 33 with respect to the inner sleeve 55 being limited by engagement of the former with a lower flange 56 on the latter. Surrounding the inner sleeve 55 is a packing sleeve 57, the lower end of which is received within a circumferential lower pocket 58 formed between the inner sleeve and an upwardly extending rim portion 59 of the lower abutment member. The upper portion of the packing sleeve 57 fits within a circumferential pocket 60 defined between the inner sleeve 55 and the depending rim 61 of a gauge ring 62 forming part of and threadedly secured to an upper abutment member 63 that is threadedly attached to the upper end of the inner sleeve 55. This upper abutment member is integral with a valve body or unloading cylindrical member 64 slidable on the body section 11 and having a plurality of side ports 65 extending therethrough. The upper end of the valve body is threadedly attached to an upper expander member 66 slidable on the body, there being an internal groove 67 formed between the lower end of the upper expander 66 and the upper portion of the valve body 64, in which a seal ring 68 is disposed above the ports 65.

The upper body section 11 is provided with elongate ports or openings 69 adapted to be substantially aligned with the valve body ports 65 whenever fluid communication between the interior of the body 10 and the exterior of the apparatus above the packing sleeve 57 is to be secured. However, the side ports 65 can be closed by relative upward movement of the packer body 10 with respect to the valve body 64, to bring a cylindrical seating surface 70 on the body 10 below the elongate ports 69 across the seal ring 68. When the ports 65 are closed, leakage of fluid between the interior and exterior of the body 10 through the elongate ports 69 is prevented by a seal ring 71, such as a rubber or rubber-like O ring, disposed in a peripheral groove 72 in the body above the elongate ports 69 and adapted to seal against a cylindrical surface or wall 73 in the upper expander member 66.

The packing sleeve 57 is expanded into sealing engagement with the wall of the well casing B upon upward movement of the lower abutment member 33 toward the

upper abutment member 63, which will foreshorten the packing sleeve 57 and cause it to shift outwardly into engagement with the wall of the well casing. The extent of foreshortening or compression of the packing sleeve is limited by engagement of an upwardly facing shoulder 74 on the compresion or thrust sleeve 32 with the lower end of the sleeve 55 that is disposed within the rubber or rubber-like packing. It is not necesary for too great a foreshortening of the packing sleeve 57 to be had, because of its particular construction. It will automatically seal against high fluid pressures without the necessity for mechanically compressing it to a great extent and causing it to shift into tight sealing engagement with the wall of the well casing B.

The packing sleeve 57 is of a particular construction, including upper and lower sections 75, 76 having internally tapered walls 77, 78 spaced from the inner metallic sleeve 55. The intermediate portion 79 of the packing sleeve consists of an inwardly directed circumferential rib having a plurality of holes 80 therethrough, establishing communication between the exterior of the packing sleeve 57 and its interior. The fluid pressure within the sleeve 57 is prevented from escaping around its ends by virtue of the threaded connections between the upper abutment 63 and the inner sleeve 55 and gauge ring 62, and because of the provision of a rubber or rubber-like seal ring 81 in an internal groove 82 in the lower abutment member 33 adapted to slidably seal against the periphery of the inner sleeve 55. Leakage of fluid between the inner sleeve 55 and the upper body section 11 is also prevented by a rubber or rubber-like O ring 83 disposed in an internal groove 84 in the inner sleeve and adapted to slidably seal against the periphery of the upper body section.

When the lower abutment member 33 is moved toward the upper abutment member 63, to bring the packing sleeve 57 into sealing engagement with the wall of the well casing B, fluid under pressure from below the packing sleeve will move upwardly along the lower section 76 of the sleeve and through the radial holes 80 to the interior of the sleeve 33, acting on the upper section 75 and expanding its more firmly against the wall of the well casing, much in the same manner as a cup type of packing element. Similarly, fluid pressure from above the packing sleeve 57 can move downwardly around the periphery of the upper portion 75 of the sleeve and through the holes 80 to the interior of the sleeve, expanding the lower portion 76 more firmly outwardly against the wall of the well casing, in the manner of a cup type of packing. The details of the packing construction form no part of the present invention by itself, being described and claimed in the application of Martin B. Conrad and John F. Muse, Serial No. 584,649, filed May 14, 1956, for "Subsurface Well Bore Packing Element." It is preferred, however, to use the type of packing sleeve 57 in the present instance because it avoids the necessity for a large range of relative movement between the upper and lower abutments 33, 63 to insure leakproof engagement of the packing sleeve 57 with the well casing under high pressure conditions. It also insures a solid abutment between the inner sleeve 55 and the shoulder 74 of the compression sleeve 32 for the transmission of longitudinal forces, as explained hereinbelow.

The upper expander 66 has upward and inwardly inclined expander surfaces 86 slidably coacting with companion tapered surfaces 87 on a set of upper slips 88 having wickers 89 thereon adapted to engage the wall of the well casing B and anchor the apparatus thereto against upward movement. The upper slips 88 and upper expander 66 have essentially the same interconnection as the lower expander segments 28 and lower slips 19, there being side tongues 90 on the slips fitting within companion grooves 91 in the upper expander. The upper slips 88 move longitudinally jointly by being coupled to an upper slip ring 92 slidable on and surrounding the body 10, the coupling including side tongues 93 on the slips engaging in side grooves 94 in the lower portion of the upper slip ring, the grooves 94 and tongues 93 preferably being inclined slightly in an outward and upward direction to facilitate appropriate digging in of the slip wickers 89 into the wall of the well casing B.

Longitudinal movement of the upper slips 88 with respect to the well casing B is resisted by a friction drag device 95 coupled to the upper slip ring 92 through a swivel connection 96. Thus, the upper slip ring 92 is secured to the lower portion of a drag body 97, which slidably encompasses the upper body section 11, by means of a two-piece tie ring 98, which has upper and lower flanges 99, 100 received within upper and lower internal grooves 101, 102 in the lower portion of the drag body 97 and the slip ring 92, respectively. The drag body 97 has circumferentially spaced longitudinal slots 103 therein receiving drag blocks 104 whose outer surfaces are urged against the wall of the well casing B by helical compression springs 105 disposed within and engaging the blocks 104 and the bottom portion of the slots 103. The extent of outward movement of the drag blocks 104 is limited by contact of their upper and lower terminal portions 106 with upper and lower stop rims 107 integral with, or suitably secured to, the drag body 97.

When the drag assembly 95 is permitted to hold the upper slips 88 against longitudinal movement, the packer body 10 can be shifted appropriately in a longitudinal direction to effect relative longitudinal movement of the upper expander 66 with respect to the upper slips 88 for the purpose of expanding or retracting the latter. The ability of such relative movement to occur depends upon the condition of a clutch device 108 which is adapted to couple the outer housing 14, that is secured to the packer body 10, to a slip control or clutch sleeve 109 disposed therewithin and intergral with or otherwise suitably secured to the drag body 97. When the clutch 108 is incapable of coupling the outer housing 14 to the control sleeve 109, the upper slips 88 and, for that matter, the packing sleeve 57 and the lower slips 19 can be expanded or shifted to retracted position. On the other hand, when the clutch 108 is permitted to couple the housing 14 to the control sleeve 109, the necessary relative movement between the various parts surrounding the body 10 of the tool cannot occur, and expansion or retraction of the several parts is incapable of accomplishment.

The particular clutch device disclosed in the drawings, by itself, forms no part of the present invention. It is described and claimed in the application of Reuben C. Baker, Serial No. 560,332, filed January 20, 1956, for "Releasable Clutch Device for Well Tools," now Patent No. 2,871,949. It includes the housing 14 and the control sleeve 109 between which a ratchet ring 110 is located, having a longitudinally extending split 111 completely therethrough (Fig. 7). This clutch ring 110 is inherently contractible, to cause its internal clutch teeth 112 to mesh with companion external clutch teeth 113 on the periphery of the slip control sleeve 109. The companion clutch teeth 112, 113 may be formed as helical threads of generally V-shaped form, so that relative longitudinal movement between the control sleeve 109 and the ratchet ring 110 causes the tapered faces of the V-shaped teeth or threads 112, 113 to cam the ratchet ring 110 laterally outward of the control sleeve 109, permitting the housing 14 and ratchet ring 110 to move longitudinally along the control sleeve 109. However, such longitudinal movement can be prevented, the threads 112 remaining in full engagement with the control sleeve 109 to couple the housing 14 and control sleeve 109 against relative longitudinal movement.

The ratchet ring 110 is provided with an upper frustoconical external surface 114 tapering in an upward and inward direction and adapted to coact with a companion internal upper tapered surface 115 on the clutch housing 14, in order to be wedged between the housing and the

control sleeve 109 of the tool, coupling these two members together for joint downward movement. Similarly, the ratchet ring 110 has a lower frusto-conical tapered surface 116 inclined in a downward and inward direction for coaction with a companion lower internal surface 117 in the clutch housing 14. Upward movement of the clutch housing 14 with respect to the ratchet ring 110 will cause the ring to wedge between the lower cam surface 117 of the housing and the control sleeve 109, to couple the housing and control sleeve together for joint upward movement. Assuming that the clutch ring 110 is held in an intermediate position out of wedging relation to both the upper and lower cam surfaces 115, 117 on the housing 14, a clearance space 118 exists between the periphery of the clutch ring 110 and the inner surfaces 115, 117 of the housing, which will permit the control sleeve threads 113 to act on the clutch ring threads 112 and expand the clutch or ratchet ring 110 outwardly, disengaging the control sleeve 109 therefrom, and allowing the housing 14 and the ratchet ring 110 to move longitudinally along the control sleeve 109. Since the housing 14 is attached to the packer body 10, longitudinal movement of the housing 14 with respect to the control sleeve 109 will necessarily be accompanied by longitudinal movement of the packer body 10 relative to the control sleeve 109.

The ability of the clutch or ratchet ring 110 to move longitudinally with respect to the control sleeve 109 depends upon the relative location of one or more clutch pins 119 fitting within a slotted or grooved arrangement 120 in the exterior of the ratchet ring 110. Actually, a pair of diametrically opposed clutch pins 119 is secured to the clutch housing 14, each pin being transversely arranged and extending into a slot structure 120 provided in the exterior of the ratchet ring. This slot structure 120 includes a transverse or horizontal slot portion 121 disposed in an intermediate cylindrical part 122 of the ratchet ring 110 between its upper and lower tapered surfaces 14, 116. The transverse slot or groove portion 121 merges at one end into an upper slot or groove 123 in the ratchet ring, and at its other end into a lower slot or groove 124 in the ratchet ring. Inasmuch as a pair of clutch pins 119 is employed, a single transverse, upper and lower slot arrangement described above extends only part way around the ratchet ring 110, there being a similar diametrically opposed arrangement of upper, transverse and lower slots in the ring 110.

When the clutch pins 119 are disposed in the transverse slot portion 121 (position 1, Fig. 8), the ratchet ring 110 is prevented from moving longitudinally in either direction with respect to the clutch housing 14. Assuming that the ratchet ring 110 has been turned so as to place each clutch pin 119 at one end of its transverse slot 121 and in alignment with the upper slot 123 (position 2, Fig. 8), then the clutch pin 119 will prevent downward movement of the clutch housing 14 with respect to the ratchet ring 110, but will permit a slight upward movement of the clutch housing relative to the ratchet ring, allowing the lower tapered surfaces 117, 116 to engage and effect a coupling of the housing 14 to the control sleeve 109 against relative upward movement. Such relative upward movement of the clutch housing 14 with respect to the ratchet ring 110 is permitted by virtue of the fact that the clutch pins 119 can move upwardly within the upper slots 123.

Assuming that the ratchet ring 110 can turn in the opposite direction, so as to locate the clutch pins 119 at the other ends of the transverse slots, and in alignment with the lower longitudinal slots 124 (position 3, Fig. 8), then the pins will prevent upward movement of the clutch housing 14 with respect to the ratchet ring 110; but will permit limited downward movement with respect to the ratchet ring. Accordingly, a wedging action is effected by the upper tapered surfaces 115, 114 to keep the teeth 112, 113 fully meshed and coupled to the control sleeve 109. Such relative downward movement of the housing 14 with respect to the ratchet ring 110 is permitted by entry of the clutch pins 119 in the lower longitudinal slots 124.

When the clutch pins 119 are in alignment with the upper longitudinal slots 123, the clutch housing 14 is prevented from moving downwardly along the clutch ring 110 to place the clutch ring in a clutching position. Accordingly, downward movement of the housing 14 will cause the sleeve teeth 113 to cam the ring 110 out of engagement therewith, allowing the ring 110 to ratchet freely in a downward direction with respect to the control sleeve 109. Similarly, when the clutch pins 119 are disposed in alignment with the lower longitudinal slots 124, the clutch housing 14 cannot move upwardly relative to the ratchet ring 110, to shift the latter to an upper wedging position. Instead, upward movement of the housing 14 will now cause the threads 113 on the control sleeve to expand the ratchet ring 110 out of engagement therewith, allowing the housing 14 and ring 110 to move upwardly along the control sleeve 109.

Assuming that the clutch pins 119 are in an intermediate position (position 1 in Fig. 8) between the upper and lower slots 123, 124, or in the transverse slot portions only, then the ratchet ring 110 is prevented from moving in both longitudinal directions with respect to the clutch housing 14, the housing and ratchet ring thereby being permitted to move in both longitudinal directions with respect to the slip control sleeve 109, the ratchet ring 110 merely ratcheting over the control sleeve threads 113.

The clutch pins 119 are definitely located in alignment with the upper longitudinal slots 123 or the lower longitudinal slots 124 by locating wall portions 130 of the ratchet ring in the transverse slots 121, each disposed adjacent one side of one of the longitudinal slots 123 or 124. Thus, the ends 131, 132 of one wall 130 are disposed adjacent the left side of the upper slot 123 and adjacent the right side of the lower slot 124, as shown in Fig. 8. Accordingly, when a clutch pin 119 engages one side 131 of one of the locating walls 130, it would be in alignment with one of the longitudinal slots, such as an upper slot 123, and when it engages the other side 132 of the diametrically opposite wall, it will be disposed in alignment with the other slot, such as the lower slot 124.

A positive rotatable coupling connection can also be provided between the slip or clutch sleeve 109 and the ratchet ring 110 to prevent their relative rotation, while permitting their relative longitudinal movement. Thus, a key 140 is secured to each locating wall 130, extending inwardly into a longitudinal keyway 141 in the control sleeve 109 (Fig. 3). Accordingly, turning of the housing 14 in either direction will not be accompanied by corresponding turning of the ratchet ring 110, since the latter is slidably keyed or splined to the clutch control sleeve 109. Because of this arrangement, assurance is had that the clutch pins 119 can be turned arcuately within the slotted structure 120 of the ratchet ring, in order to place such pins in their desired positions within the slot structure. The key and keyway arrangement 140, 141 need not be used, if desired, reliance then being placed upon the frictional engagement between the ratchet ring 110 and the control sleeve 109 to prevent the ratchet ring 110 from turning with the housing 14. However, it is preferred to provide a positive driving connection to insure the relative rotation of the housing 14 with respect to the ratchet ring 110, while still permitting the ratchet ring to move longitudinally with respect to the control sleeve 109.

In the use of the well packer A illustrated in the drawings, the parts are initially disposed in their retracted positions, such as shown in Figs. 1, 1*a* and 1*b*, in which the shoulder 74 on the thrust sleeve 32 is displaced away from and below the inner sleeve 55 of the packing structure 34, the cylindrical seating surface 70 of the packer

body 10 being disposed below the ports 65 so that the valve structure is in open condition. The body shoulder 51 engages the limit ring 49 to insure that the lower expander segments 28 are in their retracted position. The engagement of the lower body shoulder 54 with the adjusting sleeve flange 53 will also insure that the lower slips 19 are in their retracted positions. It is to be noted that at this time the lower end 14*a* of the housing is disposed in engagement with an outer shoulder 150 provided by the upper portion of the drag body 97, and that the clutch pins 119 are disposed in alignment with the transverse portions 121 of the ratchet sleeve slots 120. It is preferred that the clutch pins 119 be turned in the slots 121, so as to be in alignment with the upper longitudinal ratchet slot structure 123, in order that upward movement of the packer body 10 and housing 14 relative to the slip control sleeve 109 is prevented. Such relative downward movement is prevented by engagement of the housing terminus 14*a* with the drag shoulder 150.

The apparatus is lowered in the well casing B by means of the tubing string C, with the drag assembly 95 frictionally sliding along the wall of the well casing. The downward movement of the tubing string C is transferred directly to the packer body 10 and to the outer housing 14 surrounding the body. This downward movement is also transferred from the lower end 14*a* of the housing to the drag body 97 by virtue of engagement of the housing with the upper drag body shoulder 150, and thence down through the slip ring 92 to the upper sligs 88. The upper slips are not moved downwardly relative to the upper expander 66 since the upper expander is shifted downwardly by the packer body 10. This action occurs since the packer body shoulder 51 is engaging the limit ring 49 to pull the limit sleeve 31 and compression sleeve 32 downwardly with it. The downward motion of the compression sleeve is transferred from the lower abutment 33 to the shoulder 56 of the inner sleeve 55, and from the latter to the valve body 64, which is securely attached to the upper expander 66. Thus, during downward movement of the packer body 10, no relative movement can occur between the upper slips 88 and the upper expander 66, the upper slips remaining in their retracted position.

In view of the engagement of the lower abutment 33 with the flange 56 of the inner sleeve 55, the packing sleeve 57 will also be retained in its retracted position. Similarly, the engagement of the lowermost body shoulder 54 with the flange 53 of the adjusting sleeve 21 will cause the downward motion of the body 10 to be transmitted through the adjusting sleeve 21 and lower slip ring 20 to the lower slips 19, pulling the latter in a downward direction, to hold them in a retracted position. The expander segments 28 must also move downwardly with the body 10, since they are coupled to the limit sleeve 31 by the guide pins 36, and the limit sleeve 31 is forced downwardly with the body by engagement of the intermediate shoulder 51 on the latter with the split limit ring 49.

When the location in the well casing B is reached at which the packer A is to be set, the tubular string C is turned to the left, which will correspondingly turn the housing 14 connected thereto to the left to shift the clutch pins 119 in the transverse slot portions 121 until they engage the stop walls 130 and are in alignment with the lower longitudinal ratchet sleeve slots 124, or at least are out of alignment with the upper longitudinal slots 123. The tubing string C may now be elevated, which will also elevate the housing 14 and the body 10 with it. The ratchet ring 110 must also move upwardly with the body, since the clutch pins 119 engage the upper walls 121*a* of the transverse slots 121, allowing the ratchet ring 110 to ratchet freely over the slip control sleeve 109, thereby permitting the packer body 10 and housing 14 to move upwardly. The drag assembly 95 is resisting upward movement of the slips 88. However, upward movement of the body 10 is transferred through the helical compression spring 52, adjusting sleeve 21, lower slip ring 20, slips 19, lower expander segments 28, limit sleeve 31, compression sleeve 32, and lower abutment 33 to the packing sleeve 57. This packing sleeve is sufficiently hard as to compress very little, if any, at this point. Accordingly, the packing sleeve 57 transmits the upward motion to the valve body 64 and upper expander 66, shifting the latter upwardly within the upper slips 88 and causing the latter to be expanded outwardly into anchoring engagement with the wall of the well casing B.

When the upper slips have been anchored to the well casing, the upper expander 66 wedged therewithin cannot move upwardly to any further extent. This precludes any further upward movement of the valve body 64 and the upper abutment structure 62, 63 attached thereto. The relative hardness of the packing sleeve 57 also tends to cause it to resist upward movement of the compression sleeve 32, limit sleeve 31, and the outer expander segments 28. Accordingly, a continuation of the upward movement of the tubing string C, packer body 10 and housing 14 causes the lower expander surfaces 40, 41 on the body to move upwardly along the companion expander surfaces 42, 43 on the expander segments 28, shifting the latter in an outward direction. At the same time, the lower slips 19 are being shifted upwardly along the expander segments, the upward movement being transferred from the packer body 10 through the spring 52 to the adjusting sleeve 21 and the lower slip ring 20, until the slips 19 engage the wall of the well casing. The tubing string C and the packer body 10 can continue to move upwardly, since the spring 52 will merely compress until the outer expander segments 28 have been shifted outwardly to their fullest extent. During such upward movement of the body 10, the expander segments 28 and the limit sleeve 31 and compression sleeve 32 may also move upwardly to some extent to partially compress the packing sleeve 57. However, the shoulder 74 on the compression sleeve 32 will not engage the lower end of the inner sleeve 55 before the body expander surfaces 44, 45 are moved within the expander segments 28 and have shifted the latter outwardly to their fullest extent, as determined by engagement of the upwardly projecting segment portions with the inner wall of the limit sleeve 31. The body will move upwardly with respect to the expander segments to the extent determined by engagement of the expander surface 40 with the companion stop surface 48 on the split limit ring 49. The lower slips 19 need not move upwardly with the body 10 in view of the fact that they are not tied directly to the body, but are only urged in an upward direction by the helical compression spring 52. Such spring will merely compress to a further extent after the slips 19 have engaged the casing B and the body 10 moves upwardly with respect to the slips 19 and the exanpder segments 28 to an increased extent.

The body 10 can continue to move upwardly after its expander surface 40 has engaged the limit ring 49 to carry the outer expanders 28, limit ring 49 and compression sleeve 32 upwardly with it until the shoulder 74 on the compression sleeve engages the lower end of the inner packing structure sleeve 55. At this time, the cylindrical seating surface 70 on the body will have been shifted upwardly above the valve body ports 65 and into full sealing engagement with the valve seal ring 68, to close the port 65. During the upward movement of the lower expander segments 28 just referred to, which will only occur to a comparatively small extent, the spring 52 will shift the lower slips 19 upwardly along the wall of the well casing B to follow the upward movement of the expander segments 28.

The well packer is now anchored in packed-off condition against longitudinal movement in both directions, all of its parts being in the relative positions disclosed in Figs. 2, 2*a* and 2*b*. An upward strain can be taken on

the tubing string C and the packer body 10 to insure firm wedging of the upper slips 88 into the wall of the well casing B, such upward pull being transmitted from the packer body 10 to the limit ring 49, and from the latter through the compression sleeve 32 to the inner sleeve 55, the latter being solidly connected to the valve body 64 and the upper expander 66. In other words, there is a solid transmission of the upwardly directed force from the body 10 to the upper expander 66 to wedge, and hold the latter wedged, within the upper slips 88. Pressure in the well casing below the well packer can pass upwardly around the exterior of the lower portion 76 of the packing, moving in through the holes 80 to the interior of the packing and exerting an outward hydraulic force on the upper portion 75 of the packing to insure that the latter will be held in firm sealing engagement with the wall of the well casing. It is, thus, apparent that the tool is firmly anchored to the well casing in packed-off condition against upward movement therewithin. Accordingly, a tensile pull can be maintained on the tubing string C, if desired, while the tool remains anchored in packed-off condition.

The well packer construction will also remain anchored against the casing against downward movement therewithin, and will enable down weight to be imposed on the tubing string C, if desired. It is only necessary that the tubing string and housing 14 be turned, to insure that the clutch pins 119 are in alignment with the lower longitudinal slots or grooves 124 of the ratchet sleeve 110. Accordingly, downward movement of the tubing string and housing will cause the housing 14 to move downwardly with respect to the ratchet sleeve 110 to a slight extent, until the upper cam or tapered surfaces 115, 114 engage to hold the ratchet sleeve clutched to the slip control sleeve 109. Accordingly, the downward force imposed on the tubing string C and housing 14 will now be transmitted to the clutch control sleeve 109, and from the latter through the drag assembly 95 to the upper slip ring 92, the downward force then being transferred through the upper slips 88 and upper expander 66 to the valve body 64, from where it will be transmitted through the inner packing structure sleeve 55 directly to the thrust sleeve 32, because of the engagement of the lower end of the inner sleeve 55 with the shoulder 74 of the latter. From the thrust sleeve 32, the downward force is exerted upon the stop ring 49 and on the limit sleeve 31 directly to the inner segments 28 engaged therewith, the inner segments being urged downwardly within the lower slips 19 to wedge and hold the latter anchored against the well casing B. Actually, the aforementioned downward wedging of the lower expander segments 28 and the lower slips 19 occurs as a result of only a slight downward movement of the housing 14 relative to the ratchet sleeve 110, inasmuch as all the other parts are in solid metal-to-metal engagement with one another.

In the manner described above, the lower slips 19 will anchor the tool against downward movement in the well casing, and the packing sleeve structure 34 will also prevent fluid pressure from leaking past the packer. Such fluid pressure will by-pass the uper portion 75 of the packing sleeve 57 and enter the interior of the sleeve through the holes 80 in its medial circumferential rib 79, the pressure being exerted on the inside of the packing sleeve 57 and against its lower portion 76, to more firmly seal the latter against the wall of the well casing.

It is, accordingly, apparent that the well packer has been anchored in packed-off condition in both directions against the well casing, and that it is capable of withstanding high pressures and substantial upwardly and downwardly directed forces without displacement in the well casing.

Following anchoring of the well packer against the well casing, the tubular string C can be used to conduct the production entering the packer from a point therebelow to the top of the hole, such production, of course, passing through the fully open passage 160 in the packer body 10, which may, if desired, be made with an inside diameter at least equal to the inside diameter of the tubing string C thereabove.

In the event it is desired to release the packer A from the well casing B and shift it to a new location, or to withdraw it completely from the well bore, the clutch 108 is placed in a neutral condition, as regards downward movement of the tubing string C and the housing 14 and packer body 10 attached thereto. That is to say, the tubing string and housing are turned to the right, to place the clutch pins 119 against the locating walls 130 and in alignment with the upper longitudinal ratchet sleeve slots 123. Accordingly, downward movement of the housing 14 carries the ratchet sleeve 110 downwardly with it, its clutch teeth 112 merely ratcheting freely over the companion teeth 113 on the clutch control sleeve 109, allowing the housing 14 and the packer body 10 to move downwardly relative to the clutch control sleeve 109, the drag structure 95, and the upper slips 88 connected thereto. As a result of such downward movement, the cylindrical seating surface 70 on the body is shifted below its companion seal ring 68 and below the ports 65 to open the latter and equalize the pressure both internally and externally of the packer apparatus. A continuation of the downward movement of the body shifts the holding surfaces 44, 45 of the latter down below the companion holding surfaces 46, 47 on the expander segments 28 until the tapered surfaces 40, 41 on the body are disposed below the companion tapered surfaces 42, 43 on the segments 28, which will then permit the helical retractor springs 35 to shift the segments 28 inwardly to their retracted positions, carrying the lower slips 19 away from the wall of the well casing.

A continuation of the downward movement of the body 10 causes its lowermost shoulder 54 to engage the adjusting sleeve 21 and, if the lower slips 19 are still expanded outwardly to a partial extent, to pull the slips 19 downwardly and insure their full retraction along the expander segments 28. The intermediate shoulder 51 of the body will engage the limit ring 49, to pull the limit sleeve 31 and compression sleeve 32 downwardly, shifting the lower abutment 33 in a downward direction away from the upper abutment 62, 63, and permitting the packing sleeve 57 to return inherently to its retracted position. The lower abutment 33 will engage the flange 56 of the inner sleeve 55, to pull the latter in a downward direction and exert a downward face on the valve body 64 and the upper expander 66, shifting the latter downwardly relative to the upper slips 88 and retracting the upper slips from the wall of the well casing. The packer is now in the retracted position disclosed in Figs. 1, 1*a* and 1*b*, the downward movement of the packer body 10 along the control sleeve 109 being limited by engagement of the lower end 14*a* of the housing 14 with the drag body shoulder 150.

The well packer A can now be elevated in the well casing B without expanding any of the parts. This can occur when thhe clutch pins 119 are in alignment with the upper slots or grooves 123 of the ratchet ring 110. Assurance can be had that the parts occupy this position by turning the tubing C and the body 10 to the right, turning of the ratchet sleeve 110 being resisted by its engagement with the slip or control sleeve 109, the rotation of which is prevented by the drag blocks 104. When the clutch control pins 119 are in alignment with the upper ratchet sleeve grooves 123, upward movement of the tubing string C and housing 14 can occur relative to the ratchet sleeve 110, the control pins 119 moving upwardly within the upper grooves 123 until the lower tapered surfaces 117, 116 engage to wedge and hold the ratchet sleeve 110 in clutching engagement with the slip control sleeve 109, thereby coupling the slip control sleeve 109 and the upper slips 88 to the housing 14 and the body 10, and preventing relative movement from occur-

ring between the upper slips 88 and the upper expander 66. Without such relative movement, the upper slips 19 cannot be anchored against the well casing, which is a prerequisite to the expansion of the packing sleeve 57 against the casing and the conditioning of the lower expander segments 28 and lower slips 19 for holding against the well casing. Accordingly, all of the parts remain in their retracted positions, the drag assembly 95 merely sliding along the wall of the well casing while the tool A is being elevated in the casing and withdrawn completely therefrom.

In the event the well packer A is anchored in the well casing, and it cannot be released therefrom as a result of lowering the body 10 of the tool in the manner described above, one of the safety joints 13 or 16, which are both of left-hand thread, can be availed of to force the tool to release. Thus, if the lower packer body section 12 is immobilized, and will not turn, a right-hand turn can be taken on the tubing string C, which will turn the housing 14 and the upper body section 11 to the right. In view of the fact that the safety joint connection 13 is a left-hand threaded one, such right-hand rotation of the upper body section 11 will cause it to unscrew from the lower body section 12, elevating the upper body section 11 and the housing 14 attached thereto. The upward movement of the housing 14 can cause it to wedge the ratchet sleeve 110 against the slip control sleeve 109, so that the latter is caused to move upwardly, which will exert an upward pull on the slips 88 and shift them upwardly relative to the upper expander 66 to a retracted position, which will then enable an upward pull to be taken on the tubing string C and the other parts of the apparatus to result in a retraction of the packing sleeve 57 and the lower expander segments 28 and lower slips 19.

During the upward threading of the upper body section 11 out of the lower body section 12, the safety joint 13 acts as a jackscrew, allowing a great longitudinal upward force to be exerted on the body 11 and, through the ratchet sleeve 110, on the slip control sleeve 92 and the upper slips 88. In the event that the ratchet sleeve 110 does not cause the slip control sleeve 109 to rotate with the housing 14, then the rotation of the ratchet sleeve with the housing around the control sleeve 109 will cause the latter to move upwardly because of the threaded right-hand connection 112, 113 between the two parts. Here again, elevation of the slip control sleeve 109 and the upper slips 88 attached thereto is forced, the upper slips shifting upwardly relative to the upper expander 66 to a retracted position.

In the event that the lower safety joint 13 does not unscrew, because of the fact that the upper body section 11 is stuck in the hole, then rotation of the tubing string C and the outer housing 14 will cause the upper safety joint 16 to unscrew, shifting the housing 14 in an upward direction along the body 11 and causing it to wedge against the ratchet sleeve 110, which will be maintained clutched to the slip control sleeve 109 to pull upwardly on the slips 88. Here again, if the wedging action does not occur, the ratchet ring 110 must rotate with the housing 14 as the latter threads upwardly on the body, the threaded engagement 112, 113 between the ratchet ring 110 and the slip control sleeve 109 effecting upward movement of the latter and of the upper slips 88, to release the upper slips from the casing and shift them to a retracted position.

To insure against inadvertent unthreading of the upper safety joint 16, a shear screw 161 may be provided in the housing 14, fitting within a circumferential groove 162 in the upper body section 11. This shear screw 161 will engage the upper wall of the groove 162 and will prevent the normal turning effort being imposed on the housing 14 from effecting a disconnection of the left-hand threads 16, since it will limit the unthreading of the housing from the upper body section 11 to a very limited extent. However, when sufficient torque is applied on the housing 14, as when the upper body section 11 is stuck in the hole, the screw 161 will shift upwardly into engagement with the upper wall of the circumferential groove 162 and the screw will be sheared off, which will then enable the housing 14 to thread upwardly to the desired extent along the upper body section 11, to retract the upper slips 88 in the manner described above.

It is, accordingly, apparent that a retrievable well tool has been provided which is capable of being anchored in packed-off condition in the well casing B against movement in both longitudinal directions, and of being readily released and either shifted to a new location in the well casing or withdrawn entirely therefrom, whenever desired. In the event that difficulty is encountered in releasing the tool, the several safety joints embodied therein will assist in securing such release. The tool will remain anchored in packed-off condition under high pressure conditions and with a great tensile pull taken on the tubing string, and is also capable of remaining anchored in packed-off condition when a substantial or relatively great downweight is imposed on the tubing string. The pressure can readily be equalized internally and externally of the tool merely as a result of shifting it to a released condition, the valve mechanism 68, 70 for securing such equalizing of pressure being closed automatically as an incident of anchoring the tool against the well casing.

The inventor claims:

1. In apparatus of the character described to be set in a well conduit: a body; an inner expander on said body; a segmental outer expander on said inner expander and adapted to occupy a retracted position on said inner expander and to be expanded laterally outward by said inner expander upon longitudinal movement with respect to said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander; said inner and outer expanders having coengageable surfaces tapering in one longitudinal direction toward the axis of the body; said outer expander and slips having coengageable surfaces tapering in the opposite longitudinal direction toward the axis of the body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the conduit; and means secured to said body for movement therewith and engageable with said outer expander for imposing a force exerted in said opposite longitudinal direction on said outer expander to hold said slips engaged with the conduit.

2. In apparatus of the character described to be set in a well conduit: a body; an inner expander fixed to said body; a segmental outer expander on said inner expander and adapted to occupy a retracted position on said inner expander and to be expanded laterally outward by said inner expander upon longitudinal movement with respect to said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander; said inner and outer expanders having coengageable surfaces tapering in one longitudinal direction toward the axis of the body; said outer expander and slips having coengageable surfaces tapering in the opposite longitudinal direction toward the axis of the body; yieldable means on said body for moving said slips longitudinally of said outer expander and laterally outward into engagement with the conduit; and means secured to said body for movement therewith and engageable with said outer expander for imposing a force exerted in said opposite longitudinal direction on said outer expander to hold said slips engaged with the conduit.

3. In apparatus of the character described to be set in a well conduit: a body; an inner expander on said body; a segmental outer expander on said inner expander and adapted to occupy a retracted position on said inner expander and to be expanded laterally outward by said inner expander upon longitudinal movement with respect to said inner expander; slips engageable with said outer

expander to be expanded laterally outward by said outer expander; said inner and outer expanders having coengageable surfaces tapering in one longitudinal direction toward the axis of the body; said outer expander and slips having coengageable surfaces tapering in the opposite longitudinal direction toward the axis of the body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the conduit; and thrust means on said body for exerting a force in said opposite longitudinal direction on said outer expander to hold said slips engaged with the conduit, said thrust means including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit movement of said body in said one longitudinal direction with respect to said outer expander, said clutch being engageable to enable said thrust means to transmit said force in said opposite longitudinal direction and to prevent movement of said body in said opposite longitudinal direction.

4. In apparatus of the character described to be set in a well conduit: a body; an inner expander on said body; a segmental outer expander on said inner expander and adapted to occupy a retracted position on said inner expander and to be expanded laterally outward by said inner expander upon longitudinal movement with respect to said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander; said inner and outer expanders having coengageable surfaces tapering in an upward direction toward the axis of the body; said outer expander and slips having coengageable surfaces tapering in a downward direction toward the axis of the body; means for moving saids lips upwardly along said outer expander and laterally outward into engagement with the conduit; and means secured to said body for movement therewith and engageable with said outer expander for imposing a downward force on said outer expander to hold said slips engaged with the conduit.

5. In apparatus of the character described to be set in a well conduit: a body; an inner expander on said body; a segmental outer expander on said inner expander and adapted to occupy a retracted position on said inner expander and to be expanded laterally outward by said inner expander upon longitudinal movement with respect to said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander; said inner and outer expanders having coengageable surfaces tapering in one longitudinal direction toward the axis of the body; said outer expander and slips having coengageable surfaces tapering in the opposite longitudinal direction toward the axis of the body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the conduit; and valve means operatively connected to said body for controlling flow of fluid between the interior of said body and the exterior of said apparatus, said valve means being closed upon movement of said body in said one longitudinal direction relative to said valve means and opened upon movement of said body in said opposite longitudinal direction relative to said valve means.

6. In a well tool to be anchored in a well conduit: a body; means on said body for anchoring said body to the well conduit against movement in one longitudinal direction; an inner expander on said body; a segmental outer expander slidable on said inner expander to be expanded laterally outward by said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander into engagement with the well conduit to anchor said body against movement in the opposite longitudinal direction; said inner and outer expanders having coengaging surfaces tapering in said one longitudinal direction toward the axis of said body; said outer expander and slips having coengaging surfaces tapering in said opposite longitudinal direction toward the axis of said body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the well conduit; and means secured to said body for movement therewith and engageable with said outer expander for imposing a force exerted in said opposite longitudinal direction on said outer expander to hold said slips engaged with the well conduit.

7. In a well tool to be anchored in a well conduit: a body; means on said body for anchoring said body to the well conduit against movement in one longitudinal direction; an inner expander on said body; a segmental outer expander slidable on said inner expander to be expanded laterally outward by said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander into engagement with the well conduit to anchor said body against movement in the opposite longitudinal direction; said inner and outer expanders having coengaging surfaces tapering in said one longitudinal direction toward the axis of said body; said outer expander and slips having coengaging surfaces tapering in said opposite longitudinal direction toward the axis of said body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the well conduit; and thrust means on said body for exerting a force in said opposite longitudinal direction on said outer expander to hold said slips engaged with the conduit, said thrust means including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit movement of said body in said one longitudinal direction with respect to said outer expander, said clutch being engageable to enable said thrust means to transmit said force in said opposite longitudinal direction and to prevent movement of said body in said opposite longitudinal direction.

8. In a well tool to be anchored in a well conduit: a body; means on said body for anchoring said body to the well conduit against upward movement; an inner expander on said body; a segmental outer expander slidable on said inner expander to be expanded laterally outward by said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander into engagement with the well conduit to anchor said body against downward movement; said inner and outer expanders having coengaging surfaces tapering in an upward direction toward the axis of said body; said outer expander and slips having coengaging surfaces tapering in a downward direction toward the axis of said body; means for moving said slips upwardly along said outer expander and laterally outward into engagement with the well conduit; thrust means on said body for exerting a downward force on said outer expander to hold said slips engaged with the conduit, said thrust means including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit upward movement of said body with respect to said outer expander, said clutch being engageable to enable said thrust means to transmit said downward force and to prevent downward movement of said body.

9. In a well tool to be anchored in a well conduit: a body; means on said body for anchoring said body to the well conduit against movement in one longitudinal direction; an inner expander on said body; a segmental outer expander slidable on said inner expander to be expanded laterally outward by said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander into engagement with the well conduit to anchor said body against movement in the opposite longitudinal direction; said inner and outer expanders having coengaging surfaces tapering in said one longitudinal direction toward the axis of said body; said outer expander and slips having coengaging surfaces tapering in said opposite longitudinal direction

toward the axis of said body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the well conduit; and valve means operatively connected to said body for controlling flow of fluid between the interior of said body and the exterior of said apparatus, said valve means being closed upon movement of said body in one longitudinal direction relative to said valve means and opened upon movement of said body in said opposite longitudinal direction relative to said value means.

10. In a well tool to be anchored in a well conduit: a body; means on said body for anchoring said body to the well conduit against movement in one longitudinal direction; an inner expander on said body; a segmental outer expander slidable on said inner expander to be expanded laterally outward by said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander into engagement with the well conduit to anchor said body against movement in the opposite longitudinal direction; said inner and outer expanders having coengaging surfaces tapering in said one longitudinal direction toward the axis of said body; said outer expander and slips having coengaging surfaces tapering in said opposite longitudinal direction toward the axis of said body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the well conduit; and thrust means on said body for exerting a force in said opposite longitudinal direction on said outer expander to hold said slips engaged with the conduit, said thrust means including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit movement of said body in both longitudinal directions with respect to said outer expander, said clutch being engageable to prevent movement of said body in both longitudinal directions with respect to said outer expander.

11. In a well tool to be anchored in a well conduit: a body; means on said body for anchoring said body to the well conduit against upward movement; an inner expander on said body; a segmental outer expander slidable on said inner expander to be expanded laterally outward by said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander into engagement with the well conduit to anchor said body against downward movement; said inner and outer expanders having coengaging surfaces tapering in an upward direction toward the axis of said body; said outer expander and slips having coengaging surfaces tapering in a downward direction toward the axis of said body; means for moving said slips upwardly along said outer expander and laterally outward into engagement with the well conduit; thrust means on said body for exerting a downward force on said outer expander to hold said slips engaged with the conduit, said thrust means including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit movement of said body in both longitudinal directions with respect to said outer expander, said clutch being engageable to prevent movement of said body in both longitudinal directions with respect to the outer expander.

12. In a well tool to be anchored in a well conduit: a body; means on said body for anchoring said body to the well conduit against movement in one longitudinal direction; an inner expander on said body; a segmental outer expander slidable on said inner expander to be expanded laterally outward by an inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander into engagement with the well conduit to anchor said body against movement in the opposite longitudinal direction; said inner and outer expanders having coengaging surfaces tapering in said one longitudinal direction toward the axis of said body; said outer expander and slips having coengaging surfaces tapering in said opposite longitudinal direction toward the axis of said body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the well conduit; and thrust means on said body for exerting a force in said opposite longitudinal direction on said outer expander to hold said slips engaged with the conduit, said thrust means including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit movement of said body in said one longitudinal direction with respect to said outer expander, said clutch being engageable to enable said thrust means to transmit said force in said opposite longitudinal direction and to prevent movement of said body in said opposite longitudinal direction; said thrust means including a packing structure between said anchoring means and outer expander adapted to seal against the well conduit and through which said force is exerted.

13. In a well tool to be anchored in a well conduit: a body; means on said body for anchoring said body to the well conduit against movement in one longitudinal direction; an inner expander on said body; a segmental outer expander slidable on said inner expander to be expanded laterally outward by said inner expander; slips engageable with said outer expander to be expanded laterally outward by said outer expander into engagement with the well conduit to anchor said body against movement in the opposite longitudinal direction; said inner and outer expanders having coengaging surfaces tapering in said one longitudinal direction toward the axis of said body; said outer expander and slips having coengaging surfaces tapering in said opposite longitudinal direction toward the axis of said body; means for moving said slips longitudinally of said outer expander and laterally outward into engagement with the well conduit; and thrust means on said body for exerting a force in said opposite longitudinal direction on said outer expander to hold said slips engaged with the conduit, said thrust means including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit movement of said body in said one longitudinal direction with respect to said outer expander, said clutch being engageable to enable said thrust means to transmit said force in said opposite longitudinal direction and to prevent movement of said body in said opposite longitudinal direction; said thrust means including a packing structure between said anchoring means and outer expander adapted to seal against the well conduit and through which said force is exerted, said packing structure including a non-metallic sealing member to engage the conduit, upper and lower abutments engaging said member and movable toward each other to expand said member outwardly, and stop means for limiting the extent of movement of said abutments toward each other.

14. In a well tool to be anchored in a well conduit: a body; an upper expander slidable relatively along said body; upper slips engaging and shiftable by said expander outwardly against the well conduit to anchor said body against upward movement in the well conduit; an inner expander fixed to said body; a segmental outer expander movable on said inner expander to be expanded laterally outward by said inner expander; lower slips engageable with said conduit to anchor said body against downward movement in the well conduit; said inner and outer expanders having coengaging upwardly converging surfaces; said outer expander and lower slips having coengaging downwardly converging surfaces; means on said body for moving said lower slips upwardly along said outer expander and said upper expander along said upper slips to shift said upper and lower slips outwardly into engagement with the well conduit; and means secured to

said body for movement therewith and engageable with said outer expander for imposing a downward force on said outer expander to hold said slips engaged with the well conduit.

15. In a well tool to be anchored in a well conduit: a body; an upper expander slidable relatively along said body; upper slips engaging and shiftable by said expander outwardly against the well conduit to anchor said body against upward movement in the well conduit; an inner expander fixed to said body; a segmental outer expander movable on said inner expander to be expanded laterally outwardly by said inner expander; lower slips engageable with said conduit to anchor said body against downward movement in the well conduit; said inner and outer expanders having coengaging upwardly converging surfaces; said outer expander and lower slips having coengaging downwardly converging surfaces; means on said body for moving said lower slips upwardly along said outer expander and said upper expander along said upper slips to shift said upper and lower slips outwardly into engagement with the well conduit; and thrust means including said upper slips and upper expander for exerting a downward force on said outer expander to hold said lower slips engaged with the conduit, said thrust means further including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit upward movement of said body with respect to said upper and outer expanders, said clutch being engageable to enable said thrust means to transmit said downward force and to prevent downward movement of said body in the well conduit.

16. In a well tool to be anchored in a well conduit: a body; an upper expander slidable relatively along said body; upper slips engaging and shiftable by said expander outwardly against the well conduit to anchor said body against upward movement in the well conduit; an inner expander fixed to said body; a segmental outer expander movable on said inner expander to be expanded laterally outward by said inner expander; lower slips engageable with said conduit to anchor said body against downward movement in the well conduit; said inner and outer expanders having coengaging upwardly converging surfaces; said outer expander and lower slips having coengaging downwardly converging surfaces; means on said body for moving said lower slips upwardly along said outer expander and said upper expander along said upper slips to shift said upper and lower slips outwardly into engagement with the well conduit; means including an outwardly expansible and normally retracted packing structure interconnecting said upper expander and outer expander; and thrust means connected to said body and including said upper slips, upper expander, and interconnecting means for exerting a downward force on said outer expander to hold said lower slips engaged with the conduit, said thrust means including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit upward movement of said body with respect to said upper and outer expanders, said clutch being engageable to enable said thrust means to transmit said downward force and to prevent downward movement of said body in the well conduit.

17. In a well tool to be anchored in a well conduit: a body; an upper expander slidable relatively along said body; upper slips engaging and shiftable by said expander outwardly against the well conduit to anchor said body against upward movement in the well conduit; an inner expander fixed to said body; a segmental outer expander movable on said inner expander to be expanded laterally outward by said inner expander; lower slips engageable with said conduit to anchor said body against downward movement in the well conduit; said inner and outer expanders having coengaging upwardly converging surfaces; said outer expander and lower slips having coengaging downwardly converging surfaces; means on said body for moving said lower slips upwardly along said outer expander and said upper expander along said upper slips to shift said upper and lower slips outwardly into engagement with the well conduit; a packing structure interconnecting said outer expander and upper expander, said packing structure including a non-metallic sealing member to engage the conduit, upper and lower abutments engaging said member and movable toward each other to expand said member outwardly, and stop means for limiting the extent of movement of said abutments toward each other; and thrust means including said upper slips, upper expander, and packing structure for exerting a downward force on said outer expander to hold said lower slips engaged with the conduit, said thrust means further including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconned said body from said outer expander and permit upward movement of said body with respect to said upper and outer expanders, said clutch being engageable to enable said thrust means to transmit said downward force and to prevent downward movement of said body in the well conduit.

18. In a well tool to be anchored in a well conduit: a body; an upper expander slidable relatively along said body; upper slips engaging and shiftable by said expander outwardly against the well conduit to anchor said body against upward movement in the well conduit; an inner expander fixed to said body; a segmental outer expander movable on said inner expander to be expanded laterally outward by said inner expander; lower slips engageable with said conduit to anchor said body against downward movement in the well conduit; said inner and outer expanders having coengaging upwardly converging surfaces; said outer expander and lower slips having coengaging downwardly converging surfaces; means on said body for moving said lower slips upwardly along said outer expander and said upper expander along said upper slips to shift said upper and lower slips outwardly into engagement with the well conduit; a packing structure interconnecting said outer expander and upper expander, said packing structure including a non-metallic sealing member to engage the conduit, upper and lower abutments engaging said member and movable toward each other to expand said member outwardly, and stop means for limiting the extent of movement of said abutments toward each other; and thrust means on said body including said upper slips, upper expander and packing structure for exerting a downward force on said outer expander to hold said lower slips engaged with the conduit, said thrust means further including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit movement of said body in both longitudinal directions with respect to said upper and outer expanders, said clutch being engageable to prevent movement of said body in both longitudinal directions with respect to said upper and outer expanders.

19. In a well tool to be anchored in a well conduit: a body; an upper expander slidable relatively along said body; upper slips engaging and shiftable by said expander outwardly against the well conduit to anchor said body against upward movement in the well conduit; an inner expander fixed to said body; a segmental outer expander movable on said inner expander to be expanded laterally outward by said inner expander; lower slips engageable with said conduit to anchor said body against downward movement in the well conduit; said inner and outer expanders having coengaging upwardly converging surfaces; said outer expander and lower slips having coengaging downwardly converging surfaces; means on said body for moving said lower slips upwardly along said outer expander and said upper expander along said upper slips to shift said upper and lower slips outwardly into engagement with the well conduit; a packing structure interconnecting said outer expander and upper expander,

said packing structure including a non-metallic sealing member to engage the conduit, upper and lower abutments engaging said member and movable toward each other to expand said member outwardly, and stop means for limiting the extent of movement of said abutments toward each other; thrust means including said upper slips, upper expander and packing structure for exerting a downward force on said outer expander to hold said lower slips engaged with the conduit, said thrust means further including a releasable clutch to connect said outer expander to said body to move with said body and releasable to disconnect said body from said outer expander and permit upward movement to said body with respect to said upper and outer expanders, said clutch being engageable to enable said thrust means to transmit said

downward force and to prevent downward movement of said body in the well conduit; and valve means operatively connected to said body for controlling flow of fluid between the interior of said body and the exterior of said apparatus above said packing structure, said valve means being closed upon upward movement of said body relative to said valve means and opened upon downward movement of said body relative to said valve means.

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