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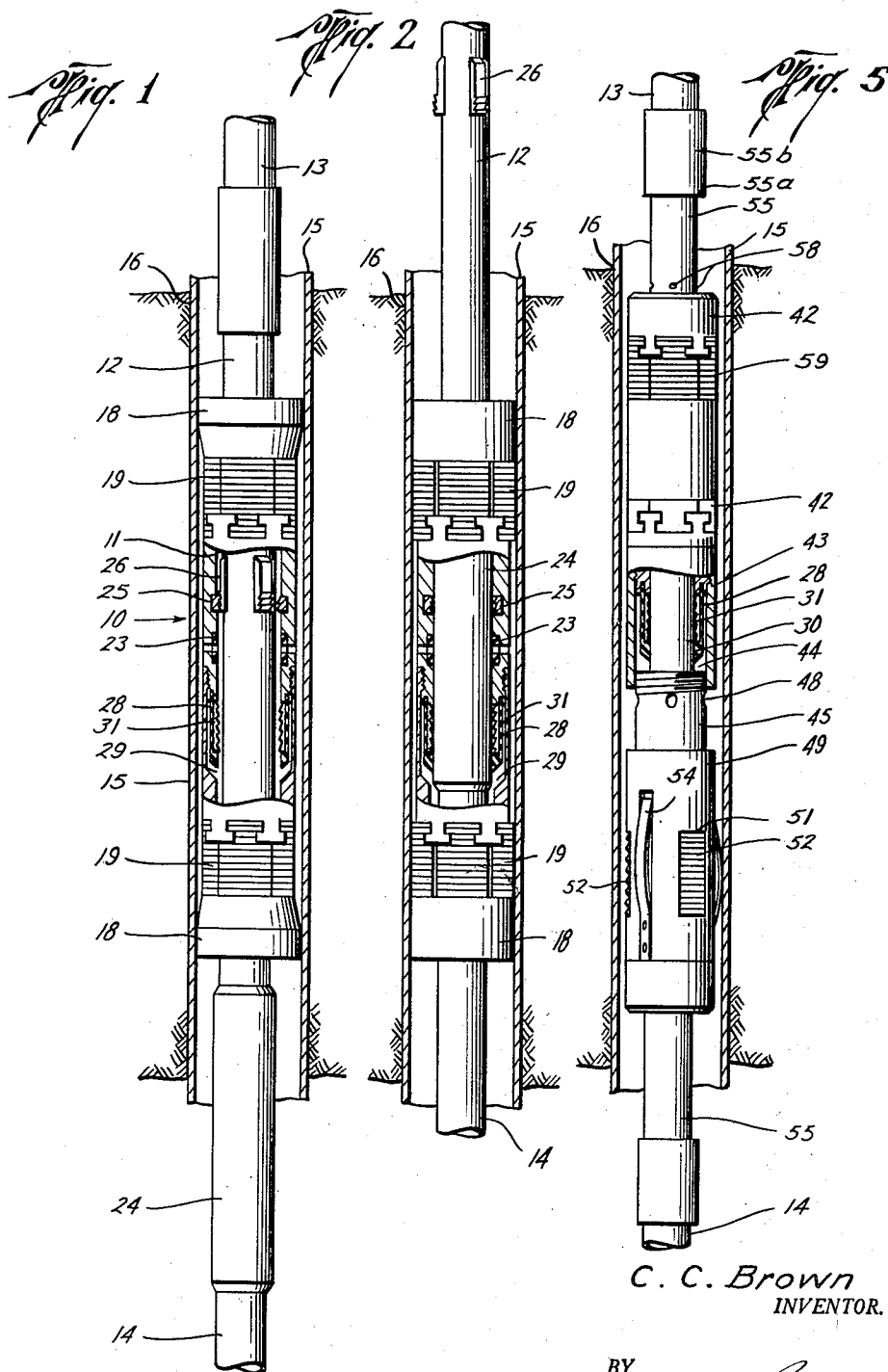
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2,822,875

PACKER WITH INTERNAL STEM HOLD-DOWN

Filed March 31, 1954

3 Sheets-Sheet 1



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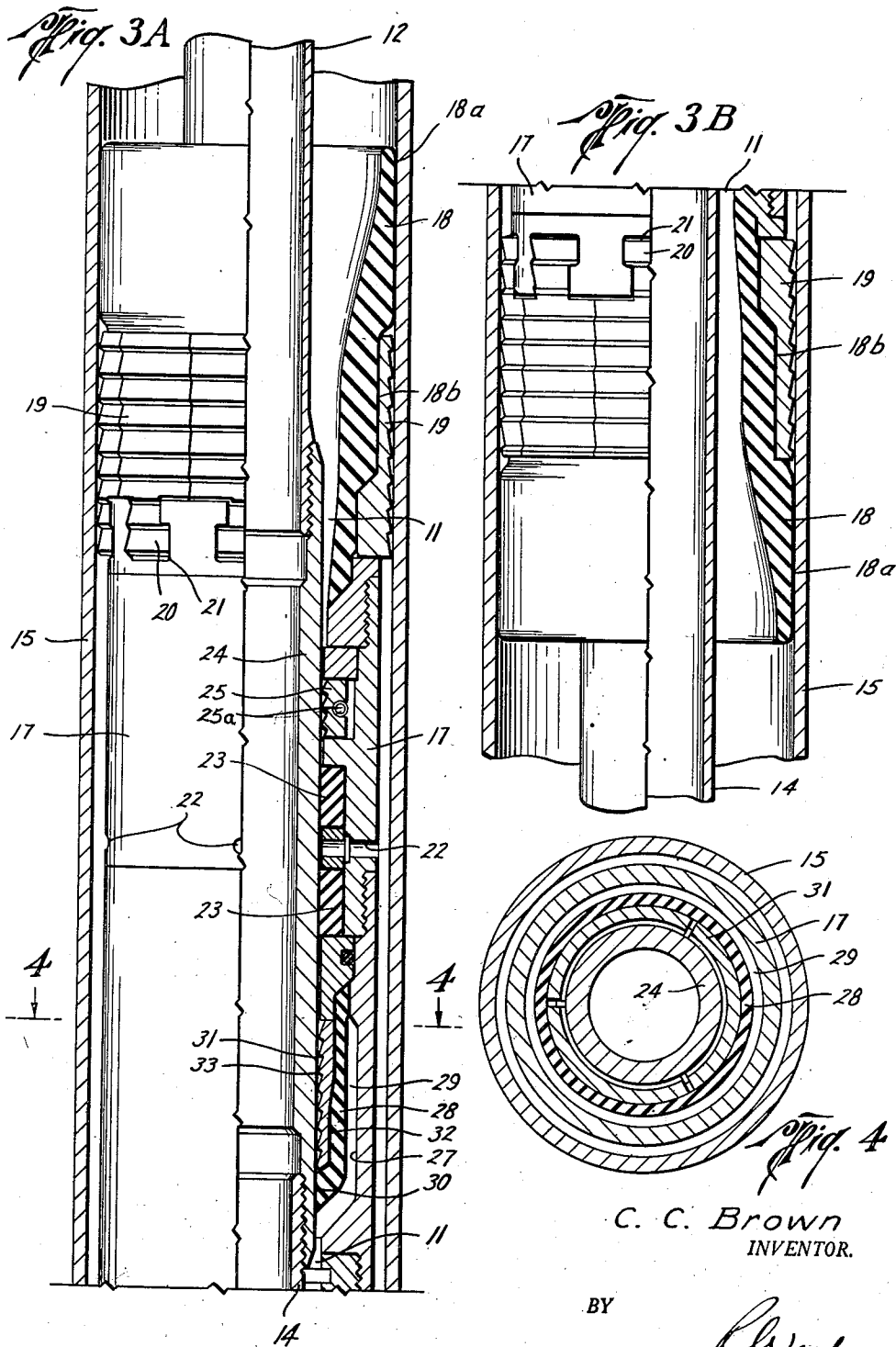
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3 Sheets-Sheet 2



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PACKER WITH INTERNAL STEM HOLD-DOWN

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Application March 31, 1954, Serial No. 420,112

14 Claims. (Cl. 166—129)

This invention relates to well packers and particularly to well packers of the hook-wall type.

Packers of the general type mentioned usually include an expansible sealing body and anchoring elements secured to the body for anchoring the packer structure to a well wall. An operating stem usually extends through the bore of the packer and is connected into a pipe string leading to the surface by which the stem is manipulated for setting and releasing the packer, and through which fluid may be conducted into and out of the well, as may be required.

In many instances the packers when set must withstand high fluid pressures from below and such high pressure will often tend to blow or lift the operating stem out of the bore of the packer and produce leakage. This is particularly true in the case of packer constructions which employ stems which are designed to be removable or retractable from the body of the packer.

It is a primary object of the present invention to provide an improved packer construction employing an internal anchoring or hold-down element for anchoring the stem against upward movement in the bore of the packer.

Another important object is to provide a hook-wall packer employing a removable operating stem and having in combination therewith external anchoring elements for engaging a well wall and internal anchoring elements for anchoring the stem in the packer.

A further object is to provide a fluid pressure-actuated internal hold-down or anchoring element for the operating stem of well packers.

Another object is to provide a hook-wall packer structure which is settable by differential fluid pressure and which includes an internal fluid pressure actuated hold-down element for gripping the operating stem of the packer.

Still another object is to provide a hook-wall well packer which is settable by compression applied through the operating stem and having an internal fluid-pressure actuated hold-down or anchoring device for gripping the stem when the packer is set.

Other and more specific objects and advantages of this invention will become more readily apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates useful embodiments in accordance with this invention.

In the drawing:

Fig. 1 is an elevational view, partly in section, illustrating a hook-wall packer of the differential pressure-actuated type positioned in a well bore, showing the parts in the inactive or unset position;

Fig. 2 is a view similar to Fig. 1, showing the parts in the positions occupied when the packer is actuated or set;

Figs. 3A and 3B, together, constitute a longitudinal quarter-sectional enlarged view of the packer illustrated in Figs. 1 and 2.

Fig. 4 is a cross-sectional view taken along line 4—4 of Fig. 3A;

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Fig. 5 is a view similar to Fig. 1 of another form of a hook-wall packer; and

Figs. 6A and 6B, together, constitute an enlarged longitudinal quarter-sectional view of the packer embodiment illustrated in Fig. 5.

Referring first to Figs. 1 to 4, there is illustrated a hook-wall packer of the differential pressure-actuated type, such as is disclosed in greater detail in my co-pending application Serial No. 403,328, filed January 11, 1954.

As illustrated, the principal elements of the packer include the packer body, designated generally by the numeral 10, having an axial bore 11, and a tubular operating stem 12 extending through the bore of the packer secured to and forming a part of an operating pipe string 13, and which may have secured to its lower end an additional section of pipe 14.

The packer is shown inserted in a casing 15 which lines the wall of a well bore 16. Packer 10 includes a generally tubular metallic body 17 which has secured to its opposite ends a pair of oppositely opening flexible, resilient cup-shaped sealing elements 18—18 having sealing portion 18a which have a pre-formed external diameter such as to normally frictionally engage the inner wall of casing 15, and reduced diameter portions 18b. Secured to the exterior surface of the reduced diameter portion 18b, as by vulcanizing or other suitable securing means, is a plurality of circumferentially arranged segmental wall-gripping slips 19, having T-heads 20 which are slidably received in T-slots 21 formed in the opposite ends of body 17, thereby permitting radial movement of the slip segments coincident with the expansion and contraction of the reduced diameter portions 18b of sealing elements 18. Seated in the inner wall of body 17 intermediate sealing elements 18 are one or more annular packings 23—23 which may be spaced apart as shown. Vent passages 22 are provided through the wall of body 17 between the packings. Operating stem 12 is provided with a tubular enlargement which constitutes a sleeve valve 24 having an external diameter such that when moved into bore 11 opposite packings 23 it will engage the packing and form therewith a fluid-tight seal for the annular space between the stem and the bore wall of body 17, whereby to close communication through bore 11 between the portions of the well above and below the packer. Vent passages 22 serve to vent any pressure fluid which may be trapped between the packings 23 and the engaging surface of valve 24 to thereby assure effective sealing between these members.

Stem 12 and body 17 may be provided with any well known and generally conventional type of releasable latch means by which the stem and packer body may be locked together to maintain the parts in inactive position while the device is being inserted or removed from a well and which may be released by manipulation of the stem in order to set the packer. The latch mechanism employed in the illustrative embodiments, comprises a segmental internally threaded nut 25, the segments of which are radially expansibly mounted in the inner wall of body 17 enclosed by the garter spring 25a, and cooperating externally threaded lugs 26 (Fig. 1) which are secured to the exterior of operating stem 12. This known type of releasable latch mechanism is engaged by simply sliding the lugs 26 downwardly through the nut segments, the expansible arrangement of the latter permitting ratcheting action between the latch members. Once the lugs and nut segments are engaged they may be disengaged by rotating the stem in a direction to unscrew the lugs from the nut segments.

It will be understood that bayonet-type connections such as conventional J-slot-and-lug connections, or other conventional releasable latch means, may be employed instead of the described segmental nut-and-ratchet-lug

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arrangement, since the function of this latch is, as noted above, merely to releasably connect the stem to the packer body, for purposes well understood in the packer art. The inner wall of body 17 is provided at a point between packings 23 and the lower sealing element 18 with an annular recess 27. Mounted in recess 27 coaxially with bore 11 is a generally tubular sleeve 28 constructed of flexible resilient material such as rubber and the like, and intermediate in diameter between bore 11 and recess 27. The upper end of sleeve 28 is secured in any suitable manner into the upper end wall of recess 27 and the body of sleeve 28 is radially spaced from the inner wall of recess 27 to provide the surrounding annular chamber 29 which is closed at its upper end and communicates with bore 11 below the lower end of sleeve 28. The lower end of sleeve 28 has an annular lip 30 which is turned inwardly toward bore 11. A plurality of arcuate slip segments 31 are secured to the inner peripheral surface 32 of sleeve 28 above lip 30, as by means of vulcanizing or other suitable and conventional arrangement such that the slips will be radially advanced and retracted coincident with the contraction and expansion of sleeve 28. The normal diameter of sleeve 28 is such that in its inactive position the slips will be retracted out of engagement with stem 12 but contraction of sleeve 28 will urge the slips 31 into gripping engagement with the stem. The outer faces of slip segments 31 are provided with teeth or wickers 33 which may be downwardly facing buttress teeth, if desired. Sleeve 28 and slips 31 constitute the internal stem anchor or hold-down device referred to above.

The packer and hold-down device above described is operated in the following manner: The packer is inserted in well casing 15 with ratchet lugs 26 locked into nut segments 25, as illustrated particularly in Fig. 1. With the parts thus locked together, it will be seen that sleeve valve 24 is below the body of the packer and bore 11 will be open to the passage therethrough of fluid displaced by the movement of the packer through the well casing, the parts of the packer generally being thus in inactive position. When the point at which the packer is to be set has been attained, stem 12 will be rotated by appropriate rotation of pipe string 13 to unscrew lugs 26 from nut segments 25. The engagement of sealing portions 18a with the wall of casing 15 will hold the packer structure stationary while permitting the necessary relative rotation of the operating stem in order to thus release the packer. When the lugs 26 have been released, the operating stem is pulled upwardly, as seen in Fig. 2, in order to draw sleeve valve 24 through bore 11 into a sealing engagement with packings 23, thereby shutting off fluid communication between the portions of the casing annulus above and below the packer, as may best be seen in Fig. 3A. When bore 11 thus has been closed, any excess pressure which exists in the well portion below the packer, or which may be created below the packer, as by pumping fluid downwardly through the operating string into the well and thence upwards against the lower end of the packer, will enter the interior of the lower sealing element 18 and will expand reduced diameter portions 18b on which slip segments 19 are mounted, thereby forcing these segments into anchoring engagement with the interior wall of casing 15. The differential pressure thus created across the packer by the closing of the valve will, as indicated, seal off from each other the portions of the well bore above and below the packer, and will simultaneously anchor the packer to the well wall. At the same time, the fluid pressure, which has thus actuated the seals and the external anchor means, will enter chamber 29 and will be exerted against the exterior of sleeve 28 to cause the latter to be contracted about the exterior of valve 24. Constriction of lip 30 will form a seal about the valve 24 and the contraction of the sleeve will urge slip segments 31 into gripping engagement

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with the exterior of valve 24. Thus, it will be seen that upon setting of the packer, any pressure differential from below will serve to actuate the internal anchor element to thereby anchor the operating stem to the packer and prevent the stem from being forced upwardly out of the packer by pressure from below. The greater the differential pressure across the packer, the tighter will lower seal 18 and the internal and external anchors be actuated. To release the packer it is only necessary to move valve 24 out of engagement with packings 23 whereby to reopen fluid communication through bore 11 and equalize the pressures across the packer. This will relieve the actuating pressure on both the external and internal anchors and thereby release the packer.

Figs. 5, 6A and 6B illustrate another embodiment in which the fluid pressure-actuated internal anchor or hold-down is incorporated in a more conventional packer construction in which the packer element and the external anchor are mechanically actuated by stem compression, rather than by differential pressure as in the previous embodiment.

As illustrated the packer includes the usual tubular sealing element 40 constructed of flexible resilient composition material and having a central bore 41. The sealing element is mounted between upper and lower end-rings 42—42. A tubular sleeve 43 is threadedly connected to the lower end-ring and has an internal diameter substantially greater than that of bore 41, thereby providing the annular recess 44 extending outwardly from bore 41. Threadedly inserted into the lower end of sleeve 43 is a tubular mandrel 45 having a downwardly and inwardly tapering conical expander surface 46 at its lower end and provided on its external surface with an upwardly facing shoulder 47. A plurality of passageways 48 extend through the upper end of the wall of mandrel 45 and provide communication between recess 44 and the exterior of the packer. Slidably mounted about mandrel 45 is a tubular slip cage 49 of generally conventional construction, having at its upper end an internal downwardly facing shoulder 50 adapted to abut shoulder 47. Slip cage 49 is provided with a plurality of angularly spaced windows 51 in which are mounted slip segments 52 having tapered inner faces 53 complementary to and engageable by expander surface 46. The cage is also provided with bow springs 54 which are adapted to normally resiliently engage the inner wall of casing 15 in order to hold the cage stationary while permitting relative rotation and longitudinal movements of the mandrel and other portions of the packer including the tubular operating stem 55 which extends through bore 41 and is adapted to be connected at its upper end to operating pipe 13 and which may also have connected to its lower end additional pipe sections 14. The upper end of stem 55 is provided with a downwardly facing shoulder or abutment 55a which may be an integral part of the stem or may be the lower end of a collar 55b employed for connecting the stem to the operating pipe string. Releasable latch means of any suitable form is provided between the stem and packer. As illustrated, stem 55 is provided adjacent its lower end with an external thread section 56 which is releasably engageable with an internally threaded segmental nut 57 positioned in the lower portion of cage 49. The thread section 56 and nut 57 constitute a releasable latch of the same general type described in connection with the previous embodiment, whereby the stem may be releasably connected to the packer structure. Stem 55 is provided near its upper end with circulation passages 58 through the wall thereof, these passages being so located with respect to threaded-section 56 that when the latter is locked in nut 57, passages 58 will be above the upper end of end-ring 42 and thus in open communication with the annular space between stem 55 and casing 15 above the packer. Annular seals, such as O-rings 59—59, are seated in the

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respective end-rings to form spaced slidable fluid-tight seals between spaced portions of the packer element and the exterior of stem 55. A plurality of segmental slips 59a are secured directly to the exterior of sealing element 40 for movement into and out of engagement with casing 15 coincident with expansion and contraction of the sealing element. A radially movable connection is provided between the slips 59a and upper end-ring 42 by means of the T-heads 60 on the slips and the T-slots 61 in the end-ring.

Mounted in chamber 44 is an internal anchoring device substantially identical in form and function with that described in connection with the previously described embodiment and includes the tubular flexible resilient sleeve 28, having the inwardly turned sealing lip 30 at the lower end thereof, and the slip segments 31 seated on the inner surface of sleeve 28 above lip 30. As in the previously described embodiment, slips 31 will normally be out of engagement with stem 55 prior to actuation of the packer.

In operation, the present embodiment will be inserted in the well with the parts in the positions illustrated in Fig. 5, wherein it will be understood that thread section 56 will be locked into nut 57. In this position mandrel 47 will be retracted relative to cage 49 and out of engagement with slips 52. Also in this position, circulation passages 58 will be open to the casing annulus above the packer, so that as the packer is lowered through the well fluid may be displaced through the bore of stem 55 and thence through passage 58, thereby equalizing the pressure above and below the packer. Under such equalized pressure the internal anchor will remain inactive.

When the setting point is reached, stem 55 will be rotated by rotation of pipe string 13 in a direction to release thread section 56 from nut 57, the bow springs 54 by their frictional pressure on the casing serving to hold cage 49 stationary while relative rotation of the stem occurs. When the stem has thus been released from the cage, the operating string is lowered relative to the packer to bring shoulder 55a downwardly against the upper end of upper end-ring 42, thus applying the compressive force of the weight of the pipe string against the packer. Moreover, as the stem compression moves packer 40 downwardly, mandrel 45 will also move downwardly relative to cage 49 and conical surface 46 will wedgingly engage the inner surface of slips 52 urging the latter outwardly into gripping engagement with the wall of casing 15. As the packer is thus anchored to the casing, the continued compression of the pipe string applied against the upper end of the packer will more tightly expand packer body 40 into tight sealing engagement with the casing. The downward movement of the stem through the packer body will move circulation passages 58 into bore 41 between the seals 59—59, thereby constituting a valve serving to close off fluid communication through the packer between the well portions above and below the packer. When bore 41 has thus been closed to fluid communication, fluid under differential pressure, due either to existing pressure in the well below the packer or created by the pumping of fluid downwardly through the operating string and the stem into the well below the packer, will enter chamber 44 and will be exerted against the exterior of sleeve 28 causing the latter to contract circumferentially about stem 55 and to force slip segments 31 into tight anchoring engagement with the exterior of the stem, thereby firmly anchoring the latter against upward movement through the packer. Raising stem 55 to move ports 58 out of the packer body 40 will again permit equalization of the fluid pressure across the packer and allow the packer body to retract and relieve the actuating pressure on both the external and internal anchors.

By thus providing a fluid actuated, releasable internal

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anchor for the packers, as described, the operating stem and the operating pipe to which it is connected will, in each instance, be held immovable irrespective of the magnitude of the pressures which may develop in the well portion below the packer. This is particularly important in connection with cementing, acidizing, and other pressure-type processes for treating sub-surface formations. The pressures applied in such operations to earth formations below the packer often run to several thousand pounds per square inch and would be hazardous to the maintenance of a tight seal by the packer in the absence of an internal anchoring element of the kind herein described, particularly for packer constructions used in such process in which the operating stem is often required to be withdrawn or reciprocated through the packer body in connection with the operations being conducted in the well. Under these conditions it will be seen that a releasable anchor for the stem is particularly advantageous.

It will be understood that numerous alterations and modifications may be made in the details of the illustrative embodiments within the scope of the appended claims but without departing from the spirit of this invention.

What I claim and desire to secure by Letters Patent is:

1. A well packer, comprising, a tubular body having a bore therethrough and a resilient sealing member expandible to seal with a well wall, a tubular operating stem slidably extending through the bore of said body, radially expandible external anchor means secured to the body for anchoring the same to the well wall, means operable by manipulation of said stem to seal said bore, and fluid pressure-actuated radially contractible internal anchor means mounted in the bore of said body for anchoring the stem to the body against upward movement relative to the body.

2. A well packer, comprising, a tubular body having a bore therethrough and a resilient sealing member expandible to seal with a well wall, a tubular operating stem slidably extending through the bore of said body, radially expandible external anchor means secured to the body for anchoring the same to the well wall, fluid pressure-actuated radially contractible internal anchor means mounted in the bore of said body for anchoring the stem to the body against upward movement relative to the body, and latch means releasably connecting the stem to said body.

3. A well packer, comprising, a tubular body having a bore therethrough and a resilient sealing member expandible by internally applied fluid pressure to seal with a well wall, a tubular operating stem slidably extending through the bore of said body, external anchor means secured directly to the exterior of said member for radial expansion therewith to anchor the body to the well wall, fluid pressure-actuated radially contractible internal anchor means mounted in the bore of said body for anchoring the stem to the body against upward movement relative to the body, and valve means operable by manipulation of the stem to direct fluid pressure from the well into said bore whereby to simultaneously actuate both of said anchor means.

4. A well packer according to claim 3, wherein said internal anchor means comprises a tubular resilient sleeve surrounding said stem and annularly spaced therefrom, said sleeve having one end secured to said body, and a plurality of slip elements secured directly to the bore wall of said sleeve.

5. A well packer, comprising, a tubular body having a bore therethrough and a resilient member sealing with a well wall, external expandible anchor means secured to the body for anchoring the same to the well wall, an operating stem extending through the bore of said body, sleeve valve means operable by manipulation of the stem to open and close the bore of said body to the passage of fluid therethrough, and internal anchor

means mounted in the bore of said body movable into anchoring engagement with said stem by differential fluid pressure produced across the packer by closing of said valve means, whereby to secure said stem against upward movement relative to said body.

6. A well packer, comprising, a tubular body having a bore therethrough and a resilient member sealing with a well wall, expandible anchor means secured to the body for anchoring the same to the well wall, a tubular operating stem slidably extending through the bore of said body, sleeve valve means operable by manipulation of the stem to open and close said bore to the passage of pressure fluid therethrough, an annular chamber in the wall of said bore surrounding the stem communicating with said bore, and internal anchor elements mounted in said chamber and radially movable into anchoring engagement with said stem by differential fluid pressure produced across the packer by closing of said valve means, whereby to secure said stem against upward movement relative to said body.

7. A well packer, comprising, a tubular body having a bore therethrough and a resilient member sealing with a well wall, external expandible anchor means secured to the body for anchoring the same to the well wall, an operating stem extending through the bore of said body, sleeve valve means operable by manipulation of the stem to open and close fluid communication through the bore of said body, and internal anchor means mounted in the bore of said body movable into gripping engagement with said stem by differential fluid pressure produced across the packer by closing of said valve means, said internal anchor means including a tubular resilient sleeve surrounding said stem and normally annularly spaced therefrom, and a plurality of slip elements secured directly to the inner face of said sleeve for radial movement coincident with contraction and expansion of said sleeve.

8. A well packer, comprising, a tubular body having a bore therethrough and a resilient member sealing with a well wall, expandible anchor means secured to the body for anchoring the same to the well wall, an operating stem slidably extending through the bore of said body, valve means operable by manipulation of the stem to open and close said bore to fluid passage therethrough, and fluid pressure-actuated anchor means releasably anchoring the stem to the body against upward movement relative to the body.

9. A well packer, comprising, a tubular body having a bore therethrough and a resilient member sealing with a well wall, expandible anchor means secured to the body for anchoring the same to the well wall, an operating stem extending through the bore of said body, valve means operable by manipulation of the stem to open and close said bore to fluid passage therethrough, and fluid pressure-actuated resiliently contractible anchor means secured to the body and releasably anchoring the stem to the body against upward movement relative to the body.

10. A well packer, comprising, a tubular body having a bore therethrough and a resilient member sealing with a well wall, expandible anchor means secured to the body for anchoring the same to the well wall, a tubular operating stem slidably extending through the bore of said body, valve means operable by manipulation of the stem to open and close said bore to the passage of pressure fluid therethrough, an annular chamber in the wall of said bore surrounding said stem and communicating with said bore, anchor elements mounted in said chamber and radially movable therefrom into

anchoring engagement with said stem by fluid pressure directed into said chamber by the closing of said valve means.

11. A well packer, comprising, a generally tubular body insertible in a well, said body having a bore therethrough and a resilient member sealing with the well wall, radially expandible external anchor means secured to the body for anchoring the body to the well wall, an operating stem extending through the bore of the body, valve means operable by manipulation of the stem to open and close fluid communication through said bore between the well portions above and below the packer, and internal anchor means positioned in the bore of said body about the stem, said internal anchor means being contractible into gripping engagement with said stem by fluid pressure from the lower well portion by closing of said valve means.

12. A well packer, comprising, a generally tubular body insertible in a well, said body having a bore therethrough and a resilient member sealing with the well wall, radially expandible external anchor means secured directly to the exterior of the member for expansion therewith to anchor the body to the well wall, a tubular operating stem extending through the bore of the body, sleeve valve means operable by manipulation of the stem to open and close fluid communication through said bore between the well portions above and below the packer, an annular chamber in said body open to said bore, internal anchor means positioned in said chamber about the stem, said internal anchor means being contractible into gripping engagement with said stem by fluid pressure from the lower well portion by closing of said valve means.

13. A well packer, comprising, a generally tubular body insertible in a well, said body having a bore therethrough and a resilient member sealing with the well wall, radially expandible external anchor means secured to the body for anchoring the body to the well wall, an operating stem extending through the bore of the body, valve means operable by manipulation of the stem to open and close fluid communication through said bore between the well portions above and below the packer, and internal anchor means positioned in the bore of said body about the stem, said internal anchor means being contractible into gripping engagement with said stem by fluid pressure from the lower well portion by closing of said valve means, said valve means, comprising, an internal annular seal in the bore of said body and a cylindrical enlargement on the stem sealingly engageable with said annular seal.

14. A well packer, comprising, a tubular body having a bore therethrough and a resilient cup-type sealing member radially expandible to seal with a wall, a tubular operating stem extending through the bore of said body, external anchor means secured directly to the exterior of the sealing member for radial expansion therewith to anchor the body to the well wall, means operable by manipulation of said stem to seal said bore, and fluid pressure-actuated radially contractible internal anchor means mounted in the bore of said body for anchoring the stem to the body against upward movement relative to the body.

References Cited in the file of this patent

UNITED STATES PATENTS

2,159,640	Strom	May 23, 1939
2,330,509	McCullough	Sept. 28, 1943
2,343,075	Otis	Feb. 29, 1944
2,620,036	Morgan	Dec. 2, 1952