Nov. 26, 1968 J. W. KISLING III 3,412,802

RETRIEVABLE WELL PACKER APPARATUS

Filed Nov. 8, 1966 3 Sheets-Sheet 1

Fig. 1A

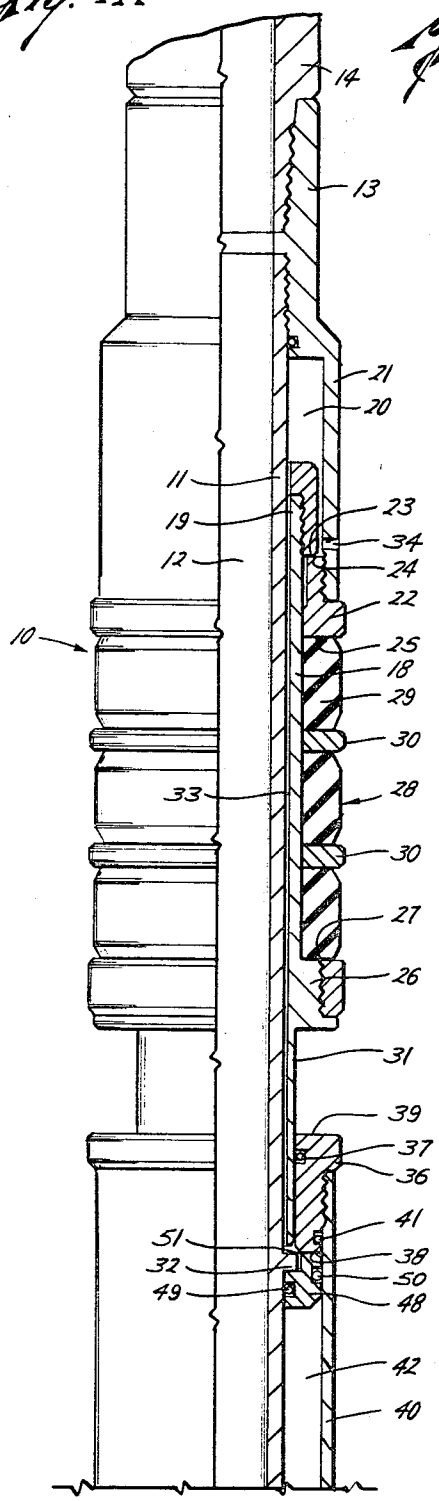
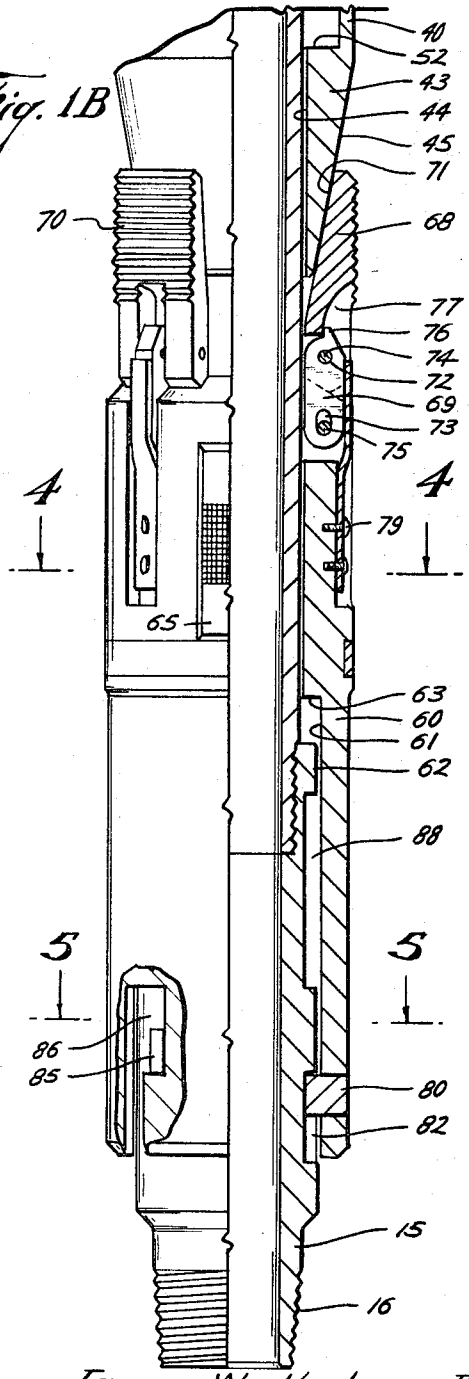


Fig. 1B



James W. Kisling, III
INVENTOR.

BY David L. Moseley

ATTORNEY

Nov. 26, 1968 J. W. KISLING III 3,412,802

RETRIEVABLE WELL PACKER APPARATUS

Filed Nov. 8, 1966 3 Sheets-Sheet 2

Fig. 2A

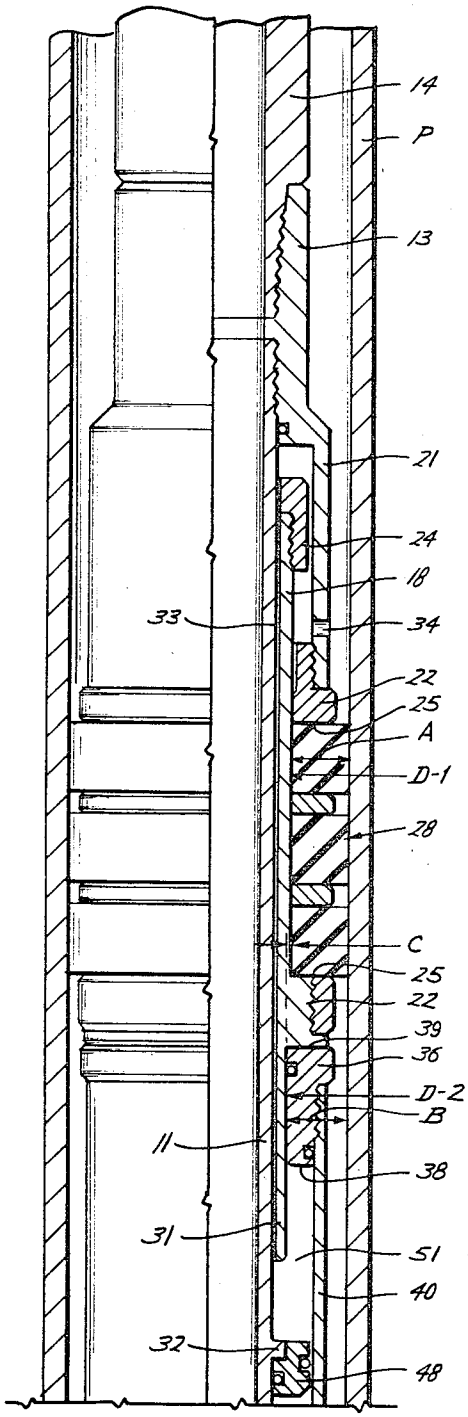
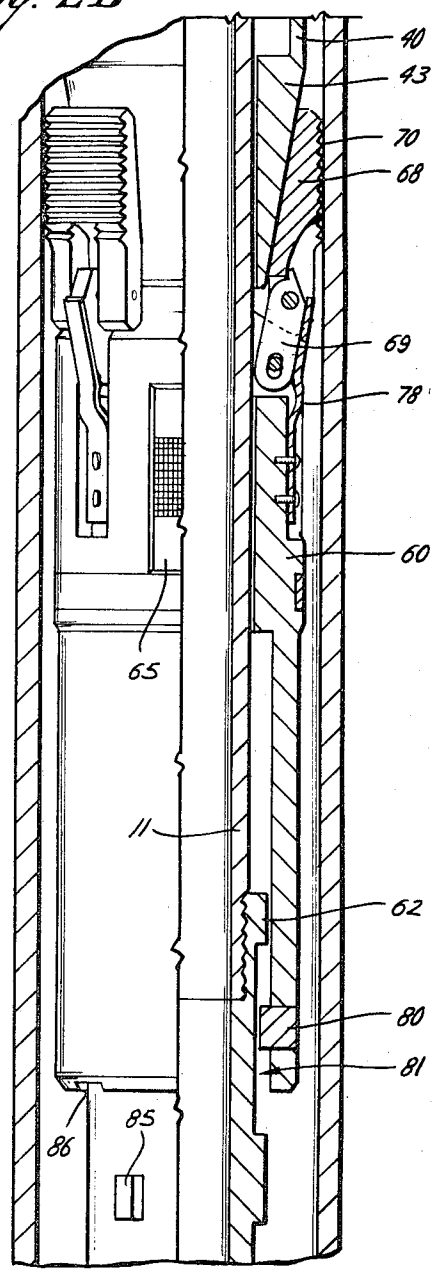


Fig. 2B



James W. Kisling, III
INVENTOR.

BY David L. Moseley
ATTORNEY

Nov. 26, 1968 J. W. KISLING III 3,412,802

RETRIEVABLE WELL PACKER APPARATUS

Filed Nov. 8, 1966 3 Sheets-Sheet 3

Fig. 3

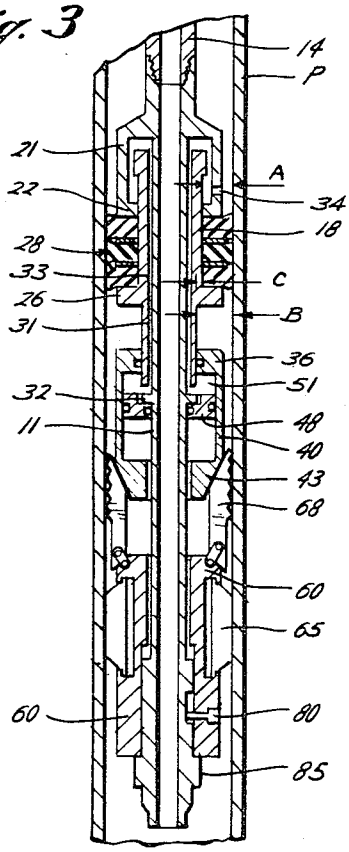


Fig. 4

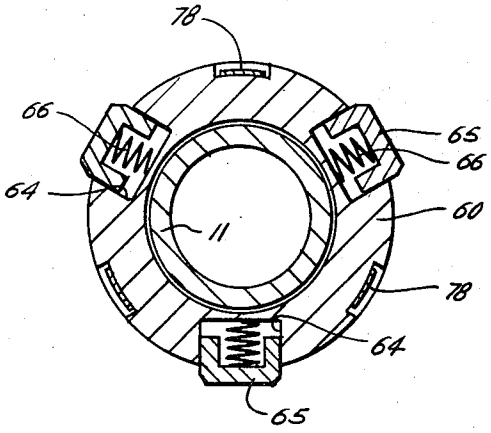


Fig. 5

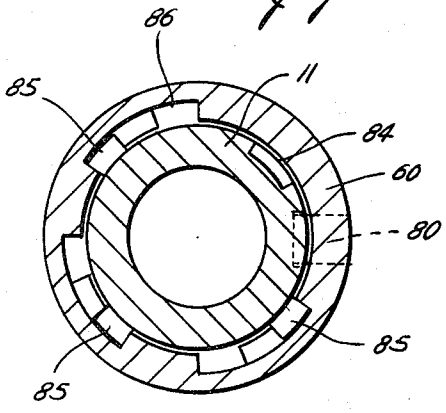
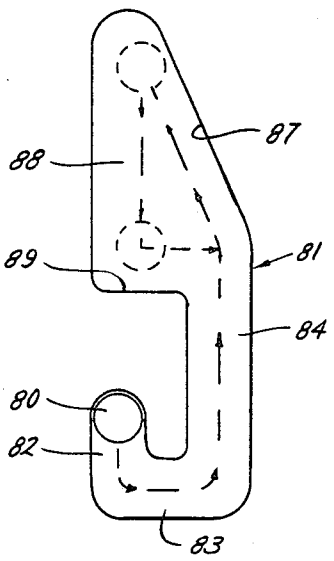


Fig. 6



James W. Kisling, III
INVENTOR.

BY David L. Moseley

ATTORNEY

United States Patent Office 3,412,802
Patented Nov. 26, 1968

3,412,802

RETRIEVABLE WELL PACKER APPARATUS

James W. Kisling III, Houston, Tex., assignor to Schlumberger Technology Corporation, Houston, Tex., a corporation of Texas

Filed Nov. 8, 1966, Ser. No. 592,804
20 Claims. (Cl. 166—120)

ABSTRACT OF THE DISCLOSURE

A retrievable well packer apparatus including a body member, expansible anchor and packing means for respectively anchoring against movement in a well conduit and packing off the well bore, said anchor and packing means being expansible in response to movement of said body member in one direction, said body member and packing being movable in the opposite direction without retracting said packing means, hydraulic means coupled to said expander means and exposed to fluid pressure on opposite sides of said packing means for holding said anchor means expanded during said movement in said opposite direction, and means for limiting movement of said body member and packing means in said opposite direction.

This invention relates generaly to well tools and more specifically to a new and improved well packer apparatus for sealing off the annular space between two flow conduits in a well.

To perform production or pressure operations in a well, a device generally called a well packer is lowered into a cased well bore on a tubing string. The packer has an elastomeric packing element capable of being expanded against the well casing to prevent vertical movement of fluids past its sealing point and anchors capable of being engaged with the well casing to prevent any substantial vertical movement of the packer itself. When the well packer is set, the tubing string provides a means of access to regions of the well bore below the packer so that fluids under pressure can be displaced through the tubing string for discharge into the well bore below the packer or so that formation fluids flowing into the well bore below the packer can be conducted through the tubing string and to the earth's surface.

It is desirable that this type of well packer be arranged to hold its position within the well casing although subjected to pressure differentials acting in both longitudinal directions. For example, during pressure operations such as hydraulic fracturing or squeeze cementing, extremely high pressures may be developed in regions below the well packer which tend to force the packer upwardly within the casing. On the other hand, if fluids are lifted through the tubing string such as, for example, during "swab" testing or during actual production of the well, annulus pressures above the packer may exceed the pressures below it and the pressure differences are effective as forces tending to move the packer downwardly within the casing. Any substantial movement in either direction is undesirable.

To prevent substantial longitudinal movement under pressure, prior art devices have resorted to opposed anchoring mechanisms each of which functions to hold in a direction opposite the other. For example, a conventional packer as shown in U.S. Patent No. 2,802,534 has opposed slips and expander cones intended to prevent longitudinal movement. This approach to the problem has made such packers exceedingly complex in structure and operation.

The present invention provides a new and improved well packer for sealing off the annular space between

two flow conduits in a well and which is arranged for anchoring against substantial longitudinal movement in the well bore.

The present invention also provides a new and improved well packer which has only a single anchoring structure yet which will hold its position within the well casing although subjected to fluid pressure differentials acting from above or below.

Moreover, the present invention provides a new and improved well packer of the full-bore retrievable type which is automatically locked against substantial upward movement in the well casing when subjected to fluid pressures acting from below the well packer, and which can be quickly released, when desired, from its locked condition, without substantial manipulation from the surface. The well packer has hydraulically operated means responsive to fluid pressures from below the well packer for exerting force on the anchor structure in a direction to maintain its firm and immovable engagement with the well casing. As an added advantage, the well packer can be set in compression for relatively deep well application and in tension for relatively shallow well applications, if desired.

Briefly, a well packer in accordance with the concepts of the present invention includes a tubular body member adapted for disposition in a well bore on a running-in string which can extend to the earth's surface. Normally retracted packing and anchors are mounted on the body for respectively packing off the cross-section of the well bore and anchoring the body member against substantial longitudinal movement therein. Means responsive to movement of the body member in one longitudinal direction is arranged for expanding the anchors and packing into engagement with the well bore wall and the body member and packing means can thereafter move relative to the anchor means in the opposite direction to a second position without retracting the packing means. Holding means operated by differences in hydraulic pressure on opposite sides of the packing means functions to maintain the anchor means in an anchoring condition during movement of the body member and packing means in the opposite direction. Also, locking means is provided to releasably lock the body member in the second position.

The novel features of the present invention are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, may be best understood by way of illustration and example of an embodiment thereof when taken in conjunction with the accompanying drawings in which:

FIGURE 1A is a longitudinal section, with portions in side elevation, of the upper portion of a well packer embodying principles of the present invention and with parts in retracted positions;

FIGURE 1B is a view similar to FIGURE 1A of the lower portion of the well packer and forms a lower continuation of FIGURE 1A;

FIGURE 2A is a longitudinal section, with portions in side elevations, of a well packer in accordance with the present invention set in a well casing;

FIGURE 2B forms a lower continuation of FIGURE 2A;

FIGURE 3 is a reduced and somewhat schematic view of the present invention with parts shifted in the well casing to a locked position therein;

FIGURE 4 is a cross-section taken on line **4—4** of FIGURE 1B;

FIGURE 5 is a cross-section taken on line **5—5** of FIGURE 1B; and

FIGURE 6 is a plan view of a part of the clutch mechanism of the present invention.

Referring to FIGURES 1A and 1B, a well packer **10** in accordance with the present invention includes a tubu-

lar body member or mandrel **11** which extends throughout the length of the well packer and which has a bore **12** therethrough providing a fluid passageway. The upper end of the mandrel **11** can have a threaded box portion **13** for connection with a tubing string **14** and the lower end portion **15** can be threaded as at **16** for connection with a string of pipe or another well tool. The bore **12** of the mandrel **11** can have an inner diameter at least as great as the drift diameter of the tubing string **14** so that an unrestricted fluid passageway is provided through the well packer **10**.

An annular compression sleeve **18** is slidably carried on the mandrel **11** with its upper end portion **19** extending into an annular recess **20** formed between the outer periphery of the mandrel **11** and an annular member **21** which can be rigidly connected to the mandrel. The annular member **21** extends downwardly over the upper portion **19** of the compression sleeve **18** and has an attached enlarged gauge ring **22** which provides an inwardly extending shoulder **23**. Shoulder **23** is engageable with a shoulder **24** on a cap member attached to the upper portion **19** to limit downward movement of the compression sleeve **18** relative to the mandrel **11**. The gauge ring **22** also provides a downwardly facing upper abutment **25**. Spaced downwardly from abutment **25** is an annular flange **26** on sleeve **18**, the flange **26** extending outwardly of the compression sleeve **18** to provide an upwardly facing, lower abutment **27**.

An elastomeric packing arrangement **28** is mounted around the compression sleeve **18** with its upper end engaging the upper abutment **25** and its lower end engaging the lower abutment **27**. The packing arrangement can take any cenventional form and, for purposes of illustration, is shown as comprised of a plurality of packing rings or elements **29** which can be separated by spacer rings **30**. It will be appreciated that downward movement of the mandrel **11** relative to the compression sleeve **18** will cause the upper abutment **25** to approach the lower abutment **27** and thereby compress the packing arrangement **28** to expand it outwardly.

A lower annular portion **31** of the compression sleeve **18** extends below the flange **26** to a location, as shown in FIGURE 1A, adjacent to an annular shoulder **32** on the mandrel **11**. The inner periphery of the compression sleeve **18** is laterally spaced from the outer periphery of the mandrel **11** to form an annular fluid passageway **33** therebetween. The plurality of side ports **34** in the annular member **21** place the passageway **33** in fluid communication with the exterior of the packer **10** above the packing arrangement **28**.

An annular, hydraulically actuated member **36** is slidably received on the lower portion **31** of the compression sleeve **18** and a suitable seal, for example an O-ring **37**, seals between the hydraulic member **36** and the outer periphery of the lower portion **31**. The outer diameter of the mandrel shoulder **32** can be sized such that it will engage the lower face **38** of the hydraulic member **36** and the upper surface **39** of the hydraulic member **36** is normally spaced from the lower face of the flange **26** on the compression sleeve **18** so that the hydraulic member **36** can reciprocate relative to the mandrel **11** between limits defined by the flange **26** and the shoulder **32**. An annular sleeve **40** is threadedly coupled to the hydraulic member **36** and a seal element **41** makes the connection fluid-tight. The sleeve **40** extends downwardly from the hydraulic member **36** to form an annulus **42** with respect to the mandrel **11** and terminates at its lower end with a frustoconically shaped expander means **43** (FIGURE 1B). The expander means **43** has a bore **44** sized for sliding reception on mandrel **11** and has outer inclined surfaces **45** which converge downwardly and inwardly toward the mandrel **11**.

An annular, floating piston member **48** is movably received within the annulus **42**. Suitable seal elements **49** and **50** seal between the inner periphery of the piston member **48** and the outer surface of the mandrel **11**, and between the outer periphery of the hydraulic member and the inner wall surface of the sleeve **40**, respectively. Thus is will be appreciated that a chamber **51** is formed between the hydraulic member **36** and piston **48**, the chamber **51** being in fluid communication with the exterior of the packer **10** above the packing **28** via the passageway **33**, the annulus **20**, and the side ports **34**. Upward movement of the floating piston member **48** is limited by its engagement with the shoulder **32** on the mandrel **11** and the piston member can move downwardly until it engages an abutment surface **52** formed between the expander means **43** and the sleeve **40**.

A tubular cage member **60** (FIGURE 1B) is carried by the lower end portion of the mandrel **11**. An internal annular recess **61** formed in the cage member **60** receives an enlarged portion **62** on the lower end of the mandrel **11** in a manner whereby the cage member can move downwardly only until the shoulder **63** formed by the recess **61** engages the upper end of the enlarged mandrel portion **62**. As shown in FIGURE 4, the cage member **60** has a plurality of circumferentially spaced radially directed recesses **64**, each of which receives a conventional drag block **65**. The drag blocks **65** are pressed outwardly by compression springs **66** for frictional engagement with the well casing to resist both rotational and longitudinal movement of the cage member **60** in the well casing in a conventional manner.

Referring again to FIGURE 1B, plurality of slip members **68**, for example three, are carried by the upper end of the cage member **60** and are pivotally attached thereto by links **69**. The slip members **68** have wickers or teeth **70** on their outer peripheries which are adapted to bite into and grip the well casing to anchor against longitudinal movement in either direction. Inclined surfaces **71** on the inner peripheries of each slip member **68** converge downwardly and inwardly toward the mandrel **11** and are complementary in shape to the inclined surfaces on the expander cone **43** in a maner whereby relative movement between the expander cone and the slip members will cause lateral shifting of the slip members. The links **69** have pin holes **72** and **73** which receive pivotal mounting pins **74** and **75** engaging in each slip member **68** and in the cage member **60**, respectively. The lower pin holes **73** are formed as slots to permit the slip members **68** to shift outwardly with their lower ends still engaging the upper end of the cage member **60**. The upper end of each link **69** has an upwardly extending projection **76** which engages in a laterally extending recess **77** in each slip member **68**. Cantilevered springs **78** can be attached to the cage member **60** by screws **79** or other suitable fasteners and have their free ends pressing against each link **69**. The inward biasing force of each spring **78** is transferred to respective slip members **68** through the projections **76** on each link **69** and the upper pins **74** to thereby hold the slip members in their normally retracted positions as shown in FIGURE 1B.

To control relative movement between the cage member **60**, to which the slip members **68** are attached, and the mandrel **11** which carries the expander cone **43**, a mechanism is provided which includes a lug or index pin **80** extending inwardly from the cage member into a specially formed recess **81** in the mandrel enlarged portion **62**. The recess **81**, shown in plan view in FIGURE 6, has a short vertical segment **82** in which the index pin **80** normally engages when the parts of the well packer **10** are retracted as shown in FIGURES 1A and 1B. In this position, the index pin **80** prevents any substantial longitudinal movement of the cage member **60** relative to the mandrel **11** as the well packer is shifted lengthwise in the well bore. By appropriate manipulation of the tubing string **14** at the earth's surface, the mandrel **11** can be moved to operate the mechanism so that the index pin **80** is displaced from the short segment **82** and moved through a horizontal segment **83** into a relatively

long vertical segment **84** of the recess **81**. In this manner, the mandrel **11** is released for substantial longitudinal movement relative to the cage member **60**. Of course, during operation of the mechanism, the cage member **60** is held against rotational movement by the frictional engagement of the drag blocks **65** with the casing.

As shown in FIGURES 1B and 5, the mandrel **11** can have outwardly extending lugs **85** which normally engage in complementarily inverted L-shaped grooves **86** in the cage member **60** when the packer parts are in retracted positions. The lower end of each groove **86** is open at the bottom end of the cage member **60**. As the mandrel is moved downwardly and as the index pin **80** traverses the long vertical segment **84** of the recess **81**, the lugs **85** are disengaged from the grooves **86** and are moved downwardly to a location below the lower end of the cage member **60**. The recess **81** has a cam surface **87** which can incline upwardly and to the left so that when the lugs **85** have cleared the lower end of the cage member **60** and as the mandrel **11** continues to move downwardly, the coaction between the index pin **80** and the cam surface **87** causes the mandrel to automatically turn slightly in a counterclockwise direction. In this manner, the lugs **85** are positioned relative to the lower end of the L-shaped grooves **86** so that should the mandrel **11** move upwardly, the lugs **85** will abut against the bottom of the cage member **60** to lock the mandrel against further upward movement. The recess **81** has a relief portion **88** to permit the mandrel **11** to move upwardly until the lugs engage the bottom of the cage member without the index pin **80** engaging a shoulder **89** in the recess **81**. In this manner, upward forces on the mandrel **11** due to high fluid pressures from below are transmitted to the cage member **60** directly through the lugs **85** and not through the index pin **80** which might be sheared off or damaged by such forces. To release the locking engagement of the lugs **85**, the mandrel **11** can be manipulated by right-hand torque applied to the tubing string **14** at the surface to move the shoulder **89** from under the index pin **80** and to align the long vertical segment **84** with the index pin. As this occurs, the lugs **85** are positioned in alignment with the open lower ends of the L-shaped grooves **86** so that the mandrel **11** can be moved upwardly relative to the cage member **60**. Thereafter, appropriate movement of the mandrel **11** can position the index pin **80** within the short vertical segment **82** of the recess **81** and secure the mandrel relative to the cage member for retrieval of the well packer **10** from the well bore.

Operation

The parts of the well packer **10** are assembled as shown in FIGURES 1A and 1B and lowered into the well casing P to a selected setting point. Although the drag blocks **65** slide along the well casing wall, the cage member **60** and the slip elements **68** can not move upwardly relative to the mandrel **11** due to the engagement of the index pin **80** within the short vertical portion **82** of the mandrel recess **81**. Accordingly, the slip elements **68** will remain in retracted positions and are pressed inwardly by the springs **78**.

At setting depth, the mandrel **11** can be elevated slightly to position the horizontal segment **83** adjacent to the index pin **80** and then torqued or turned a part-turn to the right until the index pin is in the vertical recess segment **84**. At this time lugs **85** are aligned with the long portions of the groove **86**. Then tubing weight can be applied to the mandrel **11** for moving it downwardly to set the well packer **10**.

As the mandrel **11** moves downwardly relative to the cage member **60**, the flange **26** on the compression sleeve **18** is moved downwardly until it engages the upper face **39** of the hydraulic member **36** as shown in FIGURE 2A. When this occurs, the expander cone **43** is moved by the mandrel downwardly relative to the slip members **68** to shift them outwardly until their teeth **70** grip the well casing. Thereafter, the slip members prevent further downward movement of the expander cone **43** and the slip elements. The cone and hydraulic member **36** support the compression sleeve **18**. Further downward movement of the mandrel **11** serves to compress the packing element **28** between the upper and lower abutments **25** and **27**, to expand it against the well casing wall.

As the mandrel **11** moves downwardly, the lugs **85** are shifted out of the grooves **86** in the cage member **60** and the cooperation between the inclined surface **87** of the mandrel recess **81** and the index pin **80** automatically turns the mandrel a part-turn to the left to position the lugs **85** for locking abutment with the bottom of the cage member should the mandrel **11** be moved upwardly.

With the slip elements **68** anchoring against the well casing and the packing **28** expanded to seal off the annulus between the casing and the tubing, the well packer **10** is in a set condition as shown in FIGURES 2A and 2B. The weight of the tubing string **14** can be maintained on the packer to maintain its set condition.

Fluent material or liquids under pressure can then be displaced through the tubing string **14** and discharged into the well bore below the well packer **10**. As is well known to those skilled in the art, such pressures can be extremely high so that a large pressure differential acts in an upward direction on the well packer tending to dislodge it. However, according to the unique features of the present invention, such pressures act to (1) anchor the well packer even more tightly in the casing, and (2) cause the mandrel **11** to shift upwardly to a locked position without unseating the packing element **28**.

The first of these features is accomplished in the following manner. The lower face **38** of the hydraulic member **36** is in communication with fluids in the annulus between the tubing and the casing via the passageway **33** between the mandrel and the compression sleeve **18** and the ports **34** in the upper annular member **21**. The upper face **39** of the hydraulic member **36** is exposed and responsive to the pressure of fluids in the well bore below the packing arrangement **28**. Therefore, when the pressure below the packing arrangement **28** exceeds the annulus pressure, the pressure difference provides an effective force acting in a downward direction on the hydraulic member **36** and thus, the expander cone **43**. Force in this direction increases the anchoring or holding force on the slip members **68**. Such high pressure will also act on the floating piston member **48**, but its upward movement is stopped by the mandrel shoulder **32**. Accordingly, as the fluid pressure below the packer is increased, the holding forces on the slip members increase and they will remain in firm anchoring engagement with the casing.

The second of the aforementioned features is accomplished in the following manner. Referring to the schematic illustration in FIGURE 3, the fluid pressure below the packer **10** acts as a force tending to move the mandrel **11** and the expanded packing arrangement **28** upwardly within the casing P. Upward movement is resisted by forces due to the weight of the tubing string **14**. However, should an unbalanced force in an upward direction be created by high pressure in the tubing string, upward movement is permitted in accordance with the present invention until the lugs **85** on the mandrel **11** engage the bottom end of the cage member **60**. As was previously pointed out, the lugs **85** are automatically positioned for such engagement during setting of the packer **10**. With the lugs **85** so engaged, the upward forces on the mandrel **11** are transferred through the cage member **60** and slip elements **68** directly to the casing, the slip elements being anchored against movement and firmly held in anchoring engagement by forces resulting from the same pressures which are tending to pump the mandrel **11** upwardly. When the lugs **85** engage, the mandrel **11**

is positively locked against any further upward movement.

As the mandrel shifts upwardly the packing arrangement **28** will slide upwardly within the casing. It will not become retracted or unseated because of the construction of the compression sleeve **18**. With reference to FIGURES 2A and 3, the outer diameter D–**1** of the sleeve **18** around which the packing element **28** is mounted is greater than the outer diameter D–**2** of the lower portion **31** on which the hydraulic member **36** is sealingly engaged. Accordingly, downward forces on the expanded packing arrangement **28** are distributed over the differential area A between the casing wall and the diameter D–**1** of the sleeve **18**, while upward forces are distributed over the differential area B between the casing wall and the diameter D–**2** of the lower sleeve portion **31**. Since the area B is larger than area A, there can be an unbalanced force acting upwardly on the compression sleeve **18** due to high pressure below the packing arrangement **28** which serves to maintain the packing arrangement expanded as it slides upwardly within the casing P to a position where the mandrel **11** is locked. Of course, this force may also be considered as the pressure difference between fluids in the annulus and those in the tubing string times the area C which is the difference in areas encompassed by the diameters D–**1** and D–**2**.

Moreover, higher fluid pressures in the casing-to-tubing annulus than within the tubing string **14** will cause the well packer **10** to be even more firmly set within the well casing. Although such higher pressures are communicated through the passageway **33** to the lower face of the cone-holding hydraulic member **36**, the same pressures also act an the floating piston member **48** to move it downwardly until it engages the top surface **52** of the expander cone **43**. The cross-sectional area of the floating piston member **48** is greater than the effective pressure area of the hydraulic member **36** so that the net forces on the expander cone **43** are acting in a downward direction and therefore tend to cause the slip elements **68** to tightly grip the casing. Of course, the higher annulus pressures are also tending to shift the expanded packing arrangement **28** downwardly but inasmuch as the compression sleeve flange **26** is engaging the upper face of the hydraulic member **36**, downward forces on the packing arrangement **28** are transferred to the expander cone **43** which, is turn, exerts outward holding forces on the slip elements **68**.

To release the well packer **10** for retrieval to the surface, pressures within the tubing string **14** and the annulus pressures can be equalized by bleeding off the tubing pressure at the earth's surface or by operating a conventional unloader or bypass valve (not shown) above the packer. This will equalize pressure across the expanded packing element **28**, the compression sleeve **18**, the cone-holding hydraulic member **36**, and the floating piston member **48**. Then it is only necessary to torque the mandrel **11** a part-turn to the right to align the long vertical segment **84** of the mandrel recess **81** with the index pin **80**. This movement also positions the mandrel lugs **85** for entry into the lower end of the cage grooves **86**. Upward movement of the mandrel **11** will then release the compression on the packing element **28** so that it will inherently retract. Moreover, upward movement of the mandrel **11** will bring the mandrel shoulder **32** into engagement with the lower face of the piston member **36** to pull the expander cone **43** from behind the slip elements **68** so that the springs **78** will cause the slip elements to withdraw from the casing wall. Since only right-hand torque and upward pull are all that is required to release the packer from the surface, it will be appreciated that the packer can be quickly released under either normal circumstances or under any emergency situations which may arise during a pressure operation.

When the index pin **80** engages the lowermost point of the long vertical recess segment **84**, a slight turning of the mandrel **11** to the left will position the short vertical segment **82** adjacent to the index pin. Then the cage member **60** is locked in its position for longitudinal shifting of the well packer **10** within the well bore.

It will be appreciated that the well packer **10** can be inverted for shallow well applications and the tubing string **14** approximately coupled to the mandrel threads **16** for lowering into the well bore. In this case, the well packer parts can be moved to expanded positions by upward pull or tension in the pipe string **14**. Higher annulus pressures will act on the hydraulic member **36** to maintain the slip members **70** expanded, and the mandrel **11** and expanded packing arrangement **28** can shift downwardly to a locked condition as previously described without retracting the packing arrangement.

A new and improved well packer of the full-bore retrievable type has been disclosed which can effectively seal off the annulus between two flow conduits in a well. The packer has only a single anchor structure which will anchor the packer against substantial upward movement in response to high fluid pressure from below and can be quickly released under normal or emergency circumstances. Moreover, the well packer can be inverted and disposed in a well bore for tension setting if desired.

Since certain changes may be made in the disclosed embodiment without departing from the concepts involved, it is intended that the appended claims cover all such changes or modifications which fall within the true spirit and scope of the present invention.

What is claimed is:

1. A well packer comprising: a tubular body adapted for connection to a tubing string; normally retracted anchor means and packing means carried by said body for respectively anchoring in a well casing and packing off the annulus between a tubing string and a well casing; expanding means responsive to longitudinal movement of said body in one direction relative to said anchor means for expanding said anchor means and packing means, said body and packing means being thereafter movable in the opposite direction and relative to said anchor means without retracting said packing means; and hydraulic means responsive to differences in fluid pressure on opposite sides of said packing means for holding said anchor means in an anchoring condition during movement of said body and packing means in said opposite direction.

2. The well packer of claim **1** further including locking means on said body cooperable with said anchor means to limit movement of said body and packing means in said opposite direction.

3. The well packer of claim **2** wherein said anchor means includes gripping elements and cage means for supporting said gripping elements, said locking means including abutment means engageable with said cage means upon movement of said body and packing means in said opposite direction.

4. The well packer of claim **3** further including means for automaitcally positioning said abutment means for engagement with said cage means upon movement of said body in said one direction.

5. The well packer of claim **3** wherein said holding means includes a hydraulic member cooperable with said expanding means and located on one side of said packing means, one face of said hydraulic member being arranged for response to well fluid pressures on said one side; and passage means for communicating the other face of said hydraulic member with well fluid pressures on the other side of said packing means.

6. A well packer comprising: a tubular body adapted for connection to a tubing string; expansible anchor means and packing means carried by said body for respectively anchoring in a well casing and packing off the annulus between the tubing string and the well casing; expanding means responsive to longitudinal movement

of said body in one direction relative to said anchor means for expanding said anchor means and packing means, said body and packing being movably mounted relative to said anchor means, when expanded, in an opposite direction while said packing means is expanded and including effective pressure area surfaces for producing such movement in response to a pressure differential; holding means responsive to differences in fluid pressure on opposite sides of said packing means for maintaining said anchor means in an anchoring condition during movement of said body and packing means in said opposite direction; and locking means on said body cooperable with said anchor means to limit the amount of movement of said body and packing means in said opposite direction.

7. In a well packer, the combination comprising: a body member adapted for connection to a running-in string; normally retracted packing means mounted about said body member and adapted for expansion into sealing engagement with a well conduit wall; normally retracted anchor means shiftable outwardly of said body member for anchoring said well packer in the well conduit; expander means on said body member movable relative to said anchor means for shifting said anchor means outwardly; cage means carried by said body member and arranged to support said normally retracted anchor means, said body member being movable relative to said cage means in one longitudinal direction to a first position where said packing means is expanded, said body means being thereafter movable relative to said cage means in the opposite direction to a second position; first hydraulic means responsive to differences in fluid pressures on opposite sides of said packing means for maintaining said packing means in an expanded condition during movement of said body member to said second position; and second hydraulic means responsive to differences in fluid pressures on opposite sides of said packing means for exerting force on said expander means in a direction to shift said anchor means outwardly.

8. The well packer of claim **7** further including abutment means cooperable between said body member and said cage means for limiting the amount of movement of said body member in said opposite direction.

9. The well packer of clam **7** further including means for normally preventing movement of said body member relative to said cage means in either longitudinal direction.

10. The well packer of claim **8** further including means for normally preventing movement of said body member relative to said cage means in either longitudinal direction.

11. The well packer of claim **10** wherein said last mentioned means includes structure for automatically positioning said abutment means for engagement when said body member is moved in said one longitudinal direction upon return movement of said body member in said opposite direction.

12. The well packer of claim **7** wherein said second hydraulic means includes hydraulic means on one side of said packing means, hydraulic means having a face thereon facing away from said packing means; connection means for coupling said hydraulic means to said expander means; means on said body providing a sealed chamber adjacent said face; and fluid passage means along said body for communicating said chamber means with fluids on the opposite side of said packing means.

13. The well packer of claim **7** wherein said first hyldraulic means includes a sleeve member slidable on said body, said packing means being mounted around said sleeve member; and seal means for preventing any fluid movement past said packing means and sleeve member when said packing element is expanded.

14. The well packer of claim **12** wherein said first hydraulic means includes a sleeve member slidable on said body, said packing means being mounted around said sleeve member; and seal means for preventing any fluid movement past said packing means and sleeve member when said packing element is expanded.

15. The well packer of claim **13** wherein said sleeve member includes a first portion having a first diameter, said packing means being mounted around said first portion, said sleeve member having a second portion with a second diameter smaller than said first diameter, said seal means sealingly engaging said second portion.

16. A well packer for use on a well bore comprising: a body member dapted for connection to a running-in string, said body member having a first abutment; a sleeve member slidable on said body member, said sleeve member having a second abutment; normally retracted packing means mounted around said sleeve member between said abutments so that movement of one abutment toward the other can compress and expand said packing means into sealing engagement with a well bore wall; normally retracted anchor means on said body member; expander means movable on said body member relative to said anchor means for expanding said anchor means outwardly into engagement with the well bore wall, said body member being movable relative to said anchor means in one longitudinal direction to a first position for expanding said packing means, said body member being thereafter movable in the opposite direction to a second position; hydraulic means including a portion of said sleeve member for maintaining said packing means in its expanded condition during movement to said second position; and means for locking said body member against further movement in said one direction in said second position.

17. A well packer comprising: a body member; normally retracted packing means mounted about said body member and adapted for expansion into sealing engagement with a well bore wall; normally retracted gripping means shiftable outwardly of said body member to anchor in a well conduit; expander means movable by said body relative to said gripping means for shifting said gripping means outwardly; cage means slideable on said body member for supporting said gripping means, said body member being movable relative to said cage means in one direction to a first position for expanding said packing means and for moving said expander means to shift said gripping means outwardly, said body member being thereafter movable in response to fluid pressures in the opposite direction to a second position; means on said body for sliding said packing element in its expanded condition along the well conduit wall as said body member moves in said opposite direction; abutting means coacting between said body member and cage means to limit movement of said body member in said opposite direction; and holding means connected to said expander means and responsive to said pressures for maintaining said gripping means in gripping engagement with the well bore wall regardless of movement of said body member and packing means in said opposite direction.

18. In a well packer, the combination comprising a body, anchor means and packing means expandable into engagement with a well conduit wall, means for expanding said anchor means and packing means in response to longitudinal movement of said body in one direction, said body and packing means being movable relative to said anchor means in the opposite direction, normally disengaged abutment means on said body and anchor means, means for positioning said abutment means for engagement upon movement of said body in said one direction, said abutment means being automatically engaged upon movement of said body and packing means in said opposite direction so that further movement of said body and packing means in said opposite direction can be opposed by said anchor means.

19. A well tool comprising: anchor means including normally retracted gripping members engageable with a

well conduit and cage means for supporting said gripping members; means on said anchor means for retarding movement in a well conduit; a body member movable within said anchor means in both longitudinal directions; means on said body member for actuating said gripping members into engagement with a well conduit upon movement of said body member in one longitudinal direction; normally disengaged abutment means on said body member and said cage means; and means operated by movement of said body member in said one direction for positioning said abutment means for engagement upon movement of said body member in the opposite direction, whereby said abutment means can be engaged to limit movement of said body member in said opposite direction.

20. In an apparatus for use in a well, an outer member having drag means for yieldable engagement with a well conduit wall to retard movement therein; an inner member movable within said outer member; means for controlling relative movement between said inner and outer members comprising a first recess in one of said members,

a projection on the other member normally engaging in said recess to prevent longitudinal relative movement, said projection being releasable from said recess responsive to longitudinal and rotational motion of one of said members, a second recess joining said first recess and in which said projection can move for further longitudinal movement of one of said members in one direction; normally disengaged abutment means on said members; and means in said second recess for positioning said abutment means for engagement upon movement of one of said members in the opposite direction.

References Cited

UNITED STATES PATENTS

1,772,682	8/1930	Phipps	166—138
3,036,641	5/1962	Nutter et al.	166—240
3,339,637	9/1967	Holden	166—128

JAMES A. LEPPINK, *Primary Examiner.*