

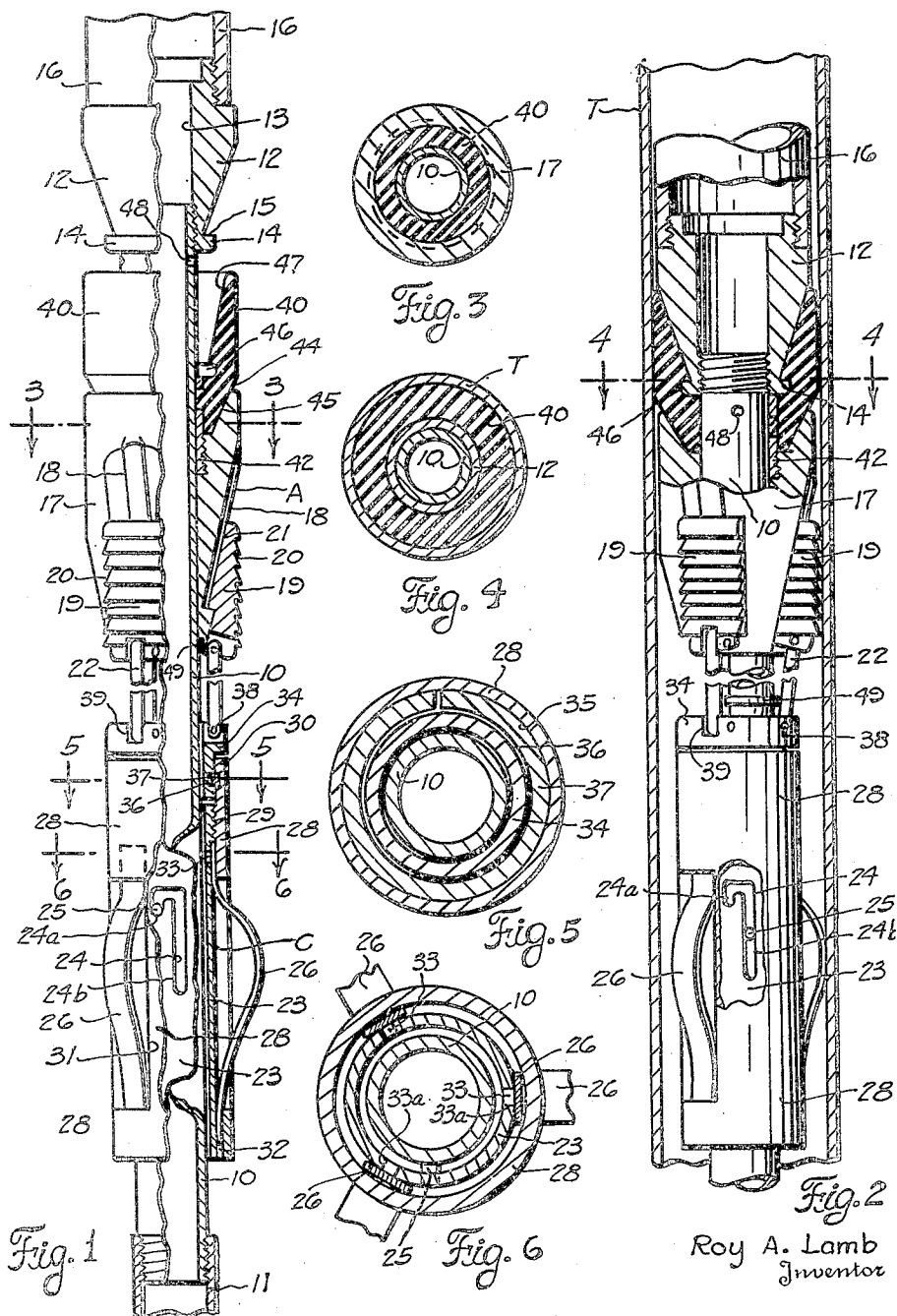
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PUMP ANCHORING DEVICE

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PUMP ANCHORING DEVICE

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This invention relates to new and useful improvements in pump anchoring devices.

One object of the invention is to provide an improved device for supporting and anchoring an insert well pump within a well conductor, said device being so constructed that it may be set or "anchored" at any desired point or elevation within the conductor to permit proper location of the well pump within said conductor.

An important object of the invention is to provide an improved pump anchoring device having means for frictionally locking the device against upward movement in the well conductor when said device is in its set position therein, whereby the operation of the pump connected thereto, and particularly the upstroke of said pump, will not cause upward displacement of the device from its originally set position.

Another object of the invention is to provide a pump anchoring device having an improved expansible packing means for sealing off the annular space between the well pump and the well tubing, said packing means being moved to and locked in an expanded sealing position in tight frictional engagement with the wall of the well tubing, whereby said packing means not only forms an efficient seal but also functions to frictionally lock the device against upward displacement within the tubing during operation of the pump which is supported by said device.

A further object of the invention is to provide a pump anchoring device, of the character described, wherein the packing means comprises an annular expansible element, together with a conical expanding member adapted to engage within said element to expand the same radially outwardly into sealing position; there being co-acting means on said expander and on said element for interlocking these parts after the element is in its sealing position, whereby considerable force is required to disengage the parts which assures that such disengagement cannot occur during normal pumping operations.

Still another object of the invention is to provide an improved anchoring device, of the character described, wherein gripping slips are utilized to lock the device within a well tubing against downward movement therein; the slip assembly being constructed of a minimum number of parts and being so constructed that said parts may be quickly and easily assembled without the use of rivets, brazing or other permanent types of fastening, whereby manufacture and assembly is simplified and costs are reduced.

A still further object of the invention is to pro-

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vide an improved pump anchoring device, of the character described, which may be anchored in position and which may be readily released and then subsequently reset at another elevation in the tubing or well conductor without removal of the device from said tubing, whereby pumping at different elevations due to changing well conditions is possible.

The 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 drawing, wherein an example of the invention is shown, and wherein:

Figure 1 is a view, partly in section and partly in elevation of an improved anchoring device, constructed in accordance with the invention, with the parts of the device in a normal position during lowering of the device through the well conductor,

Figure 2 is a similar view, with the device in a set position in said well conductor,

Figure 3 is a horizontal, cross-sectional view, taken on the line 3—3 of Figure 1,

Figure 4 is a horizontal, cross-sectional view, taken on the line 4—4 of Figure 2,

Figure 5 is an enlarged, horizontal, cross-sectional view, taken on the line 5—5 of Figure 1, and

Figure 6 is an enlarged, horizontal, cross-sectional view, taken on the line 6—6 of Figure 1.

In the drawings, the numeral 10 designates a tubular mandrel or support which has its lower end externally screw threaded, whereby an anchor tube 11 may be connected thereto. An expanding head or member 12 is threaded onto the upper end of the mandrel and is formed with an axial bore 13. The outer surface of the expanding head or member is generally tapered toward its lower end and the extreme lower portion of said head is formed with an annular flange 14, the upper surface of said flange providing an external shoulder 15. The upper end of the expanding head or member is formed with screw threads whereby the lower portion of an insert pump 16 may be connected thereto. Obviously, a suitable adapter (not shown) may be provided for coupling the head to the insert pump whereby any make or desired construction of insert pump may be connected to the head. It might be noted that in some instances the pump barrel may be connected to the head while in other instances the core of the pump is connected

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thereto; in any event, the head is adapted to be secured to the stationary portion of the pump 16.

For locking the mandrel and insert pump which it supports within a well tubing, a slip assembly A is mounted upon said mandrel. This slip assembly includes a slip expanding cone 17 which is provided with a plurality of dove-tailed projections or ribs 18 spaced around its external surface. Gripping slips 19 having gripping teeth 20 on their exterior surfaces are mounted to slide on the conical expanding cone, with each slip being provided with a groove 21 which engages the dove-tailed rib 18 in the usual manner to retain the slip on said cone. Each slip is connected by means of a link 22 with the upper end of the slip carrier C which encircles the tubular mandrel 10 and which is slidable with respect to said mandrel.

The carrier includes a cylindrical casing 23 which has an inverted J-slot 24 formed in its wall and a radially extending pin 25 projects outwardly from the mandrel to engage within the slot 24. When in the short leg 24a of the slot 24 the pin locks the casing of the carrier against downward movement. A slight upward movement and rotation of the mandrel moves the pin into vertical alignment with the elongate leg 24b of the slot and thereby permits the mandrel to move downwardly with respect to the casing 23 of said carrier.

A plurality of flat friction springs 26 are mounted upon the carrier C and are arranged to be secured to the carrier by means of an outer sleeve 28. The sleeve 28 has its upper portion connected by screw threads 29 to the upper end of the casing 23 and the extreme upper end projects above said casing to provide an upwardly projecting annular flange 30. The friction springs 26 are disposed within elongate vertical slots 31 formed in the outer sleeve 28 and the lower ends of said springs are confined within an annular space 32 which is provided between the lower end of the sleeve and the outer surface of the casing 23. The upper portion of each friction spring 26 is formed with an inwardly projecting lug or button 33 which engages an opening 33a in the inner casing 23. Displacement of said lug or button from its opening is prevented by the inner surface of the outer sleeve 28 and, as is clearly shown in Figure 1, when the outer sleeve is threaded onto the casing, the upper ends of the springs 26 are clamped between the casing and said outer sleeve. Because the lower ends of the springs 26 are merely confined within the annular space 32, the springs may be flexed inwardly with the lower ends of said springs merely moving vertically within the annular space 32.

A flanged bushing 34 is disposed within the extreme upper end of the outer sleeve 28 and for connecting this bushing to said sleeve, the sleeve is provided with an annular groove 35. A complementary annular groove 36 is formed in the external surface of the bushing so that when the bushing is in place within the upper end of the sleeve the grooves are in alignment. A split steel ring 37 engages within the two grooves 35 and 36 and serves to couple the bushing rotatably to the outer sleeve 28, whereby the sleeve may rotate with respect to the bushing. The links 22 are pivoted on pivot pins 38 within recesses 39 provided in the upper end of the bushing 34. It will be evident that the bushing 34 may be readily connected in position to the sleeve 28 by placing

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the split ring 37 within the groove 36 of said bushing. The groove has sufficient depth to accommodate the ring, whereby the bushing may be slid downwardly into the upstanding flange 30 at the upper end of the sleeve 28. When the ring moves opposite the annular groove 35 it will be expanded outwardly into said groove to couple the parts together. This provides a very simple type of swivel connection between the bushing, which is connected to the slips through the links 22, and the outer sleeve 28 of the spring carrier C.

The particular arrangement whereby the springs 26 are connected to the inner casing through the lugs 33 and openings 33a and retained in connected position by the outer sleeve is also advantageous since it eliminates the use of rivets or other fastening means for mounting the friction springs 26 on the carrier.

For packing off the annular space between the mandrel 10 and the well tubing in which the pump is to be supported, an annular packing element or sleeve 40, which may be constructed of rubber, rubber compound or other elastic material is provided. As is clearly shown in Figure 1, the packing element has the upper portion of a metal collar 42 molded in the lower portion of its bore and the lower end of said collar projects below the packing element. The projecting end of the collar is formed with external screw threads, whereby said collar may be threaded into the upper portion of the slip expanding cone 17. The lower external portion of the packing element has an inclined or conical surface 44 which engages a complementary inclined surface 45 within the upper end of the cone and in this manner the packing element is securely attached to and mounted on the cone.

Immediately above the lower portion of the bore of the packing element within which the collar 42 is molded, said packing element is provided with an internal annular groove 46 and above this groove, the bore of the packing element is inclined or tapered upwardly and outwardly as indicated at 47. The inclination of the portion 47 of the bore of the packing element is at a less angle from the vertical than the inclined surface of the expanding head element 12 and is also of a smaller diameter than the surface of said head. When the mandrel and head 12 are moved downwardly with respect to the packing element, the inclined surface of the expanding head 12 co-acts with the inclined portion 47 of the bore of the packing element to expand the packing element outwardly into engagement with the well tubing T, as is shown in Figure 2 and because of the larger diameter of the head, as well as its different inclination, the entire upper portion of the packing sleeve is distorted outwardly into sealing position (Figure 2). Movement of the head 12 downwardly into the packing element to cause its radially outward distortion causes the annular projection or flange 14 at the lower end of the head to engage within the annular groove 46 provided within the packing element. Engagement of the annular flange within the groove causes a distortion of the packing element material around the projection and above the shoulder 15 formed by the upper surface of the flange 14. With this arrangement, when the packing element is in its sealing position, the head 12 is interlocked with said packing element, whereby a considerable force must be exerted upwardly to separate the parts. As explained, the stationary part of the insert pump 16

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is secured to the head and since the head is firmly locked to the packing element and to the slip assembly which supports said packing element, upward displacement of the stationary part of the pump, during operation of said pump, is prevented. The interlocking arrangement between the head and packing element not only prevents upward displacement of the pump but also assures that the packing element 40 is retained in its sealing position.

The operation of the apparatus is believed to be obvious. The assembly is as shown in Figure 1 with the radial pin 25 of the mandrel engaged in the short leg 24a of the slot 24 of the carrier C. In this position, the slips are latched in a lower position on the slip expanding cone 17 and in such position the expanding head 12 is spaced above the packing element 40. The insert well pump 16 has its barrel or other part to be held stationary connected to the upper end of the head 12 and the assembly is run into the well tubing T. During lowering a by-pass of fluid through the mandrel and past the packing element is permitted through circulation ports 48 formed in the upper portion of the mandrel below the head 12. When the position at which the device is to be set is reached, the mandrel is lifted and rotated a slight distance so as to align the radial connecting pin 25 with the elongate leg 24b of the slot 24 of the carrier C. When this is done the mandrel and its connected parts will be moved downwardly with respect to the carrier C and also with respect to the gripping slips 19. The carrier C and slips 19 are held stationary during this downward movement of the mandrel by means of the friction springs 26 which frictionally engage the wall of the well tubing. As the mandrel moves downwardly, the slip expanding cone mounted thereon also moves downwardly until the gripping slips 19 move outwardly into engagement with the wall of the well tubing. When this occurs further downward movement of the slip expanding cone and the packing element 40 supported thereby is prevented.

Continued lowering of the mandrel 10 and the expanding head 12 connected therewith causes the head to enter the upper reduced bore of the packing element and since the diameter as well as the degrees of inclination of the outer surface of the head and the inner surface 47 of the packing element are different, the head coats with the element to distort the same radially outwardly into sealing engagement with the well tubing T. Lowering of the mandrel and head continue until the annular projection 14 on the lower end of the head 12 engages within the annular groove 46 of the packing element and by this time, the element is in its fully distorted or sealing position, as shown in Figure 2. Obviously, the head is interlocked with the packing element by means of the flange or projection 14 and groove 46 and an accidental or unintentional upward displacement of the head from the packing element is prevented. The insert pump may then be actuated and obviously on the down stroke of said pump the slips 19 prevent a downward movement of the apparatus. Upon the up stroke of the pump, the interlocking between the head 12 and the packing element prevent upward displacement of the stationary part of the pump 16 from the support. It might be noted that the frictional engagement between the slips and the cone formed by the wedging of the slips against the tubing is more than ample to pre-

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vent upward displacement of the cone from between the slips during the up stroke of the pump.

When it is desired to remove the apparatus it is only necessary to exert a sufficient upward pull on the well pump 16 and head 12 to disengage the flange 14 from the groove 46 of the packing element. After this is done, a continued upward pull will cause a recovery ring 49 which is secured to the mandrel to strike the underside of the slip expanding cone 17 and lift said cone from between the slips 19 to permit retraction of said slips. Subsequent lifting of the mandrel will remove the entire assembly from the well tubing. It is noted that during lifting of the assembly the ports 48 function to allow a free by-pass of liquid in the tubing downwardly through the assembly.

It is apparent that the device may be anchored in position and the pump operated; if for any reason it is desired to change the location of the pump, the anchoring device may be readily released, moved to another elevation within the tubing and then reset in the desired position. The release and resetting may be accomplished at any time without removal of the assembly from the tubing.

From the foregoing it will be seen that a simple and efficient anchoring device for well pumps is provided. The expanding member or head 12 is arranged to interlock with the packing element, whereby upward displacement of the stationary portion of the pump upon the up stroke of said pump is definitely prevented; also, the interlocking feature assures that the packing element 40 will remain in its sealing position so long as the pump is operating.

The construction of the slip carrier C is also a feature of the invention since said carrier provides a swivel connection between the slips 19 and the carrier, such swivel connection being accomplished through the use of the split retaining ring and the complementary grooves 35 and 36. The particular mounting of the friction springs which have their upper ends provided with the connecting lugs or buttons 33 engaged within recesses 33a in the inner casing and the retention of said lugs in connected position by the outer sleeve 28 facilitates the assembly of the carrier and eliminates the use of rivets or other fastening means. As has been pointed out the packing element may be of any suitable elastic packing material which will efficiently seal off between the mandrel and well tubing.

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 I claim and desire to secure by Letters Patent is:

1. A pump anchoring device adapted to be anchored within a well tubing including, a tubular mandrel, a slip-expanding cone mounted on said mandrel, an expansible packing element surrounding the mandrel and supported on the cone, gripping slips slidable on said cone and movable into an expanded gripping position with the well tubing upon relative downward movement of the cone with respect to the slips, a tubular slip carrier slidable on the mandrel and connected with the gripping slips, means for detachably connecting the slip carrier to the mandrel in a position holding the slips retracted, detachment of said

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means permitting downward movement of the mandrel and cone with respect to the gripping slips, whereby said slips are expanded into gripping position, means secured to the mandrel and arranged to engage within the packing element upon downward movement of the mandrel with relation to the element for expanding said element into sealing position with the wall of the tubing, said slip carrier comprising a tubular casing section surrounding the mandrel, a sleeve surrounding and secured to the upper end of the casing section, an annular bushing engaged within the upper end of said sleeve and connected with the gripping slips, said bushing and sleeve having complementary aligned annular grooves, and a split retaining ring engaged within said grooves for fastening the bushing and collar together while permitting a swivel action therebetween.

2. A pump anchoring device as set forth in claim 1, wherein arcuate flat friction springs are mounted on the carrier for engaging the tubing wall to hold the carrier and slips stationary when the mandrel is moved downwardly with relation thereto, said sleeve being threaded onto the casing section, connecting lugs on said springs engageable within openings in the casing section, said lugs being retained in connected position by the outer sleeve when said sleeve is threaded onto the casing, said sleeve having its lower end spaced from the casing, whereby the lower ends of the springs are confined between said sleeve and casing.

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3. As a sub-combination in an anchoring device, a gripping slip assembly including, a plurality of gripping slips, a slip carrier comprising a tubular section, an annular connector swivelled on the upper end of the section, connecting means between the connector and the gripping slips, a plurality of arcuate friction springs mounted on the section and extending longitudinally thereof, an annular retaining member threaded onto the upper portion of the tubular section and forming a part thereof, a connecting lug on the upper portion of each spring, said section having recesses for receiving the lugs of the friction springs, whereby when the member is in position on the section, the retaining member overlies the springs and prevents displacement of the lugs from said recesses to prevent displacement of the springs from the tubular section.

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