March 15, 1955 V. D. DAVIDSON 2,704,126

CEMENT RETAINER

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Fig. 1

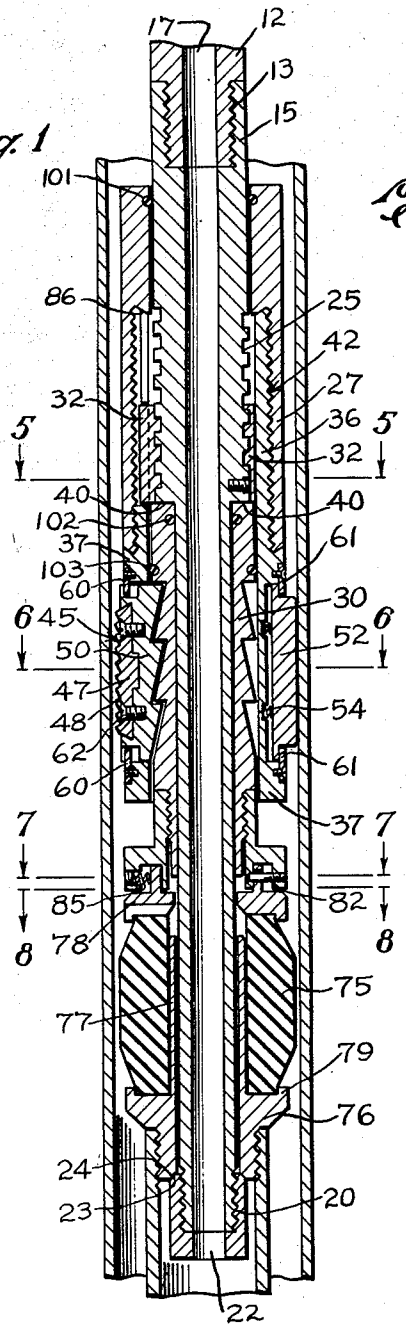
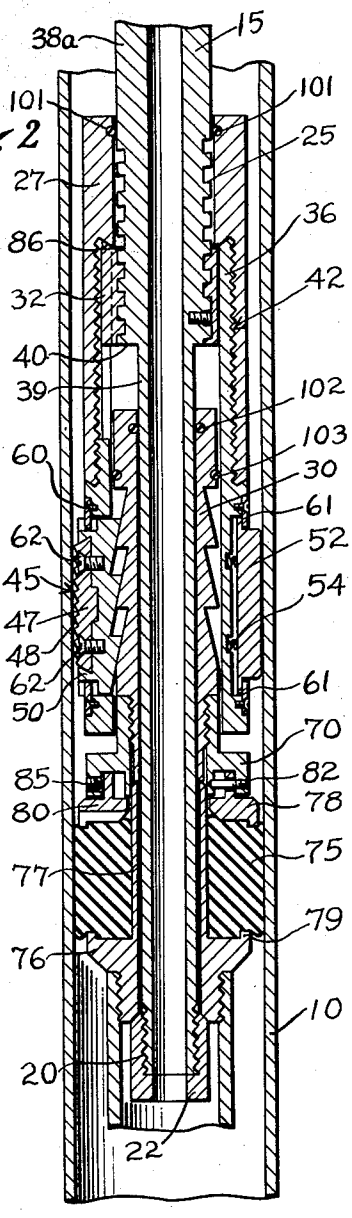


Fig. 2



Vernon D. Davidson
INVENTOR.

BY Lester B. Clark,

ATTORNEY

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Fig. 3

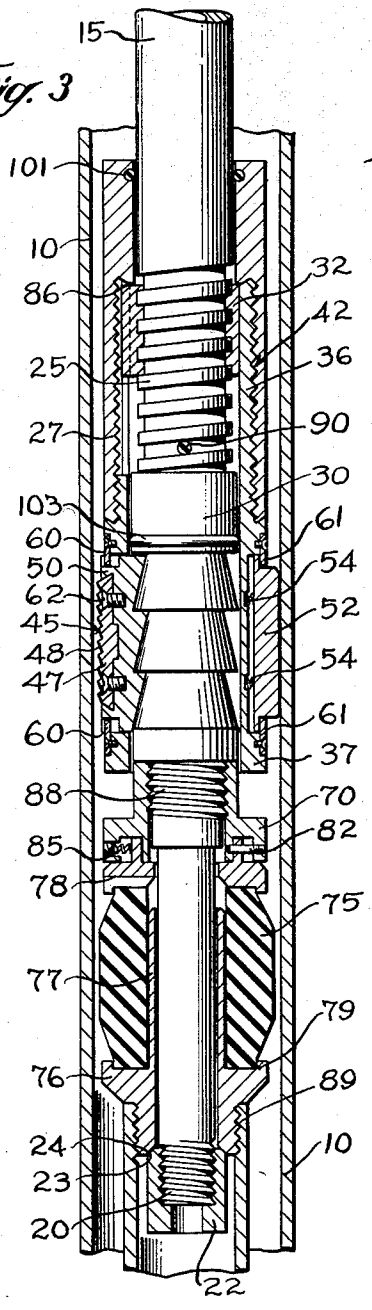
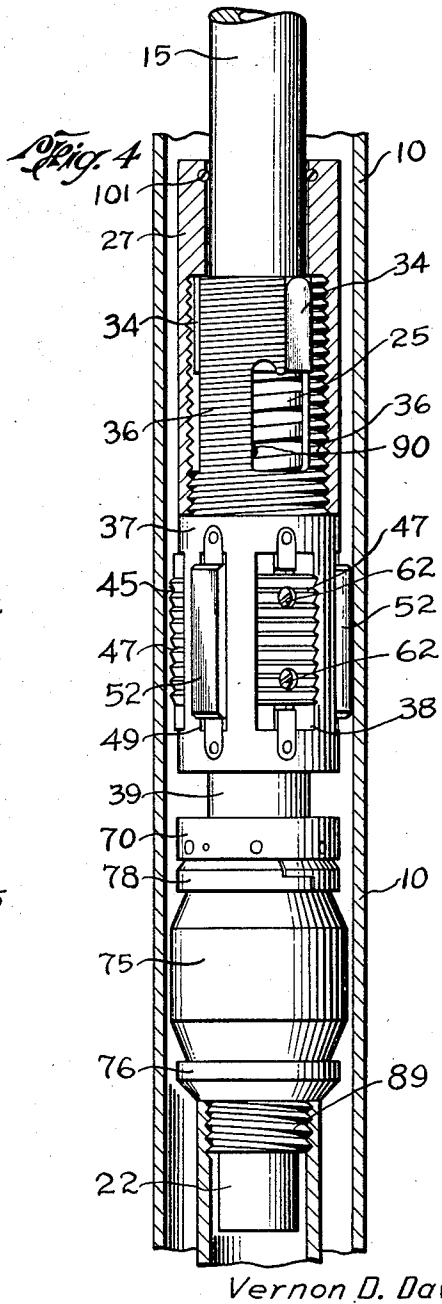


Fig. 4



Vernon D. Davidson
INVENTOR.

BY Lester B Clark
ATTORNEY

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CEMENT RETAINER

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Fig. 5

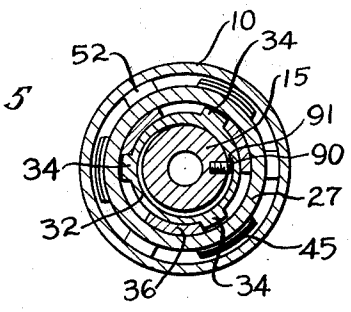


Fig. 6

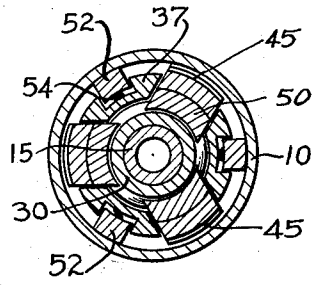


Fig. 7

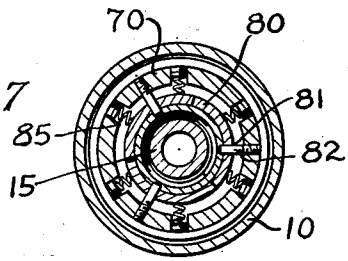
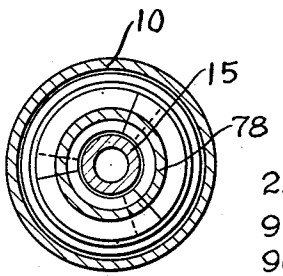


Fig. 8



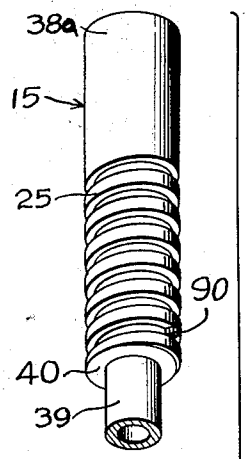
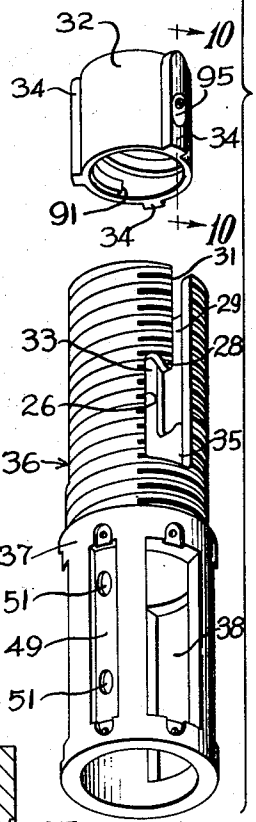


Fig. 9



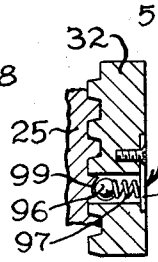


Fig. 10

Vernon D. Davidson
INVENTOR.

BY Lester B Clark
ATTORNEY

United States Patent Office 2,704,126 Patented Mar. 15, 1955

2,704,126

CEMENT RETAINER

Vernon D. Davidson, Corpus Christi, Tex.

Application July 9, 1951, Serial No. 235,754

5 Claims. (Cl. 166—140)

This invention relates to a liquid cement retainer for holding cement under pressure in a well until it solidifies, and particularly in an oil well. In applying liquid cement under pressure in oil wells, generally known as a "squeeze job" to force the cement back into the more or less porous earth formation and to create a cement packed to close the well either completely or about a pipe in the well, it is necessary that a tool be provided which can be securely anchored or held in position so as to remain stationary when pressure is applied through and below the tool in order to retain the liquid cement against the earth formation or to accomplish other functions such as plugging a well.

This present invention is in the nature of an improvement over that disclosed in U. S. Patent 2,421,399, which was granted on June 3, 1947.

In cement retainers employing a wedge-type device for forcing an anchoring means against a well tubing such as that disclosed in U. S. Patent 2,421,399, it has been the practice to obtain the release of the anchoring means by the movement of the wedge member within the anchor housing while the anchor housing is held in a fixed position with the well tubing by a resilient means urged against the tubing. However, it has been found that the inherent resiliency of the packer located on the anchor housing is insufficient, in many cases, to enable the anchor means to be released from its gripping action with the tubing.

Therefore, it is an object of this invention to provide a cement retainer which, when anchored in a well bore, can be released by the action of a control means which forms a part of the cement retainer tool.

It is another object of this invention to provide a cement retainer tool which has a mandrel and means slidable on the mandrel to anchor the tool in a well pipe and also means to seal the tool while in the well pipe, as well as latch control means on the mandrel.

It is another object of this invention to provide a cement retainer which has a latch control means which includes a mandrel which has thereon threads for engagement with a threaded nipple which is slidable within an anchor housing.

Another object of this invention is to provide a cement retainer which has a control means for controlling the latching and unlatching of an anchor means on a mandrel while the assembly is within a well bore.

Still a further object of this invention is to provide a cement retainer tool which has a control means which includes a nipple threadedly engageable with a mandrel, the nipple fitting within a J-slot sleeve for the reception and guiding of a projection on the nipple in the insertion, setting, and releasing operations with the cement retainer tool.

A further object of this invention is to provide a cement retainer tool which includes on a mandrel a sealing cup or packing which upon compression urges against a split-cap ring which is normally held in position by means of a resilient spring.

Other and further objects of this invention will be readily apparent when the following description is considered in connection with the accompanying drawings, wherein:

Fig. 1 is a section of the cement retainer tool of this invention illustrating the tool in the collapsed or released position for insertion into the well bore.

Fig. 2 is a section of the cement retainer tool of this invention illustrating the tool when it is in the set position in the pipe in a well after insertion, expansion and sealing within the well bore.

Fig. 3 is a section of the cement retainer tool of this invention illustrating the tool when the mandrel has been rotated for releasing the tool from the anchoring or locking engagement with the tubing.

Fig. 4 is an elevation view similar to Fig. 3 and illustrating, in particular, the control or J-slot sleeve and the anchoring means on the anchor housing with the parts in released position.

Fig. 5 is a section taken on line 5—5 of Fig. 1, and shows details of the stud on the mandrel engaging with a shoulder on the nipple for turning out of the J-slot.

Fig. 6 is a section taken on line 6—6 of Fig. 1 and shows the anchor slips and drag blocks.

Fig. 7 is a section taken on line 7—7 of Fig. 1, and illustrates, in particular, the split-cap ring details.

Fig. 8 is a section taken on line 8—8 of Fig. 1 and further shows the overlapping split-ring segments.

Fig. 9 is an exploded view of the control means for the cement retainer of this invention.

Fig. 10 is a section on line 10—10 of Fig. 9 and illustrates the friction lock between the mandrel and the nipple to obtain the turning of the projection on the nipple into the short part of the J-slot.

Following is a detailed description of this invention wherein like parts are referred to by like numerals in all figures of the drawings:

Fig. 1 shows the cement retainer tool of this invention being inserted into a well tubing or pipe 10. The retainer is handled by means of an operating pipe 12 which is connected by threads 13 or similar means to a mandrel 15. This mandrel has a hollow passage 17 for the passage of liquids such as cement therethrough, and is provided at one end thereof with threads 20 for the reception of a locking nut 22 thereon to hold the various parts which are about to be described in place about the mandrel. Adjacent the top of the mandrel 15, there is located a coarse acme threaded section 25 which is completely enclosed by control housing 27. Within the control housing 27 positioned on the mandrel 15 is an anchor sleeve member having on the exterior thereof a stepped wedge portion 30. This wedge portion 30 is located below the threaded section 25 on the mandrel 15. The anchor sleeve carrying wedge portion 30 is slidable on the mandrel 15 to permit relative longitudinal movement therewith to effect the locking or anchoring action hereinafter more fully described.

The threads 20 and the locking nut 22 are left-handed, whereas the coarse acme threads 25 are right-handed. Thus, when the mandrel 15 is rotated counterclockwise in the setting of the anchor means 45, the threads 20 are tightened on the locking nut 22 to prevent the locking nut 22 from becoming disengaged.

Directly above the wedge portion 30 and on the mandrel thread section 25 is positioned a threaded collar member or nipple 32. This collar member or nipple 32 has thereon projections 34 which are slidably guided by the J-slots 35 in a control sleeve or J-slot sleeve 36, as best seen in Figs. 4 and 9. This control sleeve 36 is also enclosed within the anchor housing 27.

It will be observed that the mandrel 15 is of uniform internal diameter but is of enlarged external diameter at the upper portion 38*a* and is of reduced external diameter at the lower portion 39 below the threaded section 25. This reduced diameter 39 provides a shoulder 40 which serves as an abutment for engagement with the top of the wedge portion 30. The threaded section 25 of the mandrel 15 together with the nipple 32 and the control or J-slot sleeve 36 form a control means 42 for the retainer tool of this invention. This control means 42 enables one to positively set the anchor means 45 and the packer 75 by manipulation on the surface after the tool has been inserted in the hole. This is accomplished by inserting the retainer into the well bore when the projections 34 are positioned in the crooks or short legs 33 of the J-slots 35. When the projections 34 are so positioned, the mandrel 15 cannot move upwardly or downwardly except by causing its rotation in a counterclockwise direction; therefore, the mandrel 15 being in that fixed position for going into the well prevents relative

movement of the control sleeve 36 and the mandrel 15 and since the shoulder 40 of the mandrel 15 contacts the top of the wedge 30, the wedge 30 is prevented from moving relatively to the tapered stepped blocks 50 which are attached to the control sleeve 36, so that the anchor means 45 and packer 75 cannot be prematurely set.

The anchor means 45 below the control means 42 includes a plurality of slips 47 which have teeth 48 thereon for engagement with the inner surface of the pipe or tubing 10. As best seen in Fig. 9, the control sleeve 36 is integral with the anchor housing 37. The slips 47 are connected to the tapered stepped blocks 50, and each set of a slip 47 and a block 50 is slidably mounted within each of the openings 38. These slips 47 and blocks 50 are normally held in position and are limited as to outward movement in the control sleeve 36 by the fastening plates 60, but, of course, other suitable fastening means may be used so long as there is permitted relative radial movement of the slips 47 and the blocks 52 within the anchor housing 37. The wedge 30 prevents dislodging of the slips 47 and blocks 50 in the inward direction so that the slips 47 and blocks 50 "float" in the anchor housing 37 until forced outwardly by the wedging action of the wedge portion 30 against the tapered stepped blocks 50. It will be appreciated that the slips 47, although now shown as being secured to the tapered blocks 50 by means of screws 62, that other suitable fastening means may be used, or, if desired, the slips 47 may be made integral with the blocks 50. Since the majority of wear occurs on the teeth 48 of the slips 47, it is preferable to have the slips 47 separable from the wedge blocks 50 so that they may be replaced when desired.

It will be observed that the wedge portion 30 is of frustro-conical shape and the tapered stepped blocks 50 are of the same angle and correspond with the tapers of the wedge portion 30. Thus, in the view shown in Fig. 1, where the tool is going into the well, the wedge portion 30 will be permitted to fit within the tapered areas of the tapered blocks 50 without having any frictional engagement therewith. It is generally desirable to provide a plurality of these circumferentially spaced slips 47 alternately disposed with respect to the drag blocks 52 suitably retained within the anchor housing 37 to keep the blocks 52 in dragging position with the pipe or tubing 10. Springs 54 are provided to urge the blocks 52 against the side of the tubing 10. Since the blocks 52 are normally provided in groups of three and equally spaced from each other and from the three slips 47, there will be a continuous pressure of the bars 52 against the tubing 10 in order to provide centering of the anchor housing 37 within the tubing 10. The drag blocks 52 are fitted within a recess 49, as best seen in Fig. 9, which has two sockets 51 therein for receiving the springs or other resilient means 54. Latching plates 61 which are similar to the fastening plates 60 may be used to hold the drag blocks 52 against outward movement.

Threadedly engaged to the lower portion of the wedge member 30 is a bonnet 70. This bonnet 70 serves as the upper housing for the cap 78 of the packing ring 75. The base cap 76 includes a sleeve 77 and lip projections 79 to confine the packer ring 75 in expanded position as seen in Fig. 2. The cap 78 is located between the bonnet 70 and the packing 75, as best seen in Fig. 7. This split cap ring assembly 78 is composed of a plurality of arcuate segments 80 which have openings 81 therein for the reception of guide pins 82 which are located on the bonnet 70 for guiding the arcuate segments 80 when they are moved inwardly and outwardly.

Springs 85 are also located on the bonnet 70, and are provided to urge the segments 80 inwardly under normal conditions until a pressure is exerted which forces the packing ring 75 upwardly and thereby urges the segments 80 against the springs 85. For balance, it is desired to employ at least two springs 85 on each segment; however, it will be appreciated that the invention is not limited thereto. The locking nut 22 previously referred to serves to hold the base cap 76 in position and, thus, to retain the ring 75 between the upper cap 78 and the base cap 76.

The lock nut 22 itself has a tapered seat 23 thereon which engages with the tapered surface 24 on the base cap 76. As can be seen by comparing Figs. 1 and 2, the sleeve 77 will move upwardly when the mandrel 15 is moved upwardly and as the squeezing or compression of the ring 75 is effected, the sleeve 77 would abut the cap 78; however, the cap segments 80 are urged outwardly by the compression of the packing 75 so that the sleeve 77 is permitted to move upwardly beyond the cap 78 as seen in Fig. 2. As will be appreciated from viewing Fig. 2, the ring 75 is thus confined in compression by the sleeve 77 and the upper and lower caps so that the sealing force of the ring 75 is concentrated on the inner surface of the tubing 10. As was previously mentioned, Fig. 1 illustrates the retainer tool of this invention as it is being inserted into the well bore, and prior to any anchoring with the anchor means 45. In this position the nipple 32 is near the lower extremity of the thread section 25 and the projections 34 on the nipple 32 are in the short legs or crooks 33 of the J-slots 35. When the retainer has reached its desired depth in the well bore, then this cement retainer tool must be set in anchoring position. Fig. 2 illustrates the retainer when it is in this set position, and it can be seen therefrom that the mandrel 15 has been moved upwardly so that the nipple 32 has now moved into contact with the shoulder 86 of the control housing 27. This moving up action of the mandrel 15 causes the wedge members 30 to force against the insides of the tapered block members 50 to urge them and the connected slips 47 into anchoring contact with the tubing or pipe 10. To understand the slip setting operation, it is necessary to understand the operation of the control means 42, which has been partially described previously herein. The control means 42 is shown in an exploded view in Fig. 9 and particular attention is directed thereto. The nipple 32 has internal threads which mate with the threads 25 on the mandrel 15. A stud 90 near the bottom of the threaded section 25 abuts against the abutment or stop 91 formed by the raised end of the threads on the nipple 32 to prevent further downward rotative movement of the nipple 32 on the threaded section 25. The stud 90 may be removable to permit separation of the nipple 32 and mandrel 15 for repair or other purposes. The stud 90 and the stop 91 cooperate to accomplish the unlatching of the projection 34 from the short leg 33 of the control sleeve 36. This unlatching is carried out by rotating the mandrel 15 in a counter-clockwise direction; since the nipple 32 is prevented from rotating with the mandrel 15 because of its contact with the tip 28 of each J-slot 35, the nipple 32 must necessarily move downwardly.

The stud 90 is so positioned that it contacts the abutment 91 when the uppermost part of the projection 34 has reached a point below the tip 28; the relationship of the parts at this stage are shown in cross-section in Fig. 5. Continued counter-clockwise rotation of the mandrel 15 then moves the projection 34 out of the crook 33 and into the long leg 29 of the J-slot 35. When the projection 34 reaches that position, it is believed apparent that the control housing 27, control sleeve 36, anchor housing 37 and connected parts by reason of their weight will tend to move downwardly relatively to the mandrel 15, which movement sets the anchor means 45 and the packer 75. Thus, there has been a setting of the retainer tool of this invention by a rotation and sliding action which has heretofore not been known. It will be understood that if the threaded section 25 is left-handed, the rotation of the mandrel would be in the clockwise direction and the J-slot 35 would be in a mirror-image position; in other words, everything could be made to operate in the opposite direction from that illustrated, if desired.

To obtain a further tightening of the anchor means 45 and the ring 75 after the initial setting in the tube 10, it is only necessary to pull up on the mandrel. In fact, with the mandrel 15 and the wedge member 30 in the positions shown in Fig. 2, there is a gripping or locking action by the anchor means 45, and pumping of the cement or other liquids downwardly through the passage 17 may then be commenced. The pressure resulting from the pumping of the cement or other liquids through the passage 17 causes an additional pressure to be exerted upon the ring 75, and the seal is, therefore, increased as the pressure in the well is increased by the pumping of the cement. Of course, if the gripping teeth 48 have not been forced to their maximum extent by the initial setting of the wedge portion 30, then the pressure from the pumping will increase the wedging action of the members 30 and also increase the gripping action by the anchor means 45.

It is believed to be readily apparent that due to the

position of the locking nut 22 on the end of the mandrel 15, any movement of the mandrel upwardly will, in turn, cause the lower housing member 77 to also move upwardly. Because the wedge member 30 is slidable on the mandrel 15, upon upward movement of the mandrel 15 it will lift the wedge portion 30 only until the wedge members 30 have forced the anchor means 45 into gripping contact with the tubing 10. At that point, further movement of the mandrel 15 upwardly will serve primarily to compress the packing ring 75 because when the wedge portion 30 ceases to move upwardly, the bonnet 70 ceases to move upwardly while the base cap 76 continues to move with the movement of the mandrel 15 until the maximum seal is obtained by the compression of the packing 75, at which time further upward movement of the mandrel 15 and base cap 76 is also stopped.

It has been found desirable to provide movable segments 80 of a split cap seal ring 78 so that upon compression of the ring 75, the upper portion of the ring 75 will be permitted to move against the spring and thereby to increase the radial gripping action of the ring 75. The arrangement of the springs 85 in connection with the segments 80 has been explained in detail previously.

Figs. 3 and 4 illustrate the retainer of this invention in the released or collapsed position, or, in other words, in the anchor released position for removing the entire retainer from the well bore. The control means 42 accomplishes this release of the anchor means 45. When the cement retainer is in the set position as shown in Fig. 2, the nipple 32 is at the extreme lower end of the threaded portion 25 and the projections 34 are in the long legs 29 of the J-slots 35. To get the cement retainer of this invention from the set position of Fig. 2 to the anchor-released position of Figs. 3 and 4, the mandrel 15 is turned clockwise so that it will move downwardly by reason of the threaded portion 25 turning in the thread of the nipple 32, the nipple 32 being held in position by its engagement with the walls 31 of the J-slots 35. This downward movement of the mandrel 15 will move the wedge portion 30 downwardly upon contact of the shoulder 40 with the top of the wedge portion 30. Simultaneously with the movement of the mandrel 15 downwardly, the compression and the seal provided by the ring 75 will be released, and the ring 75 will collapse to its normal inoperative position as shown in Figs. 1 and 3 due to inherent resiliency of the packer rubber. Of course, when the wedge portion 30 is moved downwardly until it reaches the position shown in Fig. 3, the anchor means 45 will move inwardly, and thus, the gripping action on the tubing 10 will cease. It will then be possible to remove the entire assembly from the tubing 10 by lifting up on the mandrel 15 since the contact of the nipple 32 with the shoulder 86 prevents any resetting of the anchor means 45 or ring 75 due to the lifting on the mandrel 15.

It should be noted that the threads 20, the threads 88 and the threads 89 on the mandrel 15 are in opposite directions from the threaded section 25 so that upon rotation of the mandrel to the right in the turning out operation, the threaded sections 20, 88 and 89 will not be disassembled. Thus, the threaded sections 20, 88 and 89 are, preferably, left-handed threads, whereas the threaded portions 25 will be right-handed threads, usually of the coarse acme type.

When the mandrel 15 and the rest of the assembly connected therewith is removed from the tubing 10, the mandrel 15 can then be rotated counter-clockwise until the projections 34 on the nipple 32 reach the lowermost point in the long legs 29 of the J-slots. At that point, clockwise movement of the mandrel 15 is effected. Ordinarily, this clockwise movement would start the nipple 32 back up the long leg 29, but the frictional engagement of the threads 25 with the threads on the nipple 32 cause the nipple 32 to also turn clockwise into the short leg or crook 33 until it abuts the wall 26 thereof. Then, as the clockwise rotation of the mandrel 15 is continued, the nipple 32 moves upwardly until it is above the tip 28 and thus prevented from further upward movement. The retainer is then ready for re-insertion into a well bore as shown in Fig. 1 and the sequence described may be repeated as often as desired.

If the frictional engagement of the threads 25 with the nipple threads is not sufficient to accomplish the rotation of the nipple projections 34 into the short legs 33 of the J-slots 35, additional friction means 95 can be used. The friction means 95 illustrated in Fig. 10 has been found particularly suitable. It includes a ball 96 which is urged against the threads 25 by a resilient means or spring 97, which is held in place by a cover plate 98 fastened to the nipple 32. The ball 96 rolls freely on the threads 25 when the mandrel 15 is rotated. In order to obtain the desired friction for turning the nipple 32 from the lower part of the long leg 29 to the lower part of the short leg 33, a notch 99 is made on the threaded section 25 for the ball 96 to drop into so that the clockwise turning of the nipple 32 is accomplished.

This cement retainer has been provided with seal rings 101, 102, and 103 so located as to prevent well fluids from entering the internal parts of the control means 42. These seals reduce the possibility of rusting or jamming of the threads due to the entrance of foreign particles into the threaded section 25. The seal 101 is at the top of the control means 42 between the control housing 27 and the mandrel 15; the seal 102 is between the wedge portion 30 and the mandrel 15; and the seal 103 is between the wedge portion 30 and the control or J-slot sleeve 36. All entrances for fluids are thus sealed off and satisfactory operation is assured.

It is believed readily apparent from the preceding description that this invention provides a cement retainer tool which has a control means co-operatively associated with an anchor means and a sealing means, which control means provides for positive release of the anchor means by rotation and sliding of the mandrel within the retainer assembly.

Broadly, this invention contemplates a cement retainer tool which has a control means for latching and unlatching a wedge-type anchor means.

What is claimed is:

1. A cement retainer tool for setting in a pipe in wells comprising a hollow mandrel operating pipe, an anchor sleeve in which said mandrel is slidable, an expansible packer connected to said sleeve and expandible into sealing engagement with the pipe by relative longitudinal movement between the mandrel and the sleeve, a wedge portion on said sleeve above said packer, an anchor housing also slidable on said mandrel and enclosing said wedge portion, anchor means carried by said housing to engage said wedge portion for expansion to grip the well pipe, and control means comprising a collar member threaded on said mandrel and non-rotatably slidable in said housing, latch means releasably connecting said collar member to said housing, said collar member being actuatable in response to relative rotation in one direction and raising of said mandrel to release said housing whereby said tool may be anchored and sealed to resist movement due to cementing pressures therethrough and by relative rotation of the mandrel in the opposite direction and lowering thereof to release said tool.

2. A cement retainer tool for setting in a pipe in wells comprising a hollow mandrel operating pipe, an anchor sleeve in which said mandrel is slidable, an expansible packer connected to said sleeve and expandible into sealing engagement with the pipe by relative longitudinal movement between the mandrel and the sleeve, a wedge portion on said sleeve above said packer, an anchor housing also slidable on said mandrel and enclosing said wedge portion, anchor means carried by said housing to engage said wedge portion for expansion to grip the well pipe, and control means comprising a collar member threaded on said mandrel and non-rotatably slidable in said housing, latch means releasably connecting said collar member to said housing, said collar member being actuatable in response to relative rotation in one direction and raising of said mandrel to release said housing whereby said tool may be anchored and sealed to resist movement due to cementing pressures therethrough and by relative rotation of the mandrel in the opposite direction and lowering thereof to release said tool, said packer including a split cap ring mounted on the sleeve to extend radially in confining the packer against pressure.

3. A cement retainer tool for setting in a pipe in wells comprising a hollow mandrel operating pipe, an anchor sleeve in which said mandrel is slidable, an expansible packer connected to said sleeve and expandible into sealing engagement with the pipe by relative longitudinal movement between the mandrel and the sleeve, a wedge portion on said sleeve above said packer, an anchor hous-

ing also slidable on said mandrel and enclosing said wedge portion, anchor means carried by said housing to engage said wedge portion for expansion to grip the well pipe, and control means comprising a collar member threaded on said mandrel and non-rotatably slidable in said housing, latch means releasably connecting said collar member to said housing, said collar member being actuatable in response to relative rotation in one direction and raising of said mandrel whereby said tool may be anchored and sealed to resist movement due to cementing pressures therethrough and by relative rotation of the mandrel in the opposite direction and lowering thereof to release said tool, said anchor means and packer means each including a left hand threaded connection for release of the mandrel therefrom.

4. A cement retainer tool for setting in a pipe in wells comprising a hollow mandrel operating pipe, an anchor sleeve in which said mandrel is slidable, an expansible packer connected to the lower end of said sleeve and expandible into sealing engagement with the pipe by upward movement of the mandrel relative to the sleeve, a wedge portion on said sleeve above said packer, an anchor housing also slidable on said mandrel and enclosing said wedge portion, anchor means carried by said housing to engage said wedge portion for expansion to grip the well pipe upon upward movement of said mandrel relative

to said housing, resilient friction members mounted in said housing extending into engagement with the pipe to prevent rotation of said housing relative to the mandrel, a collar member threaded on said mandrel and non-rotatably slidable therewith inside said housing, a J-slot in said housing, and lugs mounted on said collar to project into said J-slot for releasably connecting said collar member to said housing, said collar member being movable to and from housing-releasing position in said J-slot by rotation of the mandrel relative to the collar member.

5. In a cement retainer tool according to claim 4, a radially expandible split cap ring mounted on said sleeve in compressive engagement with the upper end of said packer, a sleeve member mounted on the mandrel and extending through the bore of said packer, said sleeve member being movable upwardly with said mandrel into radially expandible engagement with said cap ring.

References Cited in the file of this patent

UNITED STATES PATENTS

2,122,754	Rohrbaugh	July 5, 1938
2,248,211	Young	July 8, 1941
2,300,438	Spang	Nov. 3, 1942
2,633,201	Clark	Mar. 31, 1953