United States Patent

Cockrell et al.

[15] **3,678,998**

[45] **July 25, 1972**

[54] RETRIEVABLE WELL PACKER

[72] Inventors: **Darryl W. Cockrell; Rudy B. Callihan,** both of Houston, Tex.

[73] Assignee: **Baker Oil Tools, Inc.,** Commerce, Calif.

[22] Filed: **July 20, 1970**

[21] Appl. No.: **56,626**

[52] **U.S. Cl.** **166/123,** 166/134

[51] **Int. Cl.** **E21b 23/06,** E21b 33/129

[58] **Field of Search** 166/123, 125, 134, 135, 120

[56] **References Cited**

UNITED STATES PATENTS

3,398,795	8/1968	Elliston	166/120
3,244,233	4/1966	Villalon	166/134 X
3,131,764	5/1964	Muse et al.	166/134 X
3,344,861	10/1967	Claycomb	166/123 X
3,420,305	1/1969	Alexander et al.	166/123 X

Primary Examiner—David H. Brown

Attorney—Bernard Kriegel

[57] **ABSTRACT**

A well packer lowered in a well casing and having a main body carrying expanders and initially retracted slips for anchoring the body to the casing against both up and down movement therein, the body also carrying an initially retracted packing thereon expandable against the casing, the slips and packing being expanded outwardly against the casing by moving the body upwardly, and an upper device surrounding the body downwardly against the upper portion of the expander slip and packing combination, the upward force or movement of the body being transmitted to the slip and packing combination through a coupling structure releasably connecting the body to the lower portion of combination. When the packer is to be released from the casing a retrieving tool engages and releases the coupling structure, removing the upward force of the body on the lower portion of the expander slip and packing combination, an upward pull on the tool then moving the body upwardly to effect retraction of the slips and packing from the casing.

35 Claims, 26 Drawing Figures

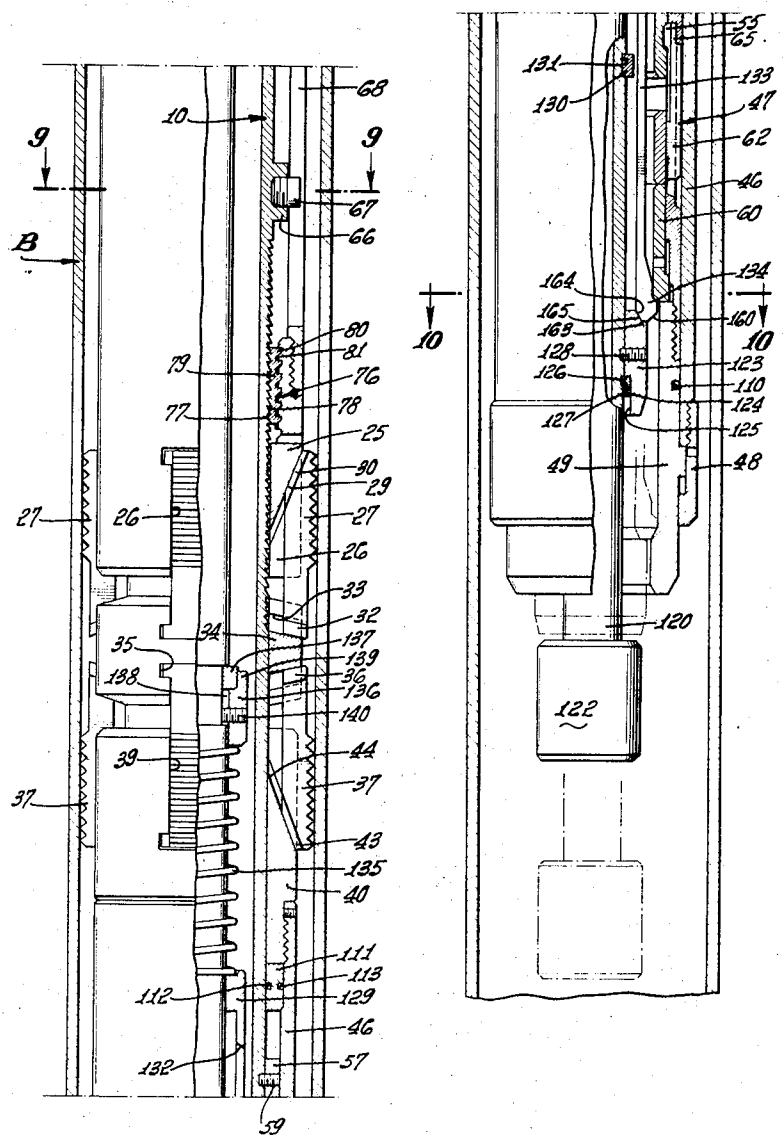


FIG. 1a.

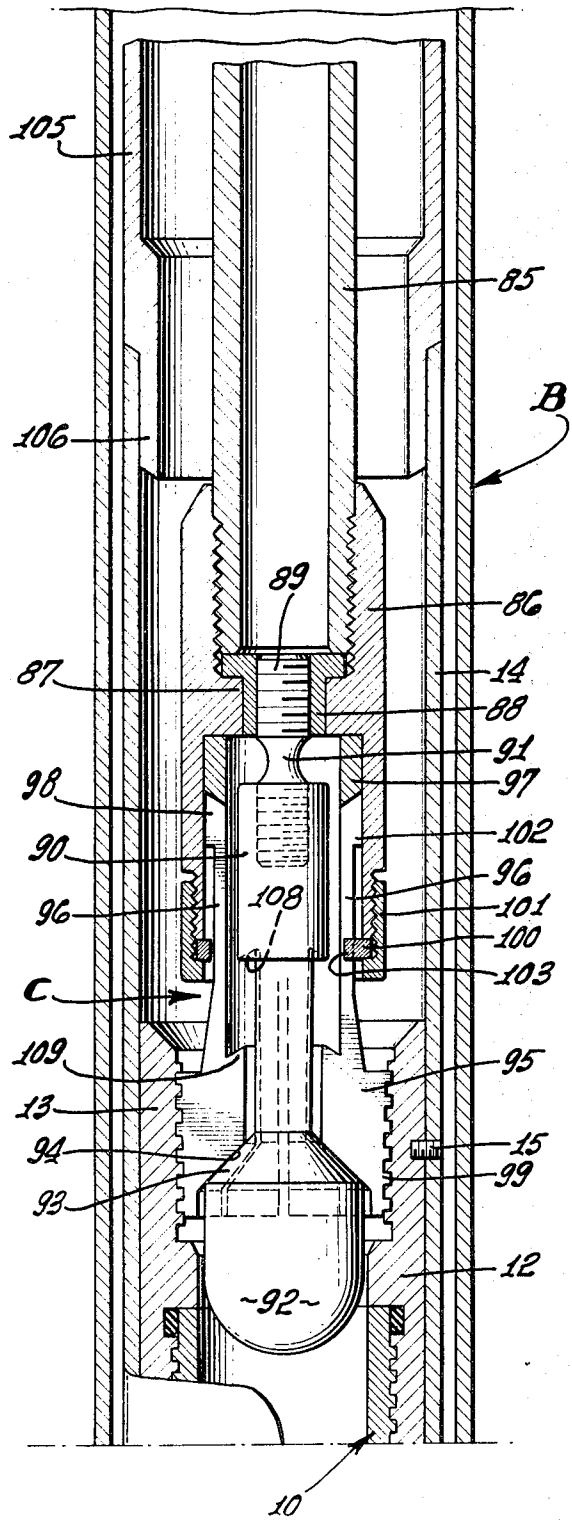
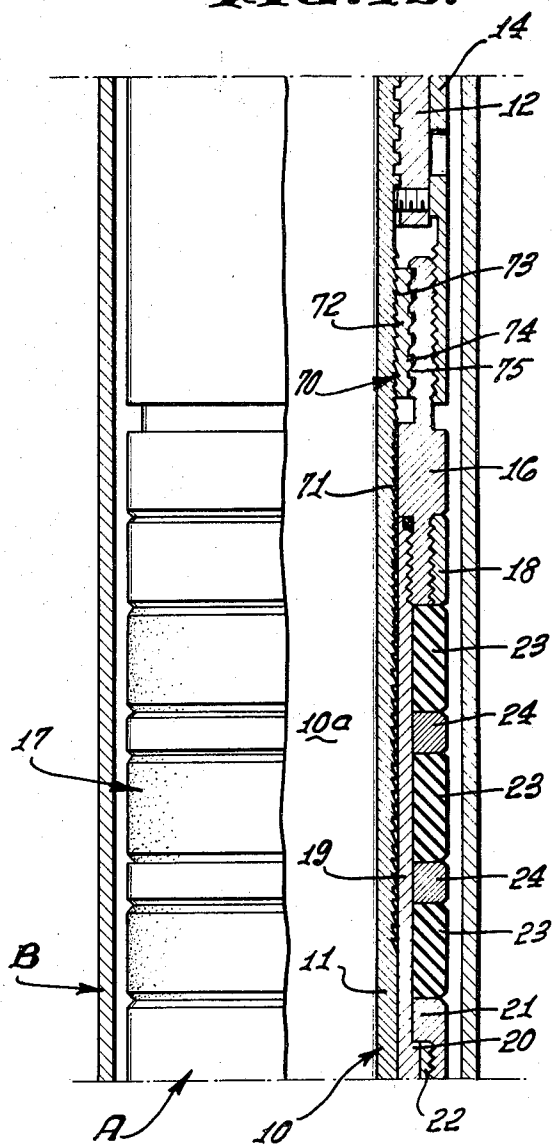


FIG. 1b.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By Bernard Kriegel
ATTORNEY.

FIG. 1c.

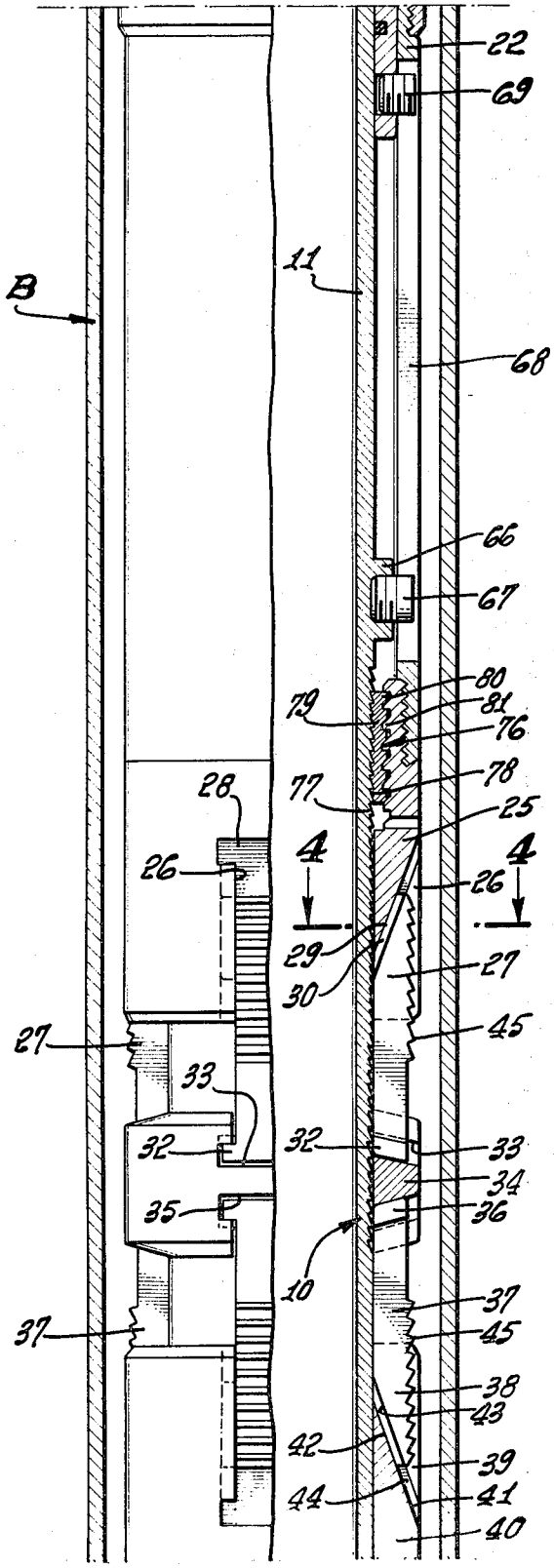
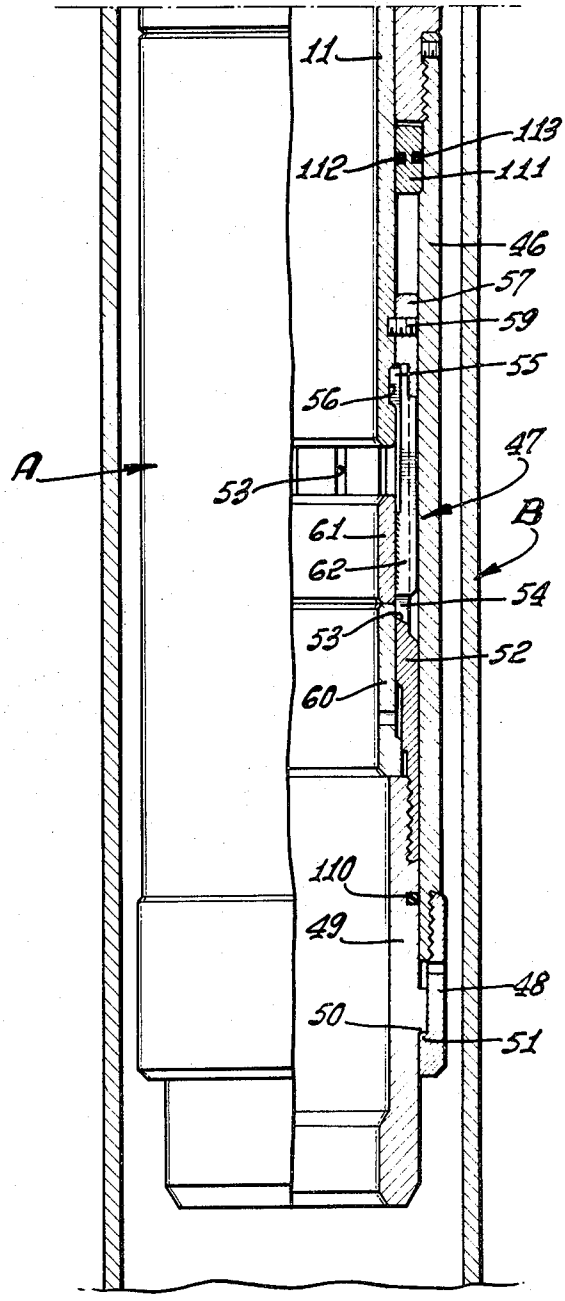


FIG. 1d.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN

By Bernard Krieger
ATTORNEY.

FIG. 3.

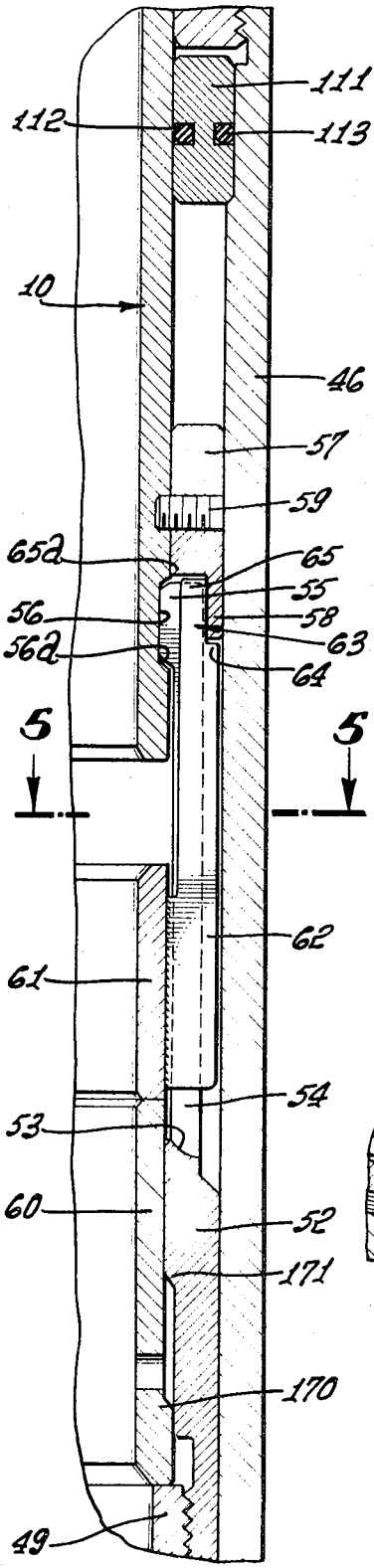


FIG. 4.

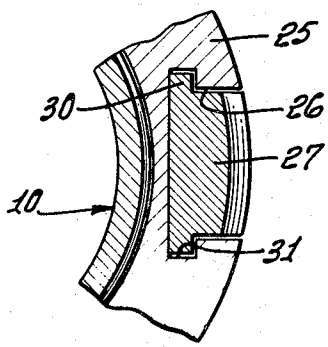


FIG. 5.

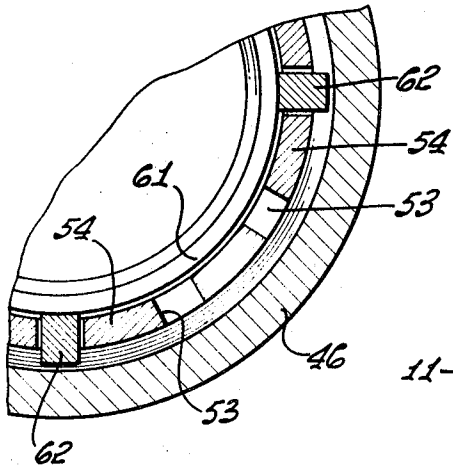
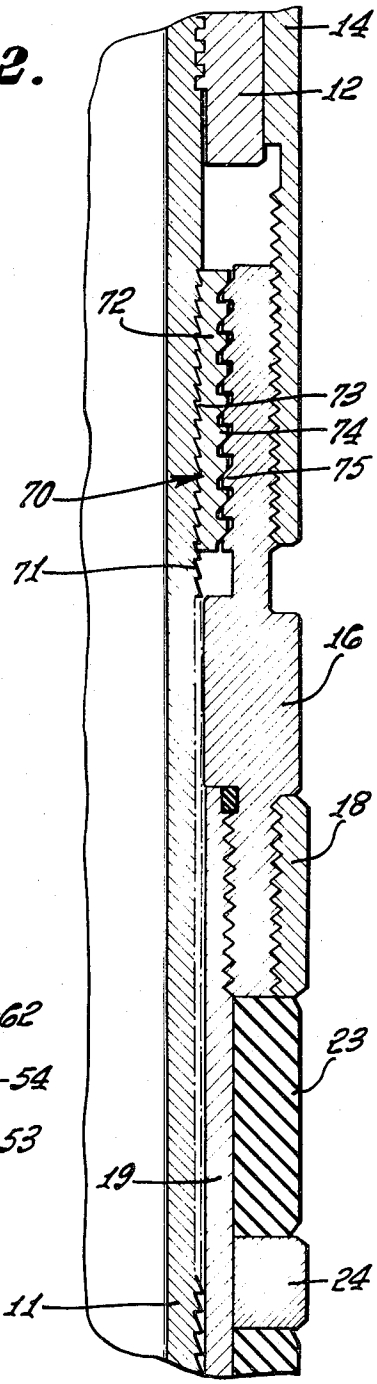


FIG. 2.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By
Bernard Kriegel
ATTORNEY.

FIG. 6a.

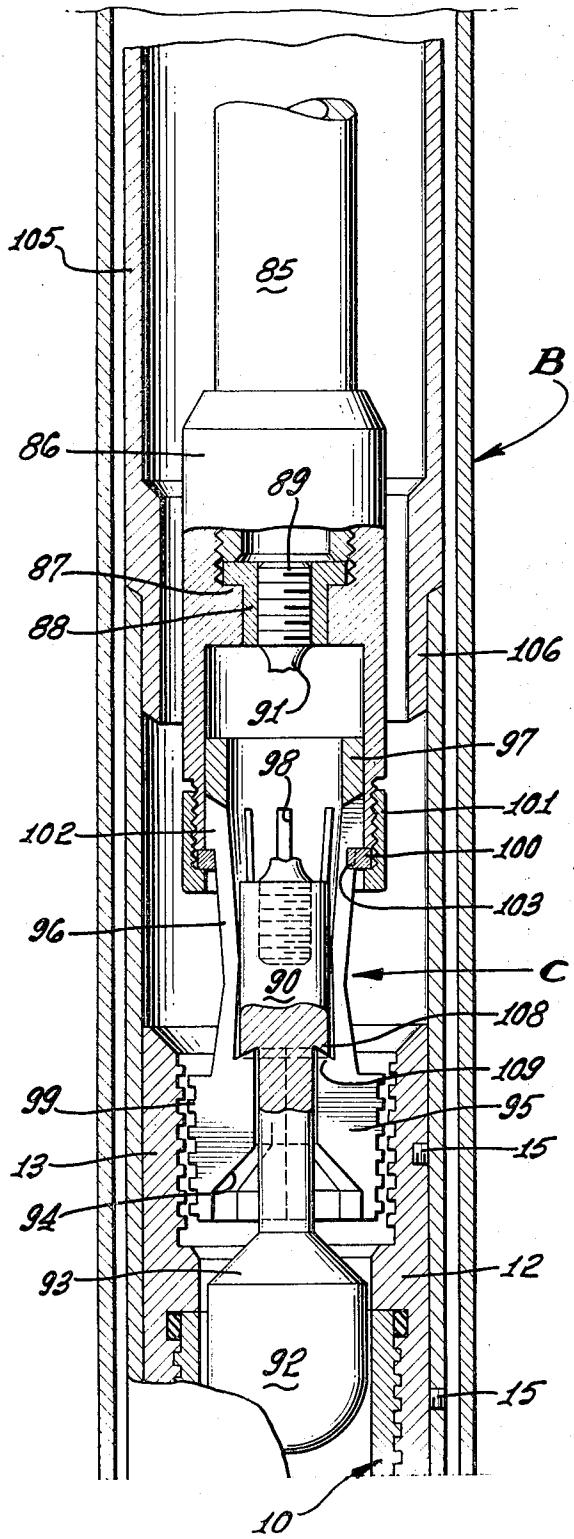
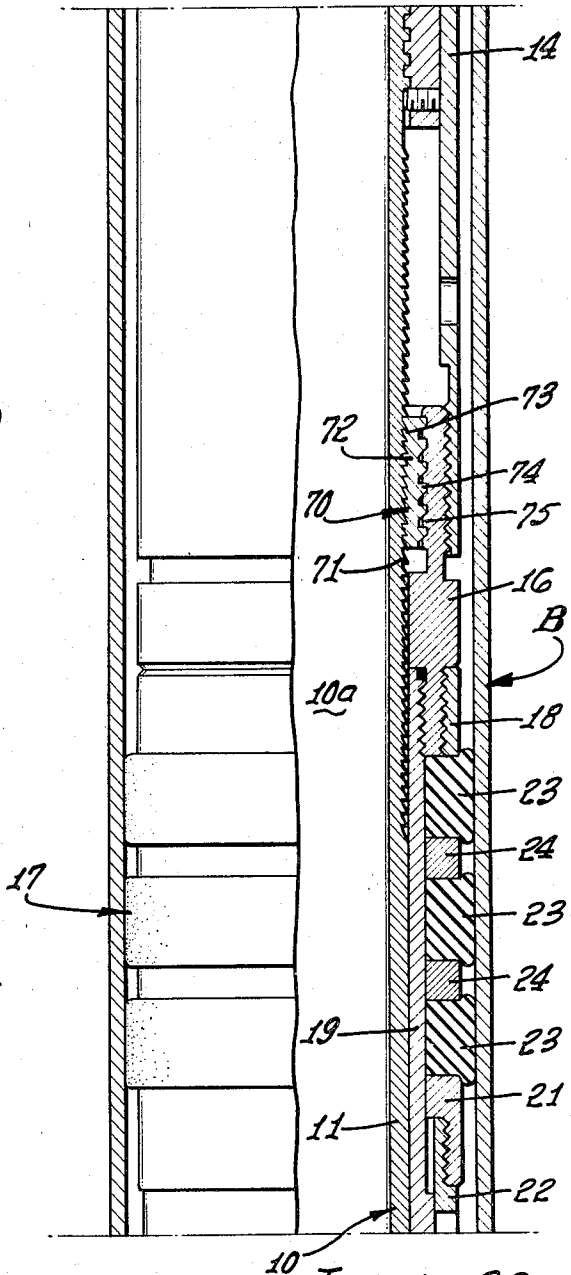


FIG. 6b.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By Bernard Kriegel
ATTORNEY.

FIG. 6c.

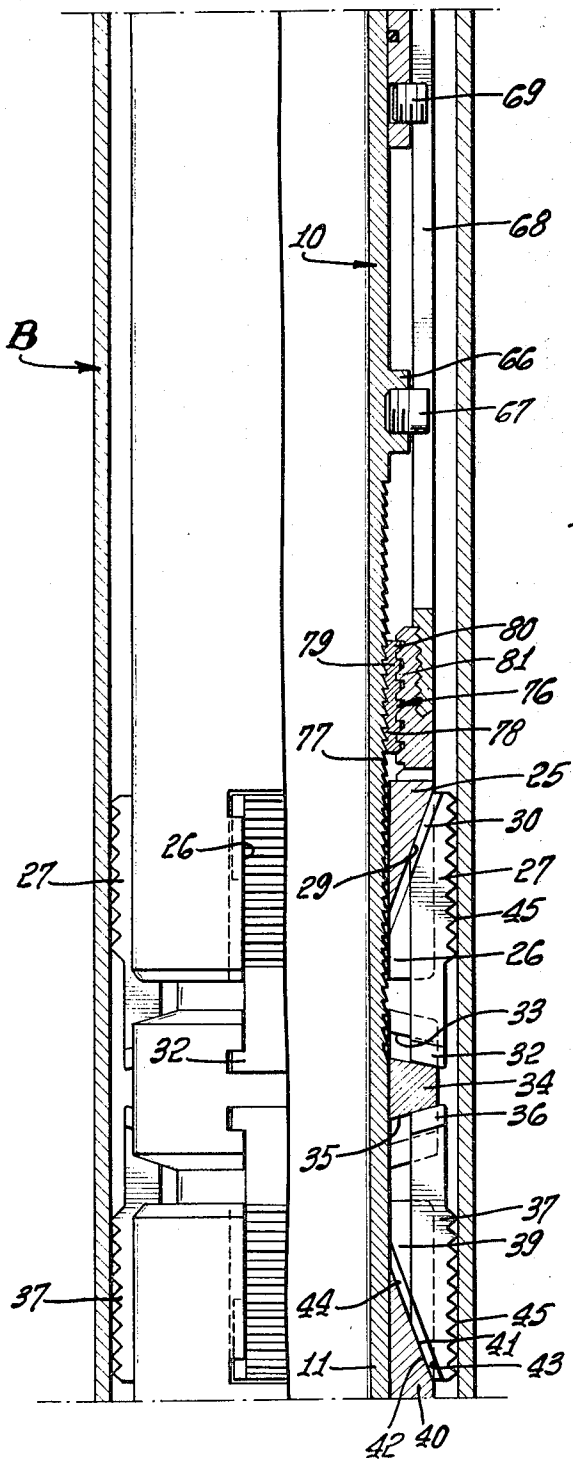
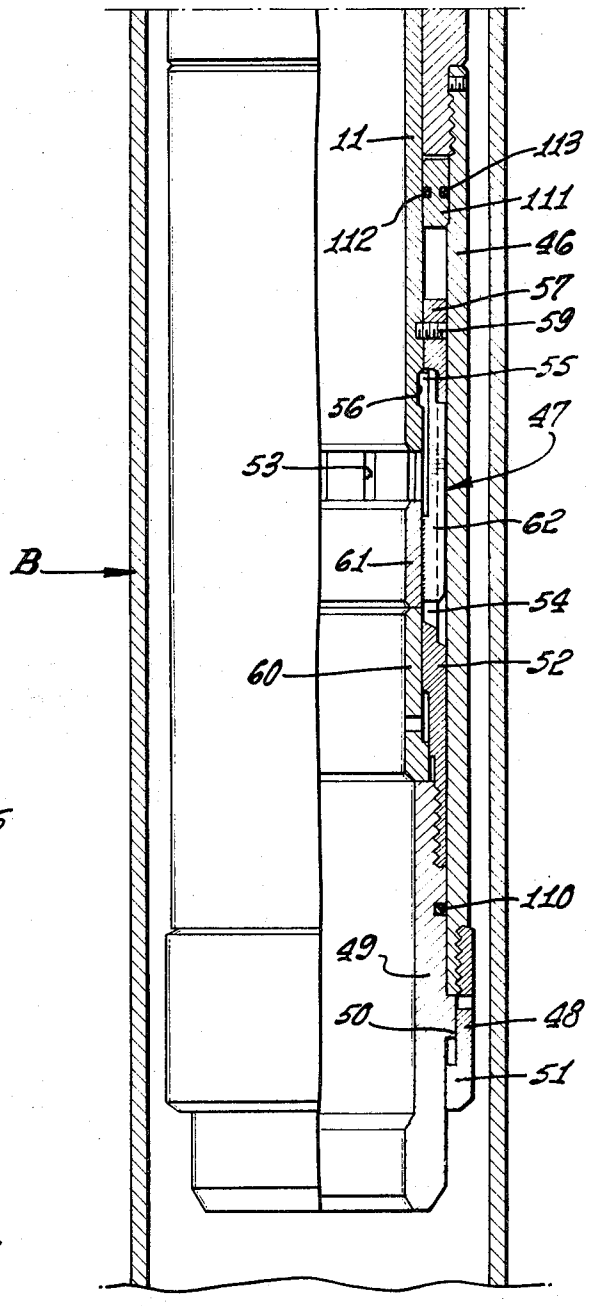


FIG. 6d.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By Bernard Kriegel
ATTORNEY.

FIG. 7a.

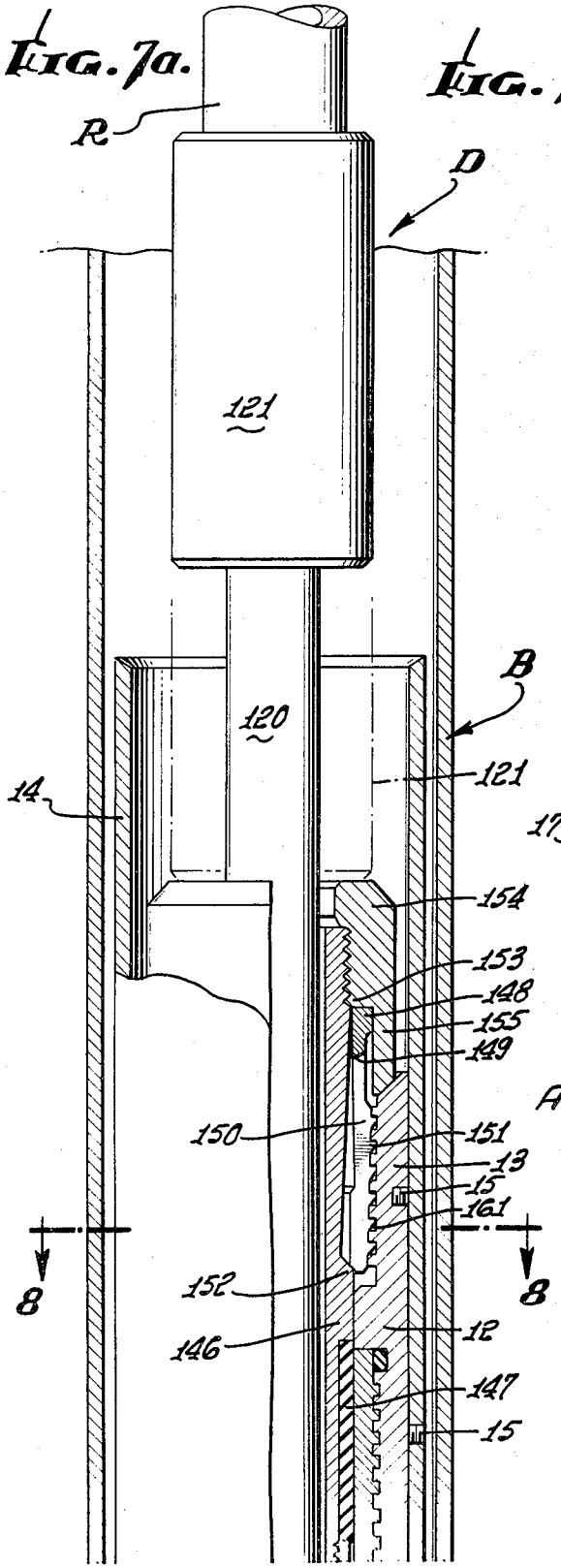
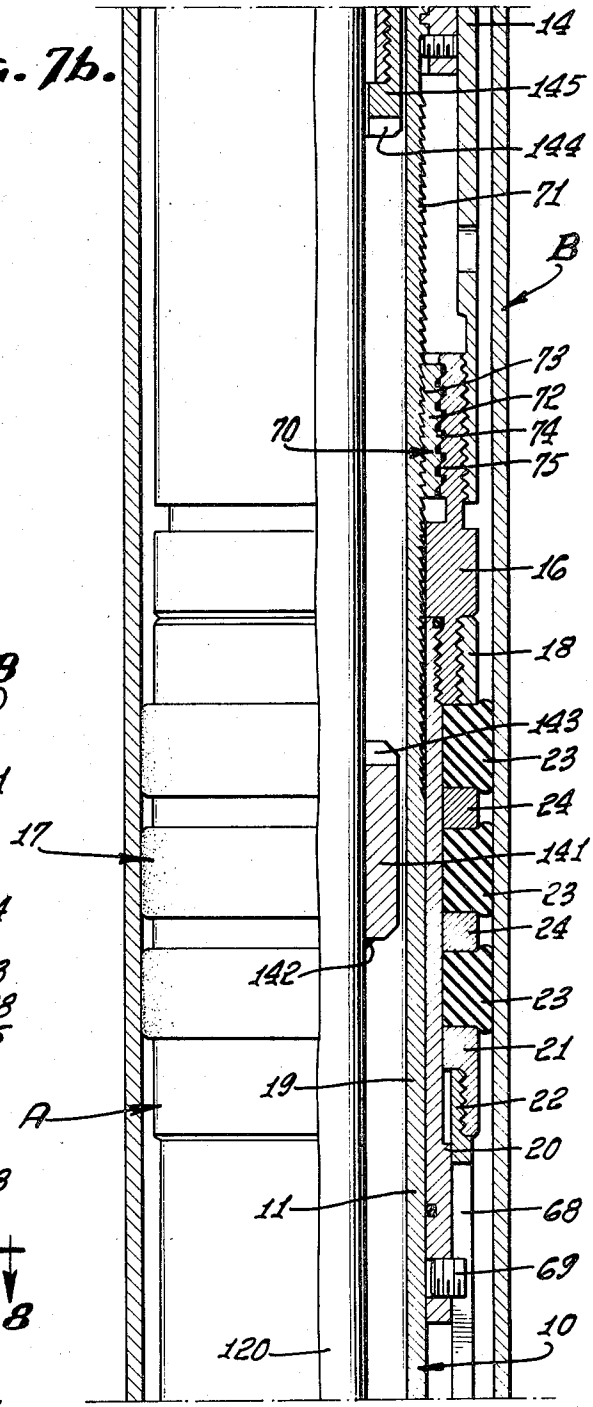


FIG. 7b.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By Bernard Kriegel
ATTORNEY.

FIG. 7c.

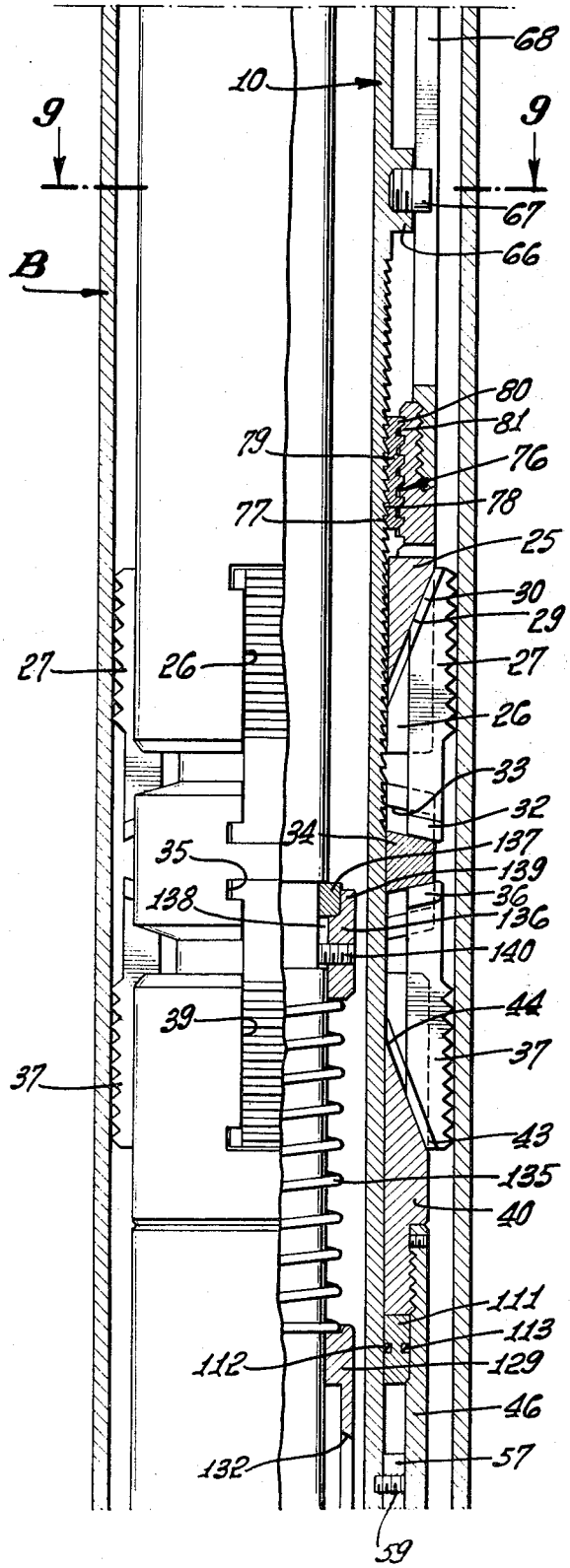
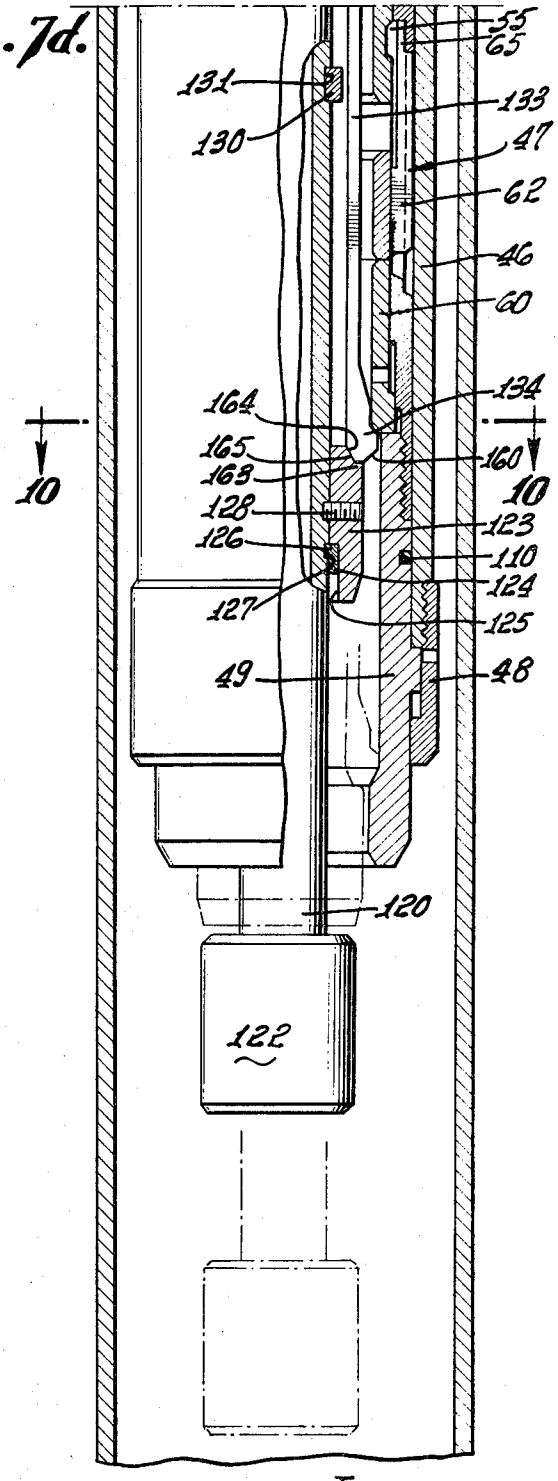


FIG. 7d.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By Bernard Kriegel
ATTORNEY.

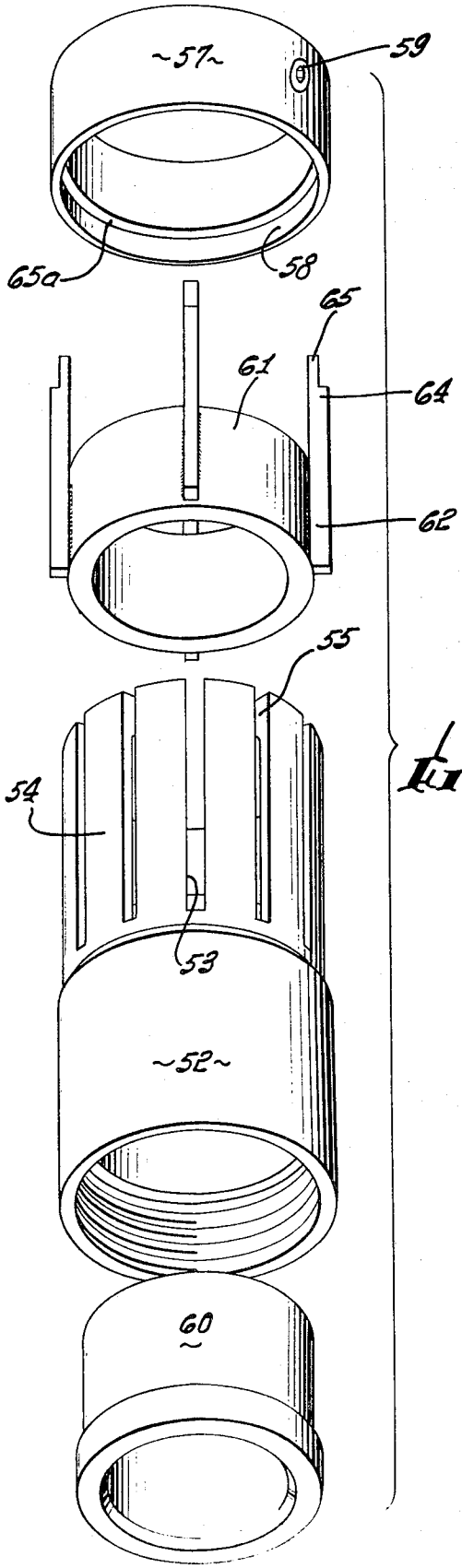


FIG. 11.

FIG. 8.

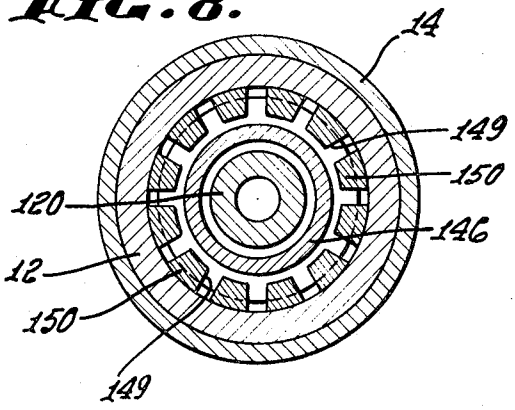


FIG. 9.

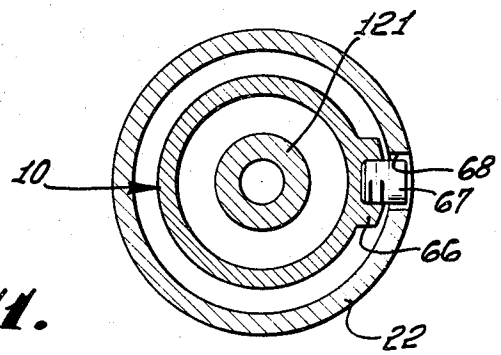
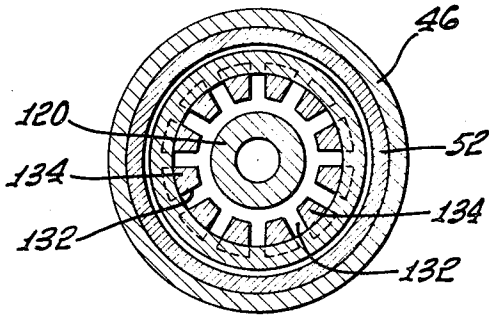


FIG. 10.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By
Bernard Kriegel
ATTORNEY.

FIG. 12.

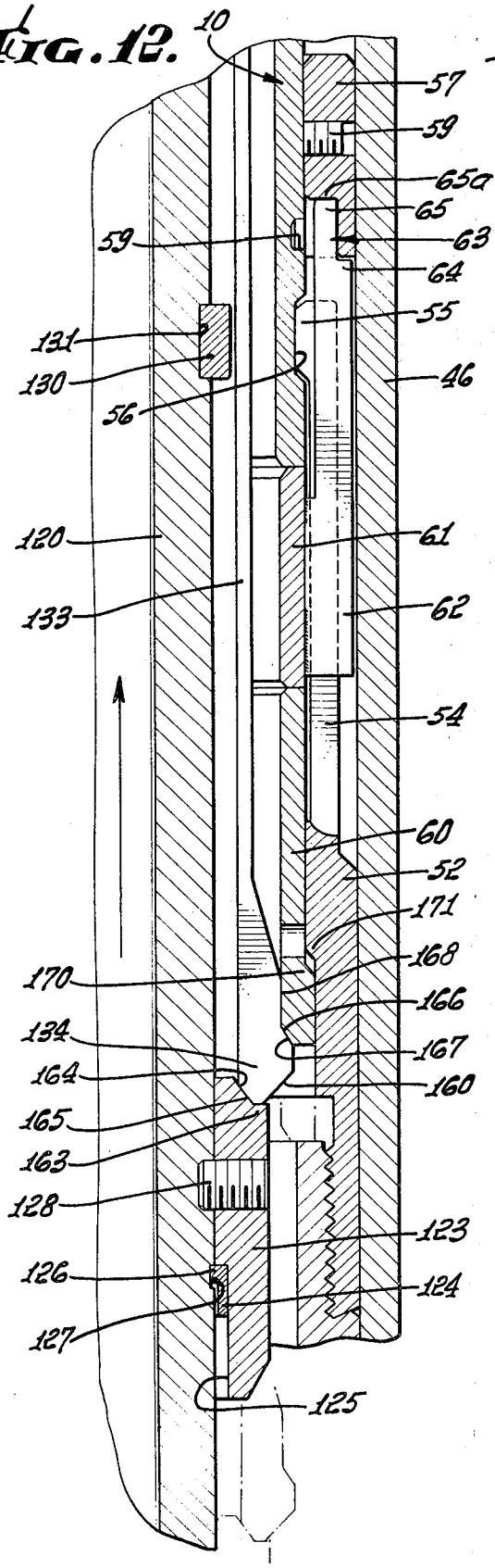
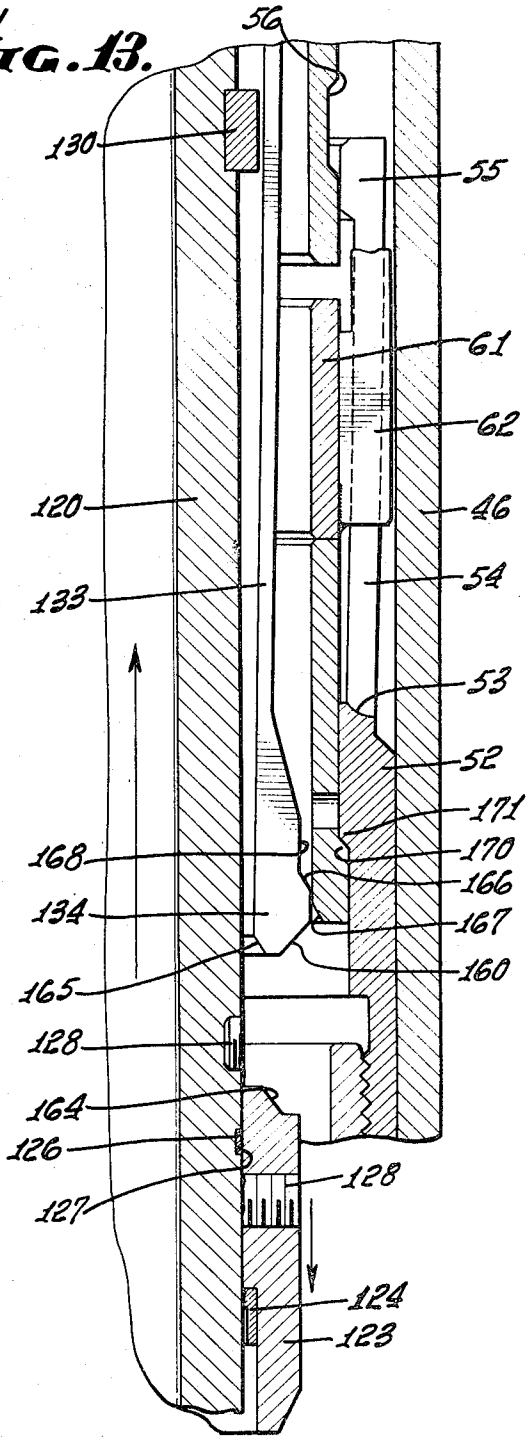


FIG. 13.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By Bernard Kriegel
ATTORNEY.

FIG. 14a.

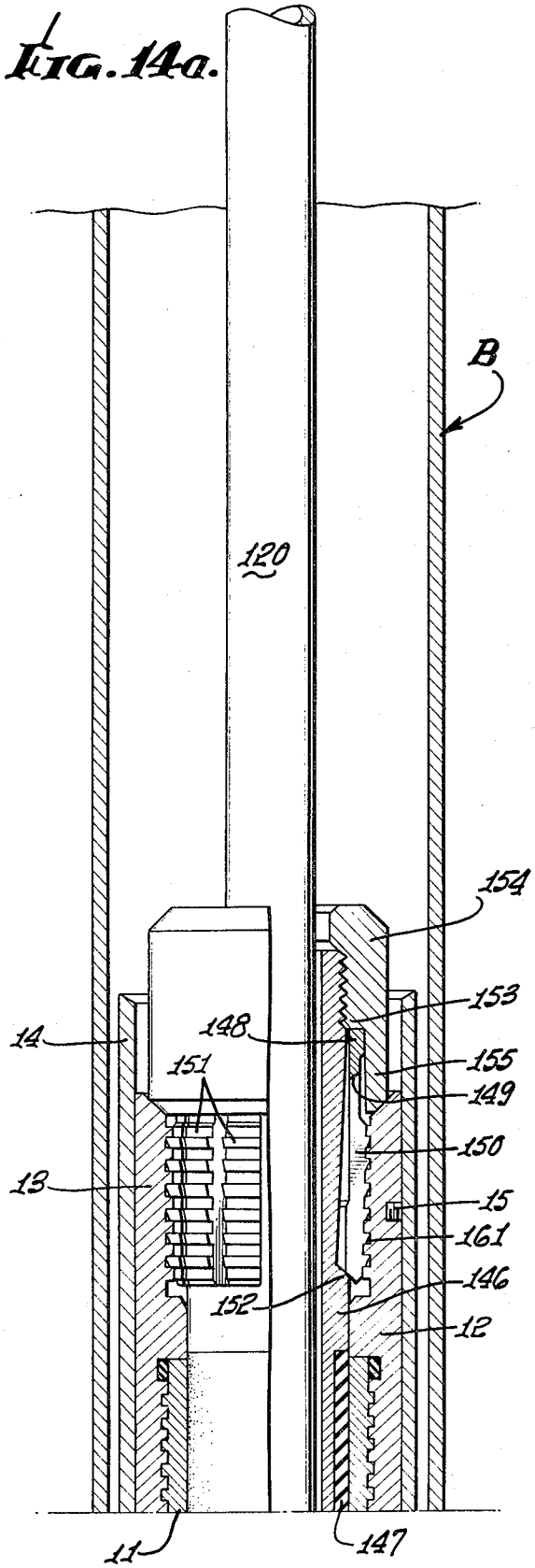
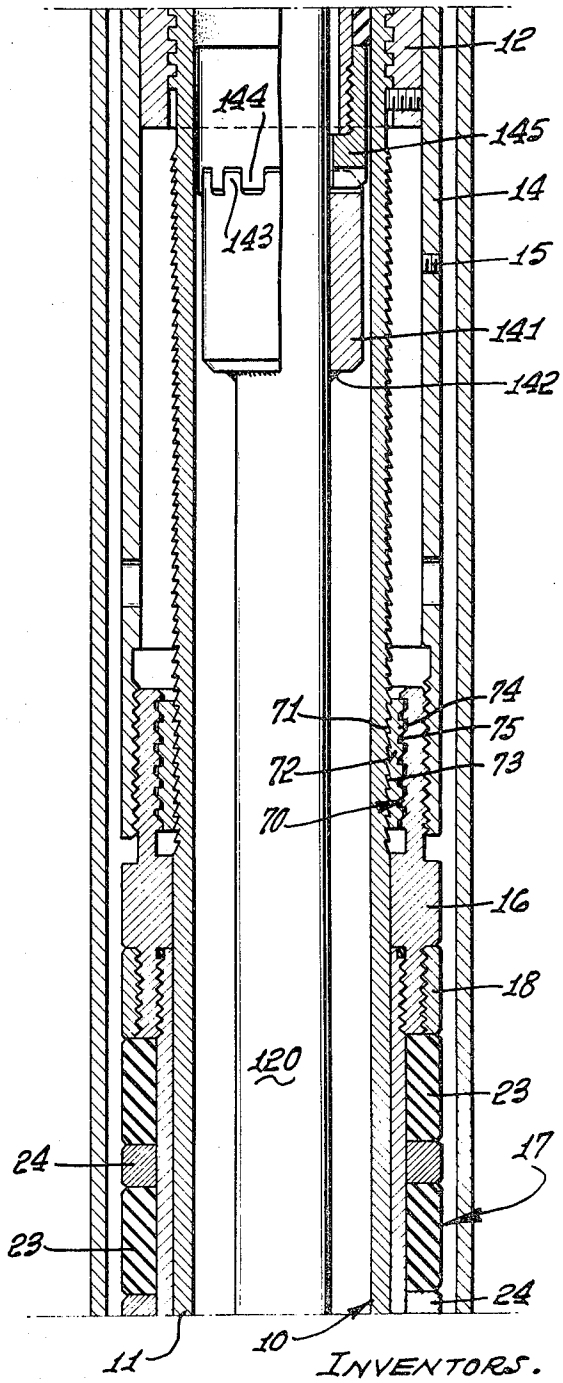


FIG. 14b.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
By Bernard Kriegel
ATTORNEY.

FIG. 14c.

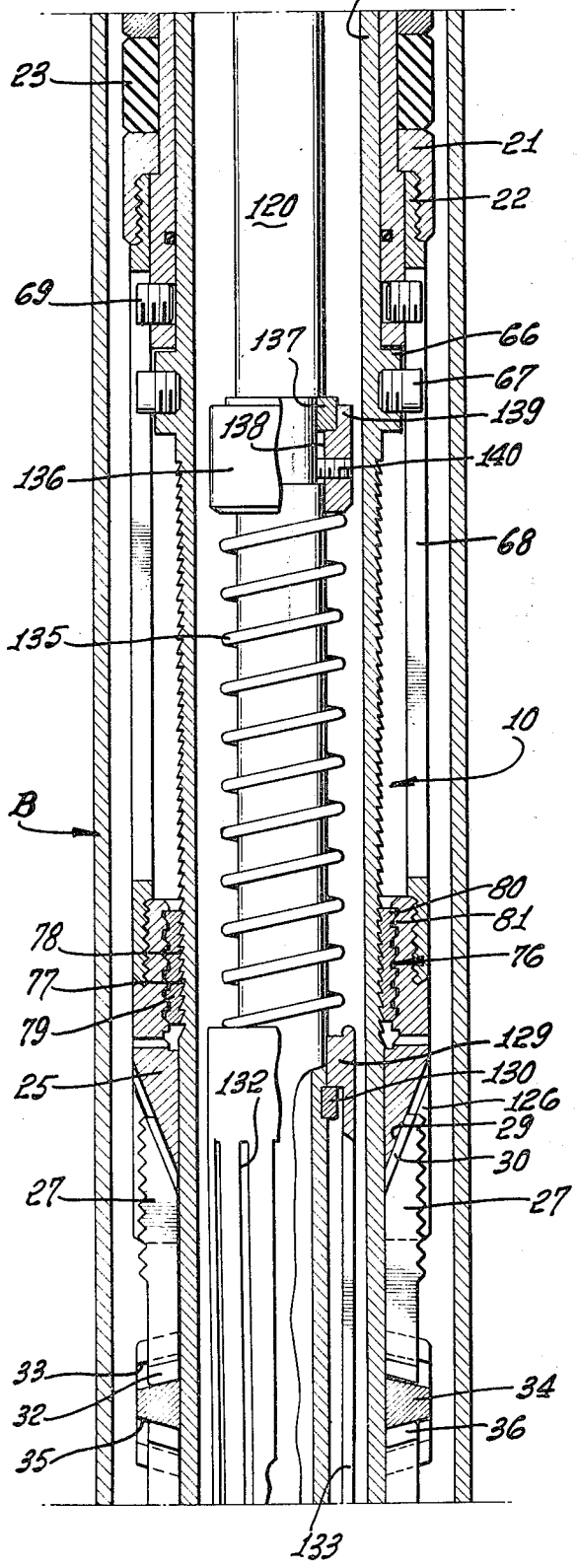
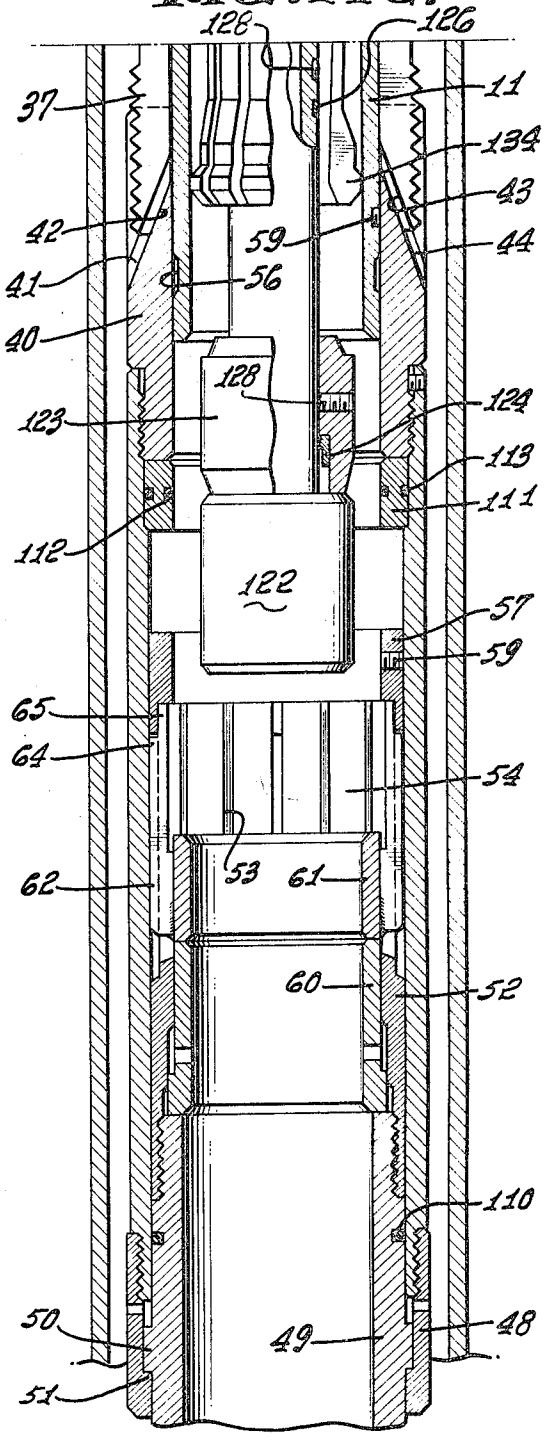


FIG. 14d.



INVENTORS.
DARRYL W. COCKRELL
RUDY B. CALLIHAN
BY Bernard Kriegel
ATTORNEY.

RETRIEVABLE WELL PACKER

The present invention relates to subsurface well bore devices, and more particularly to subsurface well packers of the retrievable type capable of being used in a variety of applications in a well bore, including production, testing, fluid injection, and zone isolation, or as a bridge plug.

Well packers of the permanent type are known which can be packed off in the well casing and anchored therein against movement in both upward and downward directions, the packer being secured in its set position. Removal of the packer can only be effected by disintegrating it through use of a drill bit or milling tool, or the like. An example of such well packer is found in U.S. Pat. No. 2,713,910, such patent also illustrating a setting tool by means of which the packer can be run in a well casing on a wireline and anchored in packed-off condition to the well casing by the setting tool, which is then released and removed from the well casing.

By virtue of the present invention, a well packer is provided having an initially retracted packing and initially retracted slips coacting with expanders capable of expanding the slips into anchoring engagement with the well casing, the packing also being expanded against the well casing, and in which the slips and packing can be released from the well casing, enabling the well packer to be withdrawn therefrom whenever desired. The slips coact with the expanders to lock the packer body against movement in the well casing in both longitudinal directions, the body being prevented from partaking of any movement relative to the expanders and slips after the slips have been anchored against the well casing. If the packing tends to extrude, due to the imposition thereon of high pressure, high temperatures, or both, the packing is still retained in an effective sealed-off condition against the well casing. Moreover, such extrusion is incapable of effecting any loosening or release of the slips from the well casing, so that assurance is had that the packer remains locked in packed-off condition against the well casing under extremely adverse conditions.

Despite the fact that the slips and coacting expanders cannot shift from their position anchoring the slips against the well casing, and the packing is held in packed-off condition against the well casing, the packer parts can still be readily released when retrieval of the well packer is desired. A releasing tool is lowered in the casing and effects a release and retraction of the slips and retraction of the packing, as a result of a straight-line (non-rotary) movement of the releasing tool, the running-in string and releasing tool attached thereto then being moved upwardly to carry the well packer upwardly through the well casing to the top thereof. Thus, it is unnecessary to effect rotation of the packer body, or other parts, in releasing the well packer from the casing, as in prior art devices, which require connection of a tubular string with the body of the tool in order to transmit rotary motion and torque from the top of the well bore to the packer body. With applicants' apparatus, the releasing of the well packer from the casing and its retrieval therefrom can be effected through use of a tubular string, if desired, or through use of a wireline running string, since no rotary motion and application of torque are required in releasing the slips and packing from the well casing.

In addition to the foregoing advantages and objectives of the present invention, a well packer of the retrievable type is provided which is capable of withstanding very high pressure differentials and also relatively high temperatures. The retrievable well packer is of strong, sturdy and comparatively simple construction for a retrievable well packer capable of being mechanically anchored in packed-off condition against movement in both longitudinal directions, and comparatively economical to manufacture.

This invention possesses many other advantages, and has other purposes 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.

Referring to the drawings

FIGS. 1*a*, 1*b*, 1*c* and 1*d* together constitute a combined side elevational and longitudinal sectional view through a well packer embodying the invention, with its parts in their initial retracted position for lowering the well packer in a well casing on a running tool, FIGS. 1*b*, 1*c* and 1*d* being lower continuations of FIGS. 1*a*, 1*b* and 1*c*, respectively;

FIG. 2 is an enlarged fragmentary longitudinal section through an upper portion of the well packer illustrated in FIG. 1*b*;

FIG. 3 is an enlarged fragmentary longitudinal section through a lower portion of the well packer shown in FIG. 1*d*;

FIG. 4 is an enlarged section taken along the line 4—4 of FIG. 1*c*;

FIG. 5 is a cross-section taken along the line 5—5 on FIG. 3;

FIGS. 6*a*, 6*b*, 6*c* and 6*d* together constitute a combined side elevational and longitudinal sectional view through the packer apparatus corresponding to FIGS. 1*a*, 1*b*, 1*c* and 1*d*, with the packer anchored in packed-off condition in the well casing and the running and setting tool released therefrom, FIGS. 6*b*, 6*c* and 6*d* being lower continuations of FIGS. 6*a*, 6*b* and 6*c*, respectively;

FIGS. 7*a*, 7*b*, 7*c* and 7*d* are views similar to FIGS. 1 and 6, illustrating the well packer, slips and packing on the point of being released from the well casing by a retrieving tool, FIGS. 7*b*, and 7*c* and 7*d* being lower continuation of FIGS. 7*a*, 7*b* and 7*c*, respectively;

FIG. 8 is a cross-section through the well packer and retrieving tool taken along the line 8—8 on FIG. 7*a*;

FIG. 9 is a cross-section through the well packer and retrieving tool taken along the line 9—9 of FIG. 7*c*;

FIG. 10 is a cross-section through the well packer and retrieving tool taken along the line 10—10 on FIG. 7*d*;

FIG. 11 is an exploded view illustrating certain parts of the releasable coupling structure of the well packer;

FIG. 12 is an enlarged longitudinal quarter sectional view illustrating the retrieving tool connected to the well packer and having initiated its release of its coupling;

FIG. 13 is a view similar to FIG. 12 disclosing the releasable coupling structure released and the releasing tool disconnected from the coupling portion of the well packer;

FIGS. 14*a*, 14*b*, 14*c* and 14*d* are views similar to FIG. 7, illustrating the well packer slips and packing retracted and retrieving tool related to the packer for effecting its withdrawal from the well casing, FIGS. 14*b*, 14*c* and 14*d* being lower continuations of FIGS. 14*a*, 14*b* and 14*c*, respectively.

As illustrated in the drawings, a well packer A is lowered within a casing string B disposed in a well bore to a desired location at which the packer is to be anchored in packed-off condition against movement in both upward and downward directions. The well packer is lowered on a running and setting tool C secured to its upper end, this setting tool being of any suitable type and attached to a running string extending to the top of the bore hole. As specifically illustrated by way of example, the setting and running tool C is secured to a wireline (not shown) extending to equipment at the top of the well bore, the setting tool being of the type specifically illustrated in U.S. Pat. No. 2,713,910. Since the setting tool is well known, only its lower portion is illustrated in the drawings.

The well packer comprises a main body **10**, including an elongate main tubular section **11**, the upper end of which is threadedly secured to a body sub or head **12** having a threaded box **13**, the threads preferably being left-hand. An upper setting sleeve **14** surrounds the head **12**, projecting upwardly beyond its upper end, and being held in its initial position by one or more shear screws **15** threaded into the box. The lower end of the sleeve is threadedly secured to a support ring or upper abutment **16** forming the upper portion of a packing as-

sembly 17. This upper abutment has a gauge ring 18 threaded thereto and an inner or compression sleeve 19 also threaded thereto and extending downwardly along the elongate body member 10, terminating in a lower external flange 20 underlying a lower abutment or gauge ring 21 threadedly attached to an upper expander extension sleeve 22 surrounding the flange. The packing assembly 17 further includes a plurality of elastomer packing elements 23 surrounding the compression sleeve 19 that are separated by spacer rings 24, the uppermost packing element engaging the upper abutment 16 and the lowermost packing element 23 engaging the lower abutment 21. Initially, the packing elements 23 occupy a retracted position, spaced inwardly from the well casing B when being lowered therein.

The lower end of the extension sleeve 22 is threadedly secured to an upper expander 25 having circumferentially spaced slots 26 in which a set of upper slips 27 are disposed. The bases 28 of the slots provide expander surfaces inclined in a downward and inward direction and coacting with companion tapered surfaces 29 on the upper, inner portions of the slips. Relative downward movement of the upper expander 25 within the slips 27 will shift the latter outwardly into anchoring engagement with the well casing, the expander remaining wedged behind such slips to retain the packer anchored to the well casing against downward movement. Relative upward movement of the expander 25 will effect retraction of the slips 27 from the well casing, by virtue of inclined oppositely directed side tongues 30 on each slip slidable within companion inclined grooves 31 in the expander and opening into the expander slot 26, the direction and extent of inclination of the tongues and grooves being the same as the coacting expander surfaces 28, 29 (FIG. 4).

The lower ends of the upper slips 27 are formed as T-shaped heads 32 slidable radially in companion T-shaped radial grooves 33 in a slip coupling ring 34 surrounding the body 10. This coupling ring has a lower set of T-shaped grooves 35 receiving the upper T-shaped heads 36 of a set of circumferentially spaced lower slips 37, the lower anchor portions 38 of which are disposed in slots 39 in a lower expander 40, the bases 41 of these slots providing expander surfaces inclined in an upward and inward direction and coacting with companion inner tapered surfaces 42 on the lower slips. Relative longitudinal movement between the lower slips 37 and lower expander 40 toward each other will expand the slips outwardly into anchoring engagement with the wall of the well casing. Relative separating movement between the lower expander 40 and lower slips 37 will effect retraction of the latter, by virtue of a tongue and groove interconnection 43, 44 between each slip and lower expander corresponding to the upper tongues 30 and grooves 31, but inclined in upward and inward directions in correspondence to the extent of inclination of the expander surfaces 41, 42 on the lower expander and lower slips.

Both the upper and lower slips 27, 37 have external wickers or teeth 45 which can embed themselves in the wall of the well casing B, the upper expander and upper slips retaining the packer against movement in a downward direction and the lower expander and slips retaining the packer in the well casing against upward movement.

The lower end of the lower expander 40 is threadedly secured to an elongate housing 46 surrounding a coupling mechanism 47 for releasably securing the lower end of the body 10 to the housing, the coupling mechanism serving to transmit longitudinal movement, as in an upward direction, between the body and housing, thereby effecting setting of the slips 27, 37 and packing assembly 17 against the well casing, and being releasable to enable the packing assembly and slips to be retracted from the well casing. The lower end of the housing 46 is threadedly secured to a lower gauge ring 48, which is actually an extension thereof, the lower portion of the housing and gauge ring surrounding a bottom sub 49 having an external flange 50 overlying an internal flange 51 of the gauge ring. The upper end of the bottom sub is threadedly secured to the lower end of a latch sleeve 52 having circumferentially spaced longitudinal slots 53 therein opening through the upper end of the sleeve to provide circumferentially spaced spring-like arms 54 that terminate in inwardly directed fingers 55 receivable within an external circumferential groove 56 in the lower portion of the body 10 (FIGs. 3, 5). These fingers are initially retained in the groove 56 by a latch retainer ring 57 surrounding the body and having a lower skirt 58 encompassing the fingers 55 to hold them within the lock groove, the ring 57 being retained initially in its position surrounding the fingers by one or more shear screws 59 threaded into the body.

Shearing of the screws 59 and elevation of the retainer 57 from the fingers 55 allows the arms 54 to expand and the fingers to move outwardly from the groove 56 in view of the radial spacing between the arms and fingers and the surrounding housing 46. Such shearing of the screws 59 and removal of the latch retainer 57 is effected by imposing an upwardly directed force (as described hereinbelow) on a latch release sleeve 60 disposed within the latch sleeve 52 and initially resting upon the upper end of the bottom sub 49, the upper end of the release sleeve engaging a release ring 61 integral with, or otherwise suitably secured to, a plurality of circumferentially spaced elongate keys 62 disposed within some of the latch sleeve slots 53, the upper ends 63 of the keys engaging the lower portion of the latch retainer 57. As specifically illustrated, the upper ends 63 of the keys are of step form with a lower outer step 64 engaging the lower end of the latch retainer skirt 58 and an inner portion 65 engaging the base 65*a* of a counterbore in the retainer ring, which forms its skirt portion 58.

The upper expander extension sleeve 22 is spaced laterally outwardly from the packer body 10, the latter having an external flange 66 provided with a screw or key 67 secured thereto and located initially within the lower end of an elongate slot 68 in the extension sleeve. The compression sleeve flange 20 also has a screw or key 69 secured thereto and initially disposed in the upper portion of this extension sleeve slot 68.

After reaching its setting location in the well casing B, the well packer A is set by imposing a downward force or movement on the setting sleeve 14 and an upward force and movement on the body 10, to shift the housing 46 and lower expander 40 and the support ring or upper abutment 16 toward each other. The downward movement of the sleeve 14 will be transmitted through the packing assembly 17 and upper expander extension sleeve 22 to the upper expander 25, and the upward movement of the body 10 will be transmitted through the latch fingers 55 and latch sleeve 52 to the bottom sub 49, and from the flange 50 of the latter to the housing 46 and upper expander 40, thereby moving the upper and lower expanders 25, 40 toward each other, effecting radial outward expansion of the upper and lower slips 27, 37 into engagement with the well casing. When such engagement occurs, the upper and lower expanders are wedged behind the upper and lower slips, respectively, and cannot move toward each other to any further significant extent, except for the slight motion attributable to firmer wedging of the expanders behind their respective slips. Accordingly, the body 10 of the packer is prevented from moving upwardly to any further extent, but the setting sleeve 14 and upper abutment 16 attached thereto can move downwardly toward the lower abutment 21, which is now prevented from moving downwardly by the upper expander 25, compressing the packing elements 23 and expanding them laterally outwardly into firm sealing engagement with the wall of the well casing.

The packing assembly 17 is retained in its expanded condition by a one-way clutch or gripper 70 provided between the upper abutment 16 and body 10. As disclosed, the upper portion of the body has a series of longitudinally extending downwardly facing ratchet teeth 71 encompassed by a split body lock ring 72 (FIG. 2) having companion upwardly facing internal ratchet teeth 73 and also external cam teeth 74 coacting with companion internal cam teeth 75 formed in the sup-

port ring 16. The one-way clutch or ratchet mechanism permits downward movement of the support ring or upper abutment 16 along the body 10 by ratcheting of the lock ring 72 along the body teeth 71. However, any tendency for the support ring 16 to move upwardly of the body causes the teeth 73, 71 to coengage and the downwardly inclined cam teeth 74, 75 to coengage and force and retain the lock ring 72 inwardly to hold the ratchet teeth in full mesh with one another. The one-way ratchet clutch mechanism 70, by itself, forms no part of the present invention, being illustrated and described in U.S. Pat. No. 3,311,171, to which attention is directed.

A lower one-way clutch or gripper mechanism 76 is also provided between the upper expander 25 and body 10, to retain the slips 27, 37 firmly anchored against the well casing. Thus, the body 10 has a series of longitudinally extending downwardly facing ratchet teeth 77 coacting with companion upwardly facing internal teeth 78 on a split body lock ring 79 disposed within an upper portion of the upper expander 25 and also having external cam teeth 80 coacting with companion cam teeth 81 in the expander. The one-way ratchet mechanism 76 operates in the same manner as the upper ratchet mechanism 70; that is to say, it permits relative downward movement of the upper expander 25 along the body, but prevents upward movement of the upper expander along the body.

It is desirable to include the lower one-way clutch mechanism 76 in the well packer to prevent inadvertent release of the slips 27, 37 from the well casing, in the event of extrusion of the packing elements 23 around the upper or lower gauge rings 18, 21, or both. Such extrusion would permit the body 10 and upper abutment 16 to shift downwardly in the well casing to a slight extent, the downward shifting of the body being transmitted through the releaseable coupling 47 to the housing 46 to shift the lower expander 40 downwardly relative to the lower slips 37, which will remove the holding force of the lower expander from the lower slips and allow them to retract, at least partially, from the well casing. The lower one-way clutch, however, precludes such downward movement of the body 10, since any tendency for the body to move downwardly will be transmitted through the clutch mechanism 76 to the upper expander 25 and wedge the latter more firmly behind the upper slips 27, the wickers 45 of which are firmly embedded in the wall of the well casing B. Accordingly, the lower expander 40 cannot be moved away from the upper expander 27, securing both the upper and lower slips 27, 37 in their anchored position within the well casing.

The upper expander 25 also cannot loosen with respect to the upper slips 27, as a result of extrusion of the packing elements 23 around the upper or lower abutments 16, 18 or 21, since downward movement of the support ring or upper abutment 16, as a result of such extrusion, will ratchet the lock ring 72 along the body 10 and resecure the upper abutment to the body in a lower position, the compressive force on the packing elements 23 being retained. The imposition of downward force on the packing assembly 17, as, for example, by the existence of a large pressure differential in the annulus surrounding the packer body 10 and above the packing elements 23, will be exerted through the packing assembly 17 in a downward direction upon the upper expander 25, wedging the latter more securely behind its slips 27 On the other hand, if a pressure differential exists below the packing assembly 17, its upward force is transmitted through the packing assembly to the upper abutment 16, and from the latter through the one-way clutch 70 to the body 10, the upward force on the body being transmitted through the latch sleeve 52 and bottom sub 49 to the housing 46 and lower expander 40, wedging the latter more firmly behind the lower slips 37 and retaining them anchored against the well casing. The upwardly directed pressure on the packing assembly 17 cannot elevate the upper expander 25 with respect to the slips 27, since the ratchet teeth 27, 37 of the one-way clutch 76 coengage and prevent such upward movement along the body.

It is, therefore, apparent that the well packer A has been anchored in packed-off condition against longitudinal movement in both upward and downward directions, and will remain in that condition until release of the packer from the well casing B and its removal are desired. Such release and removal occurs through use of a suitable mechanism, described hereinbelow, which becomes coupled to the latch release sleeve 60, shifting the latter, and the release ring 61 bearing thereagainst, upwardly to cause the keys 62 to exert an upward force on the latch retainer 57 to shear the screws 59 securing it to the body, shifting the latch retainer upwardly along the body 10 and housing 46 completely from the latch fingers 55. Such latch fingers then expand from the body groove 56, releasing the body 10 from the latch sleeve 52 and the housing 46. This permits the body 10 to be moved upwardly along the parts that surround it, the upper and lower body rachet teeth 71, 77 merely ratcheting freely through the upper and lower split lock rings 72, 79, that expand outwardly to the desired extent. Upward movement of the body 10 causes its flange 66 to engage the lower end of the compression sleeve 19, shifting the latter upwardly and carrying the upper abutment 16 away from the lower abutment 21, which allows the packing elements 23 to retract inherently from the well casing. Continued upward movement of the body 10 then causes the compression sleeve flange 20 to engage the lower abutment 21 and move it, the upper expander sleeve 22, and the upper expander 25 upwardly with it, the upper expander being shifted upwardly relative to the upper slips 27 and effecting retraction of the latter from the well casing by virtue of their tongue and groove interconnection 30, 31. Release of the body 10 from the latch sleeve 52 may result in the latch sleeve, bottom sub 49, and housing 46 dropping downwardly with respect to the body, to pull the lower expander 40 downwardly relative to the lower slips 37, and effecting retraction of the latter from the well casing, because of the tongue and groove interconnection 43, 44. However, if this does not occur, then the continued upward movement of the body 10, after the upper expander 25 has retracted the upper slips 27, will cause the latter to pull upwardly on the coupling ring 34 and on the lower slips 37, shifting the latter upwardly with respect to the lower expander 40 and radially inwardly from the well casing. The packing assembly and slip structure of the well packer have now been retracted, allowing the well packer to be removed from the well casing.

The running and setting tool C specifically illustrated is disclosed in U.S. Pat. No. 2,713,910, as noted above, only the lower portion of such setting tool being shown. A tubular actuating mandrel 85 is connected to the upper cylinder (not shown) of the setting tool, and is movable upwardly when the latter is energized, the lower end of this mandrel being releasably coupled to the packer body box 13 through the agency of a releasable connector device. As specifically disclosed, the lower end of the mandrel is threaded into a tension head member 86 having an inwardly directed flange 87 that serves to clamp a threaded clamping collar 88 against the lower end of the mandrel. A release stud 89 is threaded into the collar, with its lower portion threaded into the upper end of a shank 90 depending into the upper portion or threaded box 13 of the packer body head 12. The intermediate portion 91 of the release stud is reduced in diameter to provide a weakened section at which it will pull apart when sufficient tensile strain is imposed upon it.

Onto the lower end of the shank is secured a retaining abutment or head 92 having an upward and inwardly directed tapered shoulder 93 engaging companion tapered surfaces 94 on the heel portions of circumferentially spaced, inherently contractile threaded dogs 95 carried by the leg portions 96 of a sleeve 97 which surrounds the shank 90 and extends upwardly into the tension head 86 below its flange 87. The threaded sleeve 97 has a plurality of longitudinally extending slots 98 formed through its wall to provide the plurality of circumferentially spaced legs 96 and threaded dogs 95. The left-hand threads 99 on the dogs may be placed in threaded en-

gagement with the left-hand thread formed in the body sub **13**. However, the legs and dogs tend to retract to an extent sufficient to remove the external threads **99** completely from engagement with the companion internal threads in the packer body head **12**.

When the release stud **89** is intact, the shank **90** is disposed in an upward position, with the upper end **93** of the retaining head engaging the tapered heels **94** of the dogs, holding the latter outwardly with their threaded portions **99** firmly engaged with the packer body threads, as illustrated in FIG. **1***a*. In effect, when the tension stud is intact, the parts function as a single unit, permitting the sleeve device **97** to be threaded into the packer body. To facilitate such threading, a two-part or split ring **100** is clamped to the lower end of the tension head **86** by a nut **101** threaded onto the latter. This ring projects laterally into the interior of the tension head and extends below a shoulder **102** formed in the upper portion of the threaded sleeve **97**. The split ring also has a key **103** projecting inwardly into one of the slots **98** between adjacent depending legs **96**, forming a key connection between the tension head **86** and the threaded sleeve **97**. Such key connection permits the tension head **86** to be grasped by hand, or by a suitable tool, and turned in the proper direction to thread the dogs **95** into the packer body **10**. The turning effort is transmitted from the tension head to the dogs **95** through the agency of the split ring **100** and its key **103**.

The piston portion (not shown) of the setting tool is connected to a setting sleeve **105**, and when the setting tool is energized, the setting sleeve is urged downwardly. This setting sleeve engages the upper end of the packer setting sleeve **14** and may have a depending skirt **106** piloted within the packer sleeve to center the setting sleeve with respect thereto.

As described in U.S. Pat. No. 2,713,910, gas under pressure is produced within the setting tool C, exerting an upward pull and movement on the actuating mandrel **85** and a downward force on its setting sleeve **105**. The upward force and movement of the actuating mandrel is transmitted through the connecting device **89, 90, 92, 95** to the body sub **12**, exerting an upward force and movement on the packer body **10**. The downward force on the setting sleeve **105** of the setting tool is transmitted to the setting sleeve **14**. Thus, the body **10** of the packer and setting sleeve **14** are moved upwardly and downwardly, respectively, to effect expansion of the packing elements **23** and of the slips **27, 37** outwardly against the well casing to anchor the well packer in packed-off condition therewithin against movement in both longitudinal directions, as above described. When the setting force exceeds the tensile strength of the reduced diameter portion **91** of the release stud **89**, the latter is pulled apart at such weakened portion to effect automatic release of the setting tool C from the well packer A. The pulling apart of the tension stud allows the shank **90** and retaining abutment or head **92** to drop downwardly, removing the head from wedging engagement within the threaded dogs **95**. Since the dogs and their legs **96** tend to retract inherently, downward dropping of the head **92** away from the dogs allows the latter to snap inwardly to the extent in which their threaded portions **99** are completely out of threaded engagement with the left-hand thread in the packer body. This effects a complete release of the setting tool C from the well packer, allowing the wireline (not shown) to be elevated and carry the entire setting tool C upwardly with it. During such upward movement, the split ring **100** secured to the tension head engages the shoulder **102** on the threaded sleeve **97**, pulling the latter upwardly out of the packer body. In addition, it is to be noted that the extent of dropping of the shank **90** and head **92** is limited by engagement of a downwardly facing shoulder **108** on the shank with an upwardly facing shoulder **109** on the threaded dogs **95**. These shoulders are preferably tapered in an upward and inward direction, so that the shank shoulder **108** tends to hold the threaded dogs **95** in an inward direction, and precludes their inadvertent outward shifting.

With the removal of the setting tool C, it can be elevated in the well casing and removed completely therefrom, leaving the packer anchored in packed-off condition within the well casing, with the passage **10***a* through the body unobstructed. A tubing string, or the like, (not shown) can be lowered in the well casing and threadedly attached to the body sub or head **13**, if the well packer is to be used for well production purpose, or the well packer can be used for any other desired purpose. To prevent leakage through the coupling mechanism **47** of the packer, a seal ring **110** on the bottom sub **49** engages the housing **46**, and a seal piston **111** between the housing and body **10** carries inner and outer seal ring **112** and **113** sealingly engaging the body **10** and housing **46**, respectively.

A setting tool D for releasing the packer from the well casing (FIGS. **7, 12, 13, 14**) includes an elongate mandrel **120**, the upper end of which is threadedly secured to an adapter **121** attached to the lower end of a running string R, which may be tubing or a wireline extending to the drilling rig at the top of the well bore. The lower end of this mandrel has a stop or limit ring **122** threadedly secured thereto, and spaced above the limit ring is a backing ring **123** releasably attached to the mandrel by a shear ring **124** received within a counterbore **125** in the backing ring opening through its lower end, the shear ring having an inwardly directed flange **126** received within an external circumferential groove **127** in the mandrel, the shear ring transmitting upward force from the mandrel to the backing ring **123**. To preclude upward movement of the backing ring along the mandrel, one or a plurality of shear screws **128** are threaded into the backing ring, extending into the mandrel.

Above the backing ring, the mandrel carries a collet sleeve **129**, the upper portion of which can rest upon a support ring **130** positioned within an external groove **131** in the mandrel. The collet sleeve has a plurality of circumferentially spaced longitudinal slots **132** opening downwardly through its lower end to provide spring-like legs **133** terminating in latch feet **134**.

The collet sleeve **129** is urged in a downward direction toward its support ring by the lower end of a helical compression spring **135** engaging the upper end of the sleeve, the upper end of the spring engaging a spring seat **136** bearing against a two-piece abutment ring **137** mounted in a mandrel groove **138**, an upper extension **139** on the spring seat encompassing the two-part ring to retain it in the groove **138**, the spring seat **136** being prevented from dropping downwardly of the abutment ring **137** by a radial screw **140** threaded in the spring seat and disposed in the groove **138**. The upper portion of the mandrel **120** has a clutch sleeve **141** secured to it, as by means of a weld **142**, this clutch sleeve having upwardly projecting axial dogs or teeth **143** adapted to mesh with companion downwardly extending dogs or clutch teeth **144** on a clutch sleeve **145** threaded to the lower end of a tubular body **146**, carrying a packing or seal ring **147** adapted to frictionally engage the inner wall of the packer body **10**. The retrieving tool body **146** is surrounded by a latch sleeve **148** having circumferentially spaced slots **149** providing spring-like externally threaded dogs **150**, the threads **151** of which are companion to the internal left-hand threads in the packer box **13**. The latch sleeve **148** floats between a downwardly and outwardly inclined retaining shoulder **152** on the body **146** and a downwardly facing shoulder **153** on a head **154** threaded onto the body, this head having a depending skirt portion **155** surrounding the upper part of the latch sleeve **148** and adapted to engage the upper end of the packer body sub or head **12**. The head **154**, body **146** and clutch sleeve **145** move as a unit, and have an overall length that is much less than the distance between the lower end of the adapter **121** and the clutch sleeve **140** secured to the mandrel **120**, permitting substantial longitudinal movement of the mandrel within and with respect to the body **146** of the retrieving tool D.

When it is desired to retrieve the packer, the retrieving tool D is secured to the running string R and is lowered in the well casing B, the body clutch sleeve **145** being in contact with the

mandrel clutch sleeve **141** by gravity. When the latch feet **134** of the collet sleeve **129**, which tend inherently to occupy an expanded condition, enter the packer body **10**, the lower externally tapered surfaces **160** of the latch feet engage the body and force the feet inwardly, the collet sleeve **129** moving upwardly along the mandrel to some extent against the compressive force of the spring **135**. The downward extent of movement of the running tool within the packer body is limited by engagement of the running tool body head **154** with the upper end of the packer body **10**, **12**, the adapter **121** engaging the head **154** and causing it to force the latch sleeve dogs **150** downwardly within the packer box **13**, the lower faces **161** of the dog threads **151** being tapered in a downward direction, so that they can ratchet past the packer threads, then springing outwardly into full mesh therewith, as disclosed in FIGS. *7a* and *14a*. The engagement of the retrieving tool head **154** with the upper end of the packer box **13**, and of the engagement of the adapter **121** with the head, will limit the downward travel of the running tool and will locate the seal or packer ring **147** within the body in frictional engagement with its wall. The feet **134** of the collet sleeve **129** will be located well below the lower end of the latch release sleeve **60**, such feet then expanding outwardly to an effective diameter greater than the internal diameter through this latch release sleeve (broken lines in FIG. *7d*). When the latch feet are disposed below the latch release sleeve, the spring **135** will move the collet sleeve downwardly and engage the latch feet with an upper shoulder **163** of the backing ring **123**, and with an upwardly tapering surface **164** on the backing ring engaging companion inner tapered surfaces **165** on the latch feet to hold the latter in an outward direction. The running tool mandrel **120** is shifted upwardly to bring the latch feet **134** within and into engagement with the latch release sleeve **60**, upper inclined surfaces **166** on the latch feet engaging a companion inclined surface **167** on the release sleeve, and longitudinal surfaces **168** on the latch feet above its inclined surfaces being disposed within the release sleeve **60**. When such engagement occurs, the mandrel clutch sleeve **141** is still spaced a substantial distance from the body clutch sleeve **145** (see FIG. **7**).

A sufficient upward pull is now taken on the running string R and mandrel **120** which is transmitted through the latch release sleeve **60**, release ring **61** and its keys **62** to the latch retainer **57**, to shear the screws **59** and effect an upward shifting of the latch retainer along the body **10** and housing **46** of the packer, the extent of upward movement of the latch release sleeve **60** being limited by engagement of its lower flange **170** with a companion downwardly facing shoulder **171** in the latch sleeve **52**. The removal of the latch retainer **57** from the fingers **55** permits the latter to shift outwardly of the body groove **56** (FIG. **12**). If such outward shifting action does not occur, subsequent upward movement of the body **10** will cause the lower tapered side **56a** of its external groove to cam these fingers outwardly.

The imposition of an additional upward force on the running string R and mandrel **120** will then effect shearing of the screws **128** and shear ring **124** securing the backing ring **123** to the mandrel, the backing ring dropping downwardly along the mandrel **120** (FIG. **13**) away from the latch feet **134** and coming to rest upon the stop or limit ring **122**. The compression spring **135** will shift the collet sleeve downwardly along the mandrel to the extent limited by its engagement with the support ring **130**. However, the latch feet **134** will still be disposed above the backing ring **123** and can be shifted laterally inwardly.

Upward movement of the running string R and mandrel **120** will now carry the collet sleeve **129** upwardly within the release sleeve **60**, the feet **134** being cammed inwardly, permitting the collet sleeve to move upward through the release sleeve and release ring **61** and into the body **10** of the packer. The mandrel **120** moves upwardly until its clutch sleeve **141** engages the body clutch sleeve **145**, shifting the latter upwardly and engaging its retainer shoulder **152** with the lower ends of the dogs **150** to hold them in threaded engagement with the box **13**. Continued upward strain and movement on the running string R and mandrel **120** will now elevate the body **10** of the well packer, which has been released from the latch sleeve **52** and housing **46**, to effect retraction of the packing assembly **17** and slips **27**, **37** from the well casing in the manner described above, the well packer then being removed by the running string to the top of the bore hole, the parts being in the relative position illustrated in FIGS. *14a–14*.

We claim:

1. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted means on said body; means for expanding said normally retracted means laterally outwardly against the wall of the well bore; a coupling releasably securing said body to said expanding means for transmitting longitudinal non-rotary relative movement of said body to said expanding means to effect lateral outward expansion of said normally retracted means; means for retaining said coupling in its coupled relation, said retaining means being shiftably carried by one of said body and said expanding means; and means for shifting said retaining means upwardly of said body from its retaining position to release said coupling from its coupled relation to permit retraction of said normally retracted means.

2. In apparatus as defined in claim **1**; said normally retracted means comprising packing means expandable into sealing engagement with the wall of the well bore.

3. In apparatus as defined in claim **1**; said normally retracted means comprising anchoring means expandable into anchoring engagement with the wall of the well bore.

4. In apparatus as defined in claim **1**; said normally retracted means comprising packing means expandable into sealing engagement with the wall of the well bore; said normally retracted means further comprising anchoring means expandable into anchoring engagement with the wall of the well bore.

5. In apparatus as defined in claim **1**; said normally retracted means comprising packing means expandable into sealing engagement with the wall of the well bore; said normally retracted means further comprising anchoring means below said packing means and expandable into anchoring engagement with the wall of the well bore.

6. In apparatus as defined in claim **1**; said normally retracted means comprising packing means expandable into sealing engagement with the wall of the well bore; and lock means acting between said body and packing means for retaining said packing means in sealing engagement with the wall of the well bore.

7. In apparatus as defined in claim **1**; said normally retracted means comprising anchoring means expandable into anchoring engagement with the wall of the well bore; and lock means acting between said body and anchoring means for retaining said anchoring means in anchoring engagement with the wall of the well bore.

8. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted means on said body; means for expanding said normally retracted means laterally outwardly against the wall of the well bore; a coupling releasably securing said body to said expanding means for transmitting longitudinal non-rotary relative movement of said body to said expanding means to effect lateral outward expansion of said normally retracted means; means for retaining said coupling in its coupled relation; and means for shifting said retaining means upwardly of said body from its retaining position to release said coupling from its coupled relation to permit retraction of said normally retracted means; and a releasing tool movable into said body into engagement with said shifting means for moving said shifting means and retaining means upwardly of said body.

9. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted means on said body; means for expanding said normally retracted means laterally outwardly against the wall of the well bore; a coupling releasably securing said body to said expanding means for transmitting lon-

gitudinal non-rotary relative movement of said body to said expanding means to effect lateral outward expansion of said normally retracted means; means for retaining said coupling in its coupled relation; and means for shifting said retaining means upwardly of said body from its retaining position to release said coupling from its coupled relation to permit retraction of said normally retracted means; said normally retracted means comprising packing means expandable into sealing engagement with the wall of the well bore; said normally retracted means further comprising anchoring means expandable into anchoring engagement with the wall of the well bore; lock means acting between said body and packing means for retaining said packing means in sealing engagement with the wall of the well bore; and lock means acting between said body and anchoring means for retaining said anchoring means in anchoring engagement with the wall of the well bore.

10. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted means on said body; means for expanding said normally retracted means laterally outwardly against the wall of the well bore comprising an upper structure above said normally retracted means and shiftable relatively downwardly along said body and a lower structure below said normally retracted means and shiftable relatively upwardly toward said upper structure; a releasable coupling for transmitting non-rotary relative upward movement of said body to said lower structure to effect relative upward movement of said lower structure toward said upper structure and expansion of said normally retracted means; means for retaining said coupling in its coupled relation; and means for shifting said retaining means upwardly of said body from its retaining position to release said coupling and said body from said lower structure to allow said upper and lower structures to move relatively away from each other and said normally retracted means to return from its expanded position to its retracted position.

11. In apparatus as defined in claim **10**; frangible means securing said retaining means in its retaining position; said shifting means exerting an upward force on said retaining means to disrupt said frangible means and shift said retaining means from its retaining position.

12. In apparatus as defined in claim **10**; and a releasing tool movable in said body into engagement with said shifting means for moving said shifting means and retaining means upwardly of said body.

13. In apparatus as defined in claim **10**; and one-way lock means acting between said body and upper structure permitting upward movement of said body with respect to said upper structure but locking said body to said upper structure against downward movement relative thereto.

14. In apparatus as defined in claim **10**; said normally retracted means comprising packing means between said structures and expandable into sealing engagement with the wall of the well bore upon relative movement of said structures toward each other.

15. In apparatus as defined in claim **10**, said normally retracted means comprising packing means between said structures and expandable into sealing engagement with the wall of the well bore upon relative movement of said structures toward each other, and one-way lock means acting between said body and packing means for retaining said packing means in sealing engagement with the wall of the well bore.

16. In apparatus as defined in claim **10**; said normally retracted means comprising expander means and slip means engaging said expander means and expandable into anchoring engagement with the wall of the well bore upon relative movement of said structures toward each other.

17. In apparatus as defined in claim **10**; said normally retracted means comprising expander means and slip means engaging said expander means and expandable into anchoring engagement with the wall of the well bore upon relative movement of said structures toward each other; and one-way lock means acting between said body and expander means for retaining said slip means anchored to the wall of the well bore.

18. In apparatus as defined in claim **10**; said normally retracted means comprising packing means, expander means and slip means engageable with said expander means; said packing means and slip means being expandable against the wall of the well bore upon relative movement of said structure toward each other.

19. In apparatus as defined in claim **10**; said normally retracted means comprising packing means, expander means and slip means engageable with said expander means; said packing means and slip means being expandable against the wall of the well bore upon relative movement of said structures toward each other; one-way lock means acting between said body and packing means for retaining said packing means in sealing engagement with the wall of the well bore; and one-way lock means acting between said body and expander means for retaining said slip means anchored to the wall of the well bore.

20. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted packing means on said body; anchoring means on said body at one end of said packing means comprising an expander and normally retracted slips engaging said expander; a first structure on said body at the opposite end of said packing means; a second structure engageable with said anchoring means and shiftable relatively toward said first structure to expand said packing means and slips toward the wall of the well bore; a releasable coupling for transmitting longitudinal non-rotary movement of said body to one of said structures to effect relative movement of said structures toward each other and expansion of said slips and packing means; means for retaining said coupling in its coupled relation; and means for shifting said retaining means upwardly of said body from its retaining position to release said coupling and said body from said one of said structures to allow said structures to move relatively away from each other and said packing means and slips to return from their expanded positions to retracted positions.

21. In apparatus as defined in claim **20**; said one of said structures being located below said packing means and anchoring means and the other of said structures being located above said packing means and anchoring means; said coupling transmitting upward movement of said body to said one of said structures.

22. In apparatus as defined in claim **20**; said one of said structures being located below said packing means and anchoring means and said other of said structures being located above said packing meanS and anchoring means; said coupling transmitting upward movement of said body to said one of said structures; and one-way lock means between said body and said other of said structures permitting upward movement of said body with respect to said other of said structures but locking said body to said other of said structures against downward movement relative thereto.

23. In apparatus as defined in claim **20**; said one of said structures being located below said packing means and anchoring means and the other of said structures being located above said packing means and anchoring means; said coupling transmitting upward movement of said body to said one of said structures; and one-way lock means between said body and said other of said structures permitting upward movement of said body with respect to said other of said structures but locking said body to said other of said structures against downward movement relative thereto; and a releasing tool movable into engagement with said shifting means for moving said shifting means and retaining means upwardly of said body.

24. In apparatus as defined in claim **20**; said one of said structures being located below said packing means and anchoring means and the other of said structures being located above said packing means and anchoring means; said coupling transmitting upward movement of said body to said one of said structures; and one-way lock means between said body and said other of said structures permitting upward movement of said body with respect to said other of said structures but locking said body to said other of said structures

against downward movement relative thereto; and a releasing tool movable into engagement with said shifting means for moving said shifting means and retaining means upwardly of said body; said releasing tool including means adapted to be connected to said body to elevate said body and retract said packing means and anchoring means from the wall of the well bore.

25. In apparatus as defined in claim **20**; said one of said structures being located below said packing means and anchoring means and the other of said structures being located above said packing means and anchoring means; said coupling transmitting upward movement of said body to said one of said structures; and one-way lock means between said body and said other of said structures permitting upward movement of said body with respect to said other of said structures but locking said body to said other of said structures against downward movement relative thereto; and a releasing tool movable into engagement with said shifting means for moving said shifting means and retaining means upwardly of said body; said releasing tool comprising a mandrel movable within said body, latch means on said mandrel movable into coupling relation to said shifting means, and means on said mandrel connectible to said body to elevate said body and retract said packing means and slips from the wall of the well bore.

26. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted packing means on said body; anchoring means on said body at one end of said packing means comprising an upper expander, a lower expander and normally retracted slips engaging said expanders; a first structure on said body at the opposite end of said packing means; a second structure engageable with said anchoring means and shiftable relatively toward said first structure to expand said packing means and slips into engagement with the wall of the well bore to secure said apparatus in packed-off relation in the well bore against movement in both longitudinal directions; a releasable coupling for transmitting longitudinal non-rotary movement of said body to one of said structures to effect relative movement of said structures toward each other and expansion of said slips and packing means; means for retaining said coupling in its coupled relation; and means for shifting said retaining means upwardly of said body from its retaining position to release said coupling and said body from said one of said structures to allow said structures to move relatively away from each other and said packing means and slips to return from their expanded positions to retracted positions.

27. In apparatus as defined in claim **26**; wherein said one of said structures is located below said packing means and anchoring means and said other of said structures is located above said packing means and anchoring means; said coupling transmitting upward movement of said body to said one of said structures.

28. In apparatus as defined in claim **26**; wherein said one of said structures is located below said packing means and anchoring means and said other of said structures is located above said packing means and anchoring means; said coupling transmitting upward movement of said body to said one of said structures; and a releasing tool movable into engagement with said shifting means for moving said shifting means and retaining means upwardly of said body.

29. In apparatus as defined in claim **26**; wherein said one of said structures is located below said packing means and anchoring means and said other of said structures is located above said packing means and anchoring means; said coupling transmitting upward movement of said body to said one of said structures; and a releasing tool movable into engagement with said shifting means for moving said shifting means and retaining means upwardly of said body; said releasing tool including means adapted to be connected to said body to elevate said body and retract said packing means and anchoring means from the wall of the well bore.

30. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted means on said body; anchoring means on said body below said packing means comprising an upper expander, a lower expander and normally retracted slips engaging said expanders; an upper structure on said body above and engaging said packing means; a lower structure below and engaging said lower expander; said structures being shiftable relatively toward each other to expand said packing means and slips into engagement with the wall of the well bore to secure said apparatus in packed-off relation in the well bore against movement in both longitudinal directions; a releasable coupling for transmitting upward non-rotary movement of said body to said lower structure; means for retaining said coupling in its coupled relation; said retaining means being shiftable upwardly from its retaining position to release said body from said lower structure to allow said structures to move relatively away from each other and said packing means and slips to return from their expanded positions to retracted positions; and means for shifting said retaining means upwardly of said body from its retaining position.

31. In apparatus as defined in claim **30**; and one-way lock means between said body and upper structure permitting upward movement of said body within said upper structure but preventing downward movement of said body within said upper structure.

32. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted means on said body; anchoring means on said body below said packing means comprising an upper expander; a lower expander and normally retracted slips engaging said expanders; an upper structure on said body above and engaging said packing means; a lower structure below and engaging said lower expander; said structures being shiftable relatively toward each other to expand said packing means and slips into engagement with the wall of the well bore to secure said apparatus in packed-off relation in the well bore against movement in both longitudinal directions; a releasable coupling for transmitting upward non-rotary movement of said body to said lower structure; means for retaining said coupling in its coupled relation; said retaining means being shiftable from its retaining position to release said body from said lower structure to allow said structures to move relatively away from each other and said packing means and slips to return from their expanded positions to retracted positions; and one-way lock means between said body and upper expander and positioned below said packing means permitting upward movement of said body within said upper expander but preventing downward movement of said body within said upper expander.

33. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted means on said body; anchoring means on said body below said packing means comprising an upper expander, a lower expander and normally retracted slips engaging said expanders; an upper structure on said body above and engaging said packing means; a lower structure below and engaging said lower expander; said structures being shiftable relatively toward each other to expand said packing means and slips into engagement with the wall of the well bore to secure said apparatus in packed-off relation in the well bore against movement in both longitudinal directions; a releasable coupling for transmitting upward non-rotary movement of said body to said lower structure; means for retaining said coupling in its coupled relation; said retaining means being shiftable from its retaining position to release said body from said lower structure to allow said structures to move relatively away from each other and said packing means and slips to return from their expanded positions to retracted positions; one-way lock means between said body and upper structure permitting upward movement of said body within said upper structure but preventing downward movement of said body within said upper structure; and one-way lock means between said body and upper expander permitting upward movement of said body within said upper expander but preventing downward movement of said body within said upper expander.

34. In apparatus as defined in claim 33; and means for shifting said retaining means upwardly of said body from its retaining position.

35. In subsurface apparatus adapted to be set in a well bore: a body; normally retracted means on said body; means for expanding said normally retracted means laterally outwardly against the wall of the well bore; a coupling releasably securing said body to said expanding means for transmitting longitudinal non-rotary relative movement of said body to said expanding means to effect lateral outward expansion of said normally retracted means; means for retaining said coupling in its coupled relation; and means for shifting said retaining means upwardly of said body from its retaining position to release said coupling from its coupled relation to permit retraction of said normally retracted means; and a releasing tool movable into said body into engagement with said shifting means for moving said shifting means and retaining means upwardly of said body; said releasing tool comprising a mandrel movable within said body, latch means on said mandrel movable into coupling relation to said shifting means, and means on said mandrel connectible to said body to elevate said body and retract said normally retracted means from the wall of the well bore.

* * * * *

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,678,998 Dated July 25, 1972

Inventor(s) DARRYL W. COCKRELL ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, line 9, change "14" to --14d--.

Column 12, line 45 (claim 22, line 3), cancel "said" (first occurrence) and substitute --the--.
line 46, change "meanS" to --means--.

Signed and sealed this 6th day of March 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents