

July 20, 1965

D. T. HARBISON ET AL

3,195,643

PUMP ANCHORS WITH SLIPS AND PACKER

Filed Feb. 8, 1963

3 Sheets-Sheet 1

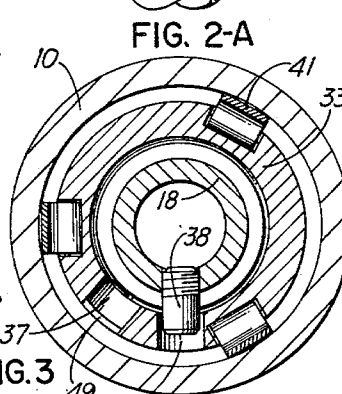
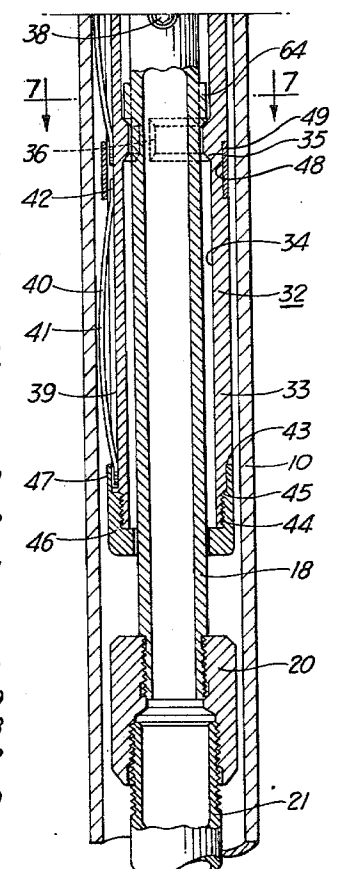
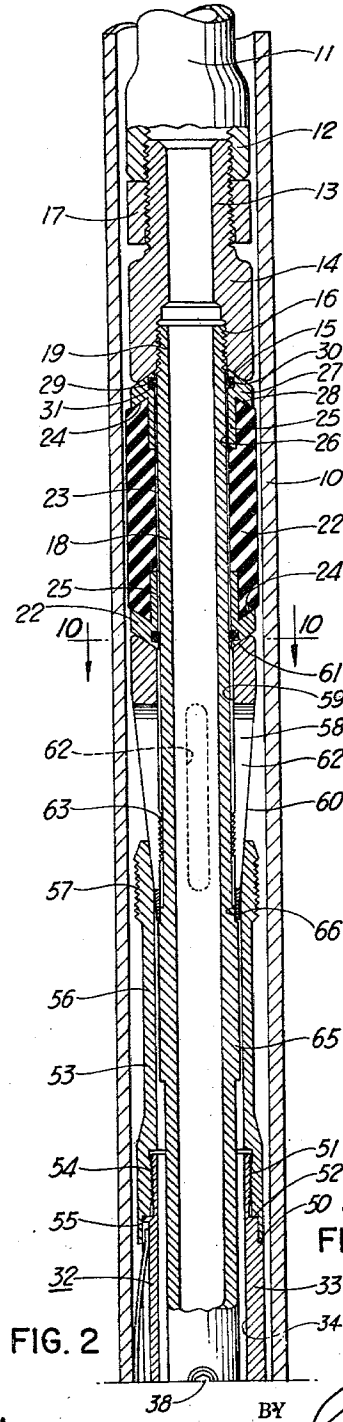
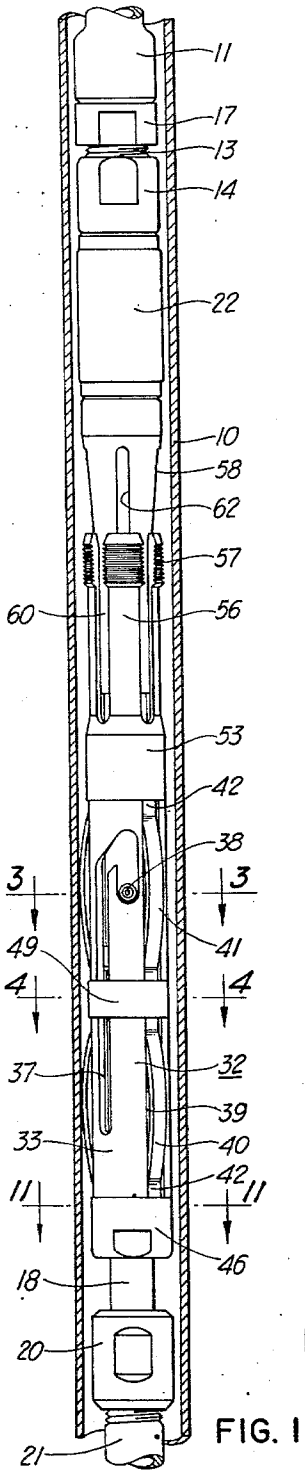


FIG. 2

FIG. 2-A

FIG. 3

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3 Sheets-Sheet 2

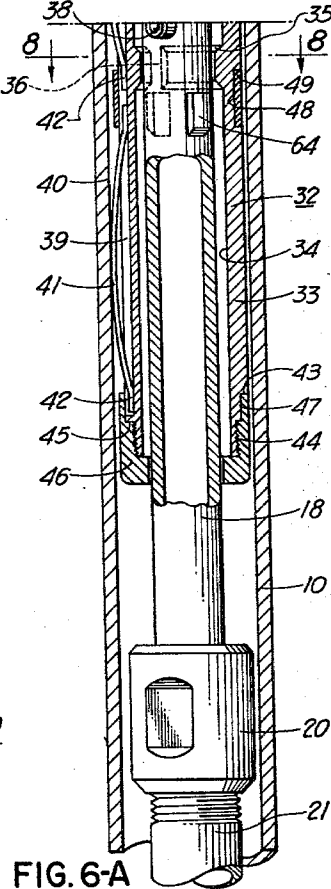
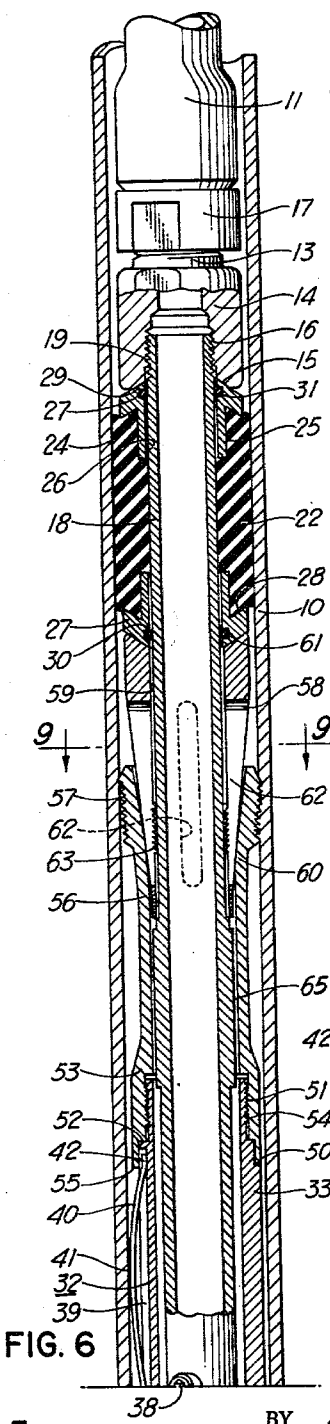
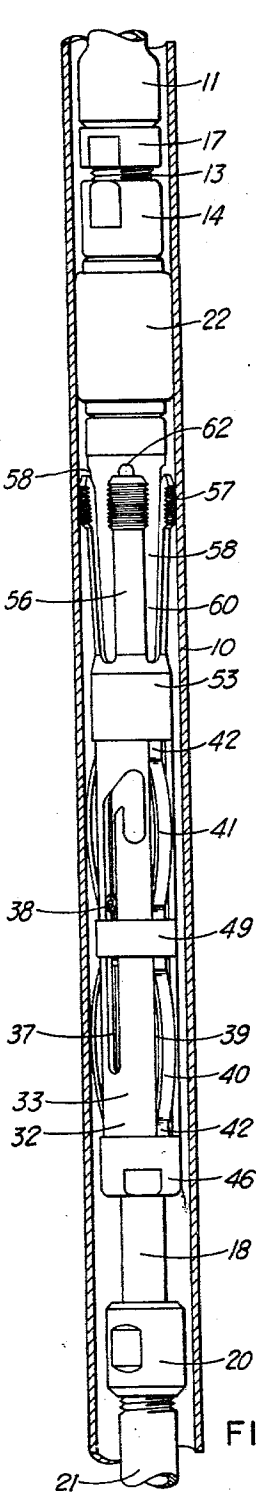


FIG. 6-A

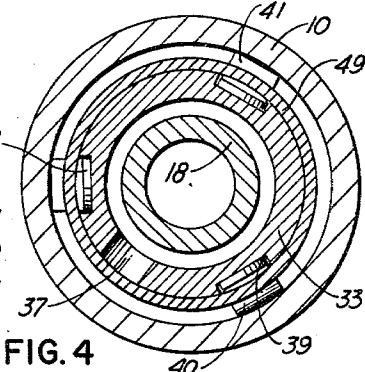


FIG. 4

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PUMP ANCHORS WITH SLIPS AND PACKER

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3 Sheets-Sheet 3

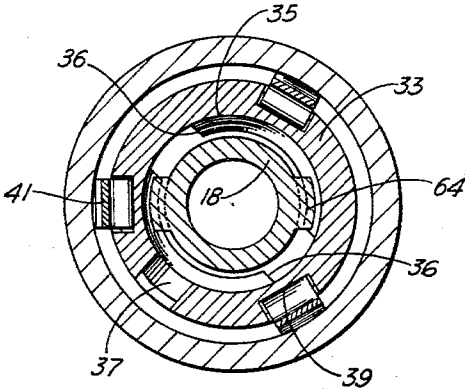


FIG. 7

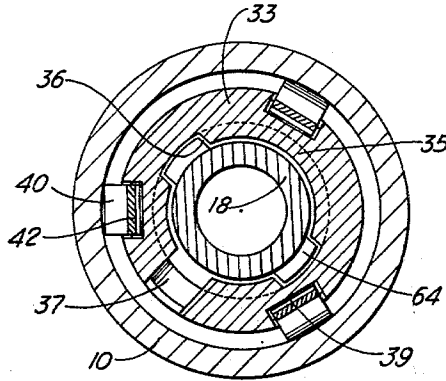


FIG. 8

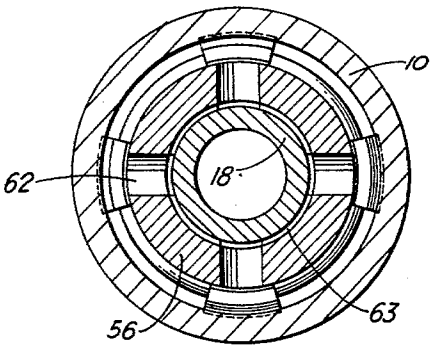


FIG. 9

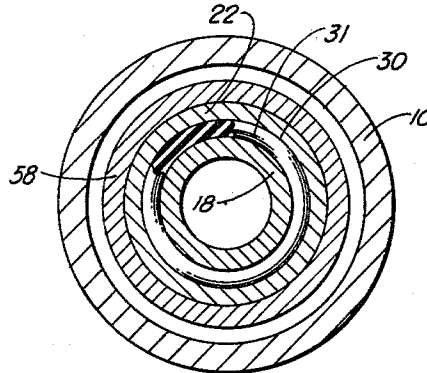


FIG. 10

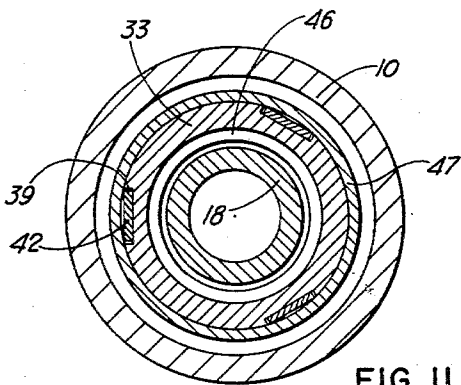


FIG. 11

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PUMP ANCHORS WITH SLIPS AND PACKER
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Filed Feb. 8, 1963, Ser. No. 257,296
5 Claims. (Cl. 166—138)

This invention relates to new and useful improvements in pump anchors for well pumps.

In present practice, pump anchors for well pumps must engage in a seating shoes which is located at a fixed elevation in the well tubing. If it is desired to anchor the pump at a deeper elevation or an appreciably higher elevation, the tubing must be removed from the well bore and a seating shoe installed at the changed elevation.

A principal object of the invention, therefore, is to provide an improved pump anchor for well pumps of the types utilized in oil wells and, in some instances, in water wells, by means of which a well pump may be anchored and secured at any desired point in a well tubing so that the pump is not limited to positioning at an elevation at which a conventional pump seating shoe has previously been provided in the well tubing.

A further principal object of the invention is to provide an improved pump anchor for well pumps having incorporated therein a packing member protected against internal leakage or seepage.

A still further object of the invention is to provide an improved pump anchor for well pumps in which the conventional latching or locking and unlocking means which normally includes a pin element is protected against excessive loads tending to break or shear off said pin element.

An additional object of the invention is to provide an improved pump anchor for well pumps having a unique setting assembly for setting the anchor in any desired location in a well tubing and at the same time securing within the setting assembly an internal mandrel of the anchor and holding the packing member of the anchor in set and sealing position.

A particular object of the invention is to provide an improved pump anchor having positive stop means for preventing shearing off of the latch pin during running, setting or retrieving operations.

Other and more particular objects of the invention will be apparent from a reading of the following description:

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, wherein an example of the invention is shown, and wherein:

FIG. 1 is a side elevational view of a pump anchor constructed in accordance with this invention and showing the anchor in an unset position,

FIG. 2 is an enlarged vertical sectional view of the pump anchor in an unset position,

FIG. 2-A is a continuation of FIG. 2,

FIG. 3 is an enlarged cross-sectional view taken upon the line 3—3 of FIG. 1,

FIG. 4 is an enlarged cross-sectional view taken upon the line 4—4 of FIG. 1,

FIG. 5 is a side elevational view of the pump anchor showing it in its set position,

FIG. 6 is an enlarged, vertical sectional view of the pump anchor in its set condition,

FIG. 6-A is a continuation of FIG. 6,

FIG. 7 is an enlarged, cross-sectional view taken on the line 7—7 of FIG. 2-A,

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FIG. 8 is an enlarged, cross-sectional view taken on the line 8—8 of FIG. 6-A,

FIG. 9 is an enlarged, cross-sectional view taken on the line 9—9 of FIG. 6,

FIG. 10 is an enlarged, cross-sectional view taken on the line 10—10 of FIG. 2, and

FIG. 11 is an enlarged, cross-sectional view taken on the line 11—11 of FIG. 1.

In the drawings, the numeral 10 designates a conventional well tubing positioned within a well bore and within which the pump anchor of this invention is adapted to be utilized. The pump anchor may be lowered into the well tubing in any desired or suitable fashion, the embodiment illustrated including a suitable well pipe 11 having a screwthreaded box 12 at its lower end for receiving the upstanding screwthreaded pin 13 provided upon the upper end of a packing member thimble 14 having at its lower end a beveled seat 15 surrounding a screwthreaded box 16. A lock nut 17 on the neck 13 secures the joint between said neck and the box 12.

An elongate tubular mandrel 18 has its screwthreaded upper end 19 received in the box 16 and projects downwardly throughout the length of the anchor into a screwthreaded coupling or collar 20 at its lower end from which the usual tail pipe 21 extends downwardly in the well tubing.

A packing member is disposed on the mandrel beneath the thimble 14 and includes an elongate, annular body 22 formed of rubber or a rubber-like or other distortable material and having an axial bore 23. The end faces 24 of the body 22 are convergent, the upper face being upwardly convergent toward the axial bore 23 and the lower face being downwardly convergent toward the bore. End caps are provided for the packer body 22 and include tubular sleeves 25 having an internal bore 26 approximately equal in diameter to the axial bore 23 and being recessed and bonded in the end portions of the body 22. The sleeves 25 carry annular outwardly extending flanges 27 at their exposed ends, the flanges having inner faces 28 angularly disposed to conform to the end faces 24 of the body 22 and approximately parallel outer faces 29 complementary to the beveled lower end 15 of the thimble 14. The end caps are identical so that the packing member is reversible upon the mandrel 18. The inner or inside faces 28 of the flanges 27 are also bonded to the end faces of the packer body 22, and for additional safeguarding against leakage or seepage into the interior of the packing member, the sleeves 25 carry internal O-ring grooves 30 facing inwardly toward the mandrel 18, and each of the O-ring grooves 30 receives a sealing O-ring 31 which engages the outer surface of the mandrel and seals thereagainst. Thus, liquid cannot seep or leak between the packer body 22 and the sleeves 25 due to the bonding of the sleeves to the packer body, nor can liquid seep between the sleeves and the mandrel due to the presence of the sealing O-rings 31.

A setting assembly surrounds the mandrel 18 below the packing member and includes friction shoe means 32 having an elongate tubular body member 33 with an axial bore 34 within which the mandrel 18 is longitudinally movable. Intermediate the ends of the bore 34, the body member carries an integral internal shoulder 35 having cut therein diametrically-opposed, longitudinal grooves or notches 36. An inverted J-slot 37 is cut through the wall of the body member 33, and a pin 38 projecting radially outwardly from the mandrel 18 engages in the J-slot 37 in order that longitudinal movement of the setting assembly 32 upon the mandrel 18 may be controlled as desired.

The body member 33 has formed therein a plurality of longitudinal external grooves 39 extending from a point closely adjacent its lower end to a point closely adjacent

its upper end, and within each of the grooves 39 is mounted a pair of longitudinally aligned spring shoes 40 having outwardly bowed center sections 41 and short rectilinear end portions 42. The lower end of the body 33 is reduced in diameter to form an annular, external, downwardly facing shoulder 43 and has its lower extremity further reduced to form a depending screwthreaded pin 44 and an annular, external, downwardly facing shoulder 45. A screwthreaded cap 46 is engaged upon the pin 44 with its upper end abutting the shoulder 45, and carries a marginal, upwardly extending flange 47 on its upper end which engages the shoulder 43 and loosely confines the lower rectilinear ends 42 of the spring shoes 40 within the lower portions of the grooves 39.

Intermediate its ends, the friction shoe body 33 is provided with a wide and shallow circumferential groove 48 overlying the medial portions of the grooves 39 and receiving a retaining band 49 which overlies in the grooves the upper rectilinear ends 42 of the lower friction shoes 40 as well as the lower rectilinear ends of the upper set of friction shoes. It is noted that each of the grooves 39 is greater in depth than the thickness of the ends of the friction shoes 40 and that the grooves are greater in overall length than the sum of the lengths of the two friction shoes disposed therein, so that the latter are free to undergo limited longitudinal movement within the grooves as they are flexed by the inner wall of the tubing 10 as well as some lateral movement. Such relative looseness of mounting protects the spring shoes 40 against breakage, permits their quick and ready replacement, and allows their desirable freedom of movement under flexing conditions.

At its upper end, the friction shoe body 33 is also reduced in diameter to provide an external upwardly facing shoulder 50, and still further reduced at its upper extremity to form an upstanding screwthreaded pin 51 and an upwardly facing external shoulder 52. A tubular first setting member 53 has a screwthreaded box 54 in its lower end which receives the pin 51, and also carries a marginal depending flange 55 which seats upon the shoulder 50 and confines in the upper ends of the grooves 39 the upper rectilinear ends of the upper set of friction shoes 40. Again, the friction shoes do not extend entirely to the ends of the grooves 39 and are loosely confined by the skirt 55 for freedom of movement and flexing while being securely retained as a part of the friction shoe member.

Above the box 54, the first setting member 53 is reduced in external diameter and longitudinally slotted to its upper end to form a plurality of upwardly projecting arms 56 which are flexible in nature and capable of being forced outwardly toward the inside wall of the tubing 10. Gripping elements 57 in the form of outwardly facing, transversely grooved or serrated slip faces are formed on the upper ends of the arms 56 and are adapted to be forced outwardly into gripping engagement with the inner wall of the tubing 10. For forcing the gripping elements outwardly as well as gripping the mandrel 18, a second setting member 58 having an axial bore 59 for receiving the mandrel 18, is formed with a frusto-conical lower portion 60 having a relatively small degree of taper and extending downwardly around the mandrel 18 into telescoping engagement within the arms 56 and especially the portions thereof carrying the gripping elements 57. The upper end of the second setting member 58 is enlarged and carries a beveled seat 61 engaging the lower end cap member 25 of the packing member. The second setting member is also slotted longitudinally from a point immediately below its enlarged upper end to a point spaced above its lower end, as indicated at 62, such slotting causing the medial portion of the member 58 to have a degree of flexibility and allowing this portion to be forced inwardly toward the mandrel 18. A plurality of transverse slip teeth or gripping edges 63 are formed on the wall of the axial bore 59 intermediate the upper and lower ends of the slots 62 and are adapted to engage the mandrel 18 in gripping relationship.

The mandrel 18 carries a pair of integral, diametrically-opposed rectilinear lugs 64 adapted to engage the shoulder 35 when the pin 38 is in the shorter leg of the J-slot 37 and the anchor is in latched condition as shown in FIGS. 1, 2 and 2-A. Thus, the mandrel is held against downward movement in the body member 33, and the pin 38 is protected against being sheared off against the lower end of the shorter leg of the J-slot 37. When, however, the mandrel is revolved in the body member 33 to shift the pin 38 into the longer leg of the J-slot 37 for unlatching the anchor, the lugs 64 will be moved into alignment with the grooves or notches 36 so that the mandrel is free to move downwardly in the body member 33. Thus, the notched shoulder member and the lugs form a pair of interrupted shoulder means. As the mandrel is moved upwardly during the unlatching operation, the spacing between the bottom cap 46 and the coupling 20 is such that the pin 38 cannot engage the upper end of the shorter leg of the J-slot 37 and be damaged thereby. Of course, the pin 38 can never reach the bottom of the longer leg of the J-slot.

The mandrel 18 has a slightly enlarged portion 65 on its outer surface within the first setting member 53 reduced at its upper end to form a radially-outwardly facing step 66 over which the lower frusto-conical end 60 of the second setting member 58 telescopes so as to prevent engagement of the slip teeth 63 with the mandrel until the packing member 22 is fully set and the mandrel has moved further downwardly to withdraw the step 66 from beneath the lower end of the second setting member. It will be noted that in the unset position of the pump anchor in which it is lowered into the well bore, the lower end of the second gripping or setting member 58 abuts the enlarged portion 65 on the mandrel 18, as shown in FIG. 2, thus preventing the second setting member 58 from being accidentally forced downwardly between the arms 56 and causing premature engagement of the gripping elements 57 with the wall of the tubing 10. As is customary, the upper portions of the arms 56 have an internal bowl-like configuration for receiving the lower end of the second setting member 58.

In use, the anchor assembly, depending from a well pump by means of the pipe or connector 11, is lowered into the tubing 10 with the pin 38 disposed in the bottom portion of the short arm of the J-slot 37. As the anchor moves downwardly through the tubing, the friction shoes 40 in engaging the inside wall of the tubing 10 will tend to cause the friction shoe member 32 and the first setting member 53 to move upwardly over the mandrel, but the engagement of the shoulder 35 with the lugs 64 will preclude such movement. At the same time, the engagement of the lower end of the second setting member 58 with the enlarged portion 65 on the mandrel 18 will prevent downward movement of said second setting member, thus ensuring the operator that the gripping elements 57 will not be prematurely flexed outwardly and protecting the packing body 22 from any force tending to distort the packing body outwardly.

Upon reaching the desired elevation in the well bore, the downward movement of the anchor is halted, and the pipe 11 elevated from the ground surface so as to elevate the mandrel 18 along with the second setting member 58. The friction shoe member 32 will resist such upward movement, however, due to the engagement of the friction shoes 40 with the tubing 10 so that the pin 38 will move into the upper end of the short leg of the J-slot, abutment of the cap 46 with the collar 20 preventing any possible damaging contact of the pin 38 with the upper end of the J-slot. Then, upon clockwise rotation of the pipe 11, and again the friction shoe member being held stationary by the friction shoes 40, the pin will be moved laterally into alignment with the longer leg of the J-slot 37 and the lugs 64 will be moved into registry with the notches 36, after which the pipe 11 is again lowered. The pin 38 is now free to move downwardly a considerably greater distance, passing under the band 49 if necessary, and accordingly,

the downward movement of the pipe 11 and mandrel 18 forces the frusto-conical lower end 60 of the second setting member 58 downwardly between the arms 56 of the first setting member, expanding them outwardly and forcing the gripping elements 57 into tight gripping engagement with the interior of the tubing 10. The gripping elements 57 anchor the assembly much more securely in position than the spring shoes 40, and accordingly, as further downward force is applied to the mandrel, endwise thrust is applied to the packing body 22 to distort it outwardly into sealing engagement with the tubing 10 as shown in FIG. 6. At the same time, the end caps 27 bonded to the ends of the packer body 22 and the O-rings 31 ensure against any leakage interiorly of the packing member and protect the member against damage or leakage due to internal seepage.

The pump anchor is now fully set and has sealed off the bore of the tubing 10 so that the well pump may be placed in operation in the usual fashion. At any time, an upward pull may be exerted upon the pipe 11 to reverse the above described operation and release the packer so that it may be removed from the well tubing or moved to a different location therein.

At this point, the lower end of the second setting member 58 is still telescoped by the step 66 and hence restrained against full inward flexure to move into gripping engagement with the mandrel. After the packing member 22 is fully set, however, continued downward movement of the mandrel moves the step 66 out from within the lower end of the member 58 while forcing the second setting member further into the first setting member, causing the intermediate portion of the member 58 to flex inwardly and bringing the slip teeth 63 into locking engagement with the mandrel 18.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

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

1. A pump anchor for well pumps including, an elongate mandrel, first setting means on the mandrel having outwardly-facing pipe engaging and gripping elements carried for outward movement, second setting means on the mandrel having inwardly-facing mandrel engaging and gripping elements carried for inward movement, the second setting means having a wedge-shaped portion telescoping the first setting means for forcing the gripping elements thereof outwardly and forcing the gripping elements of the second setting means inwardly, friction shoe means carried on the mandrel and connected to one of the setting means, the friction shoe means and first and second setting means forming a setting assembly, locking and unlocking means carried by the friction shoe means and the mandrel for limiting movement of the friction shoe means longitudinally of the mandrel, annular packing means surrounding the mandrel, and means on the mandrel for forcing the packing means against the setting assembly to distort the packing means into a packing position, the second setting member having slots extending longitudinally through its mandrel gripping elements, the slots terminating short of the ends of the second setting member.

2. A pump anchor for well pumps including, an elongate mandrel, first setting means on the mandrel having outwardly-facing pipe engaging and gripping elements carried for outward movement, second setting means on the mandrel having inwardly-facing mandrel engaging and gripping elements carried for inward movement, the second setting means having a wedge-shaped portion telescoping the first setting means for forcing the gripping elements thereof outwardly and forcing the gripping elements of the second setting means inwardly, friction shoe means carried on the mandrel and connected to one of the setting means, the friction shoe means and first and second setting

means forming a setting assembly, locking and unlocking means carried by the friction shoe means and the mandrel for limiting movement of the friction shoe means longitudinally of the mandrel, annular packing means surrounding the mandrel, and means on the mandrel for forcing the packing means against the setting assembly to distort the packing means into a packing position, the friction shoe means including a plurality of elongate longitudinally arcuate spring shoe elements having rectilinear ends and annular retaining elements overlying the ends of the spring shoe elements and confining the spring shoe elements loosely on the exterior of the friction shoe means.

3. A pump anchor for well pumps including, an elongate mandrel, first setting means on the mandrel having outwardly-facing pipe engaging and gripping elements carried for outward movement, second setting means on the mandrel having inwardly-facing mandrel engaging and gripping elements carried for inward movement, the second setting means having a wedge-shaped portion telescoping the first setting means for forcing the gripping elements thereof outwardly and forcing the gripping elements of the second setting means inwardly, friction shoe means carried on the mandrel and connected to one of the setting means, the friction shoe means and first and second setting means forming a setting assembly, locking and unlocking means carried by the friction shoe means and the mandrel for limiting movement of the friction shoe means longitudinally of the mandrel, annular packing means surrounding the mandrel, and means on the mandrel for forcing the packing means against the setting assembly to distort the packing means into a packing position, the friction shoe means including a plurality of elongate longitudinally arcuate spring shoe elements having rectilinear ends and annular retaining elements overlying the ends of the spring shoe elements and confining the spring shoe elements loosely on the exterior of the friction shoe means, the spring shoe elements being arranged in longitudinally aligned pairs.

4. A pump anchor for well pumps including, an elongate mandrel, first setting means on the mandrel having outwardly-facing pipe engaging and gripping elements carried for outward movement, second setting means on the mandrel having inwardly-facing mandrel engaging and gripping elements carried for inward movement, the second setting means having a wedge-shaped portion telescoping the first setting means for forcing the gripping elements thereof outwardly and forcing the gripping elements of the second setting means inwardly, friction shoe means carried on the mandrel and connected to one of the setting means, the friction shoe means and first and second setting means forming a setting assembly, locking and unlocking means carried by the friction shoe means and the mandrel for limiting movement of the friction shoe means longitudinally of the mandrel, annular packing means surrounding the mandrel, and means on the mandrel for forcing the packing means against the setting assembly to distort the packing means into a packing position, the mandrel carrying means for restraining inward movement of the mandrel engaging and gripping elements of the second setting means during a portion of the longitudinal movement of the mandrel with respect to the assembly.

5. A pump anchor for well pumps including, an elongate mandrel, first setting means on the mandrel having outwardly-facing pipe engaging and gripping elements carried for outward movement, second setting means on the mandrel having inwardly-facing mandrel engaging and gripping elements carried for inward movement, the second setting means having a wedge-shaped portion telescoping the first setting means for forcing the gripping elements thereof outwardly and forcing the gripping elements of the second setting means inwardly, friction shoe means carried on the mandrel and connected to one of the setting means, the friction shoe means and first and second setting means forming a setting assembly, locking and unlocking means carried by the friction shoe means and the mandrel

for limiting movement of the friction shoe means longitudinally of the mandrel, annular packing means surrounding the mandrel, means on the mandrel for forcing the packing means against the setting assembly to distort the packing means into a packing position, and a pair of interrupted shoulder means each having gaps between its shoulder portions and carried one by the mandrel and one by the friction shoe means, the shoulder portions of the shoulder means engaging in one rotational position of the mandrel with respect to the friction shoe means to prevent longitudinal movement between the friction shoe means and the mandrel, and the shoulder portion of one shoulder means alining with the gap of the other shoulder

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means in another rotational position of the mandrel with respect to the friction shoe means to permit longitudinal movement between the mandrel and the friction shoe means.

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