July 15, 1952 J. D. NIXON 2,603,163

TUBING ANCHOR

Filed Aug. 11, 1949 2 SHEETS—SHEET 1

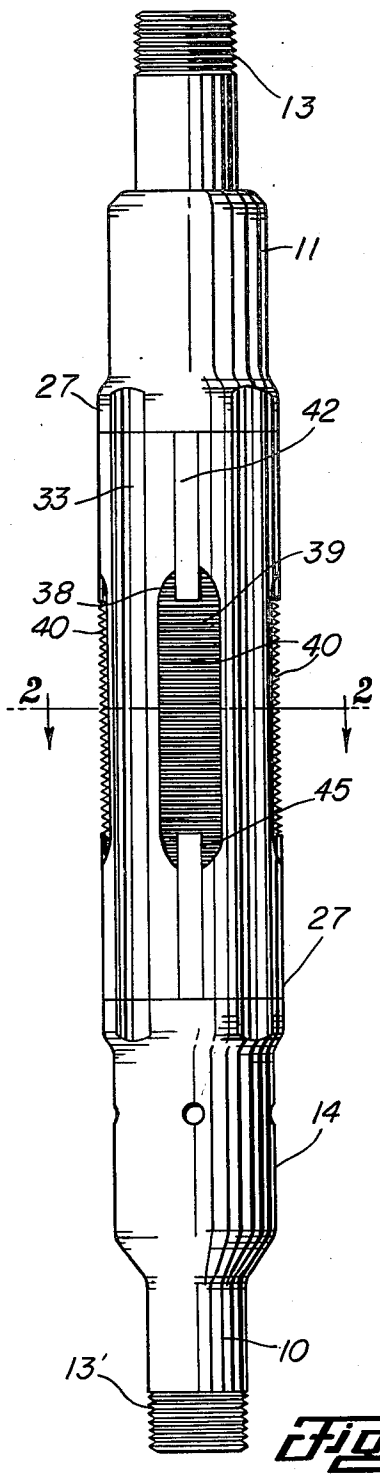

Fig. 1

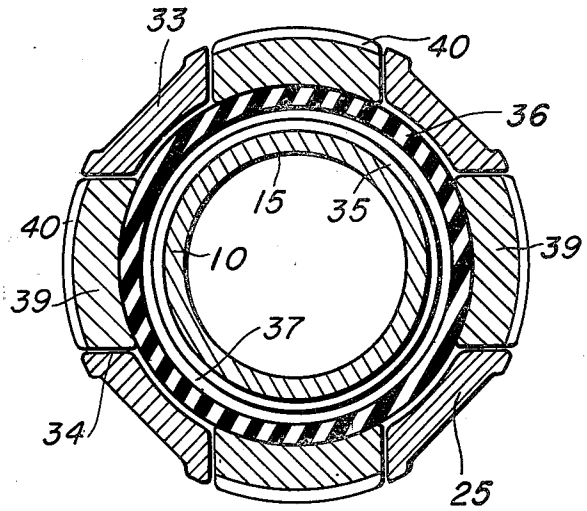

Fig. 2

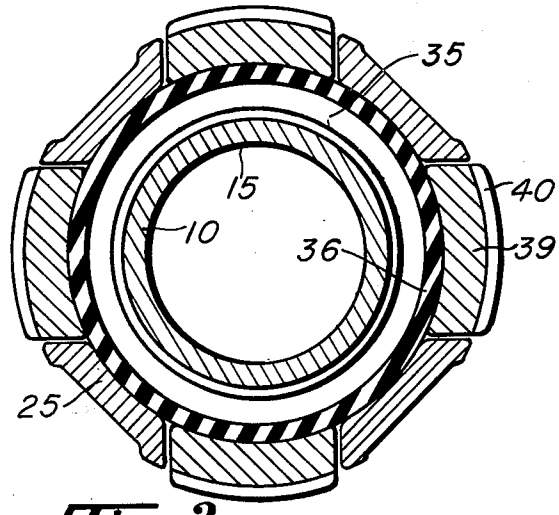

Fig. 3

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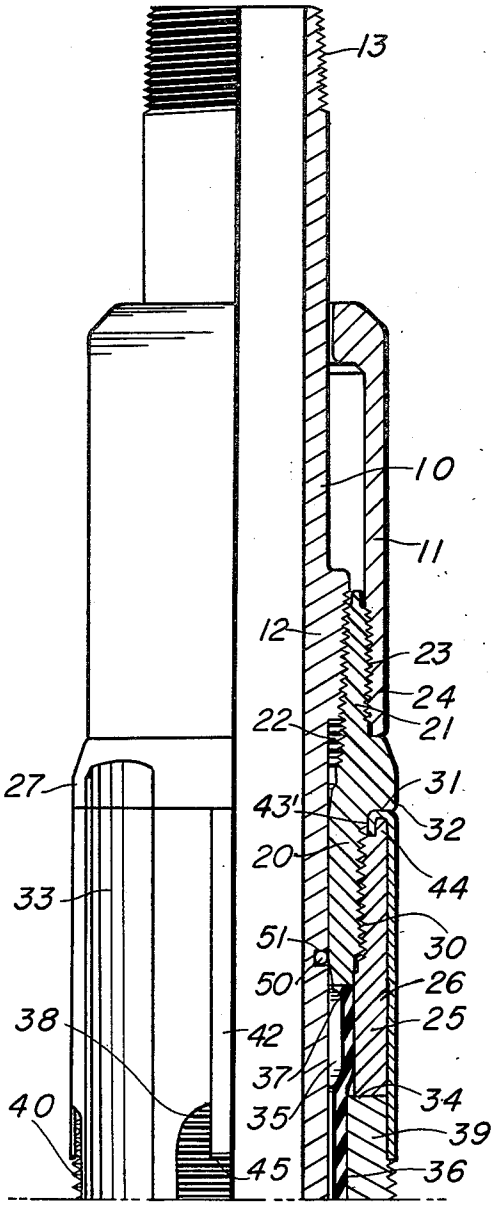

Fig. 4

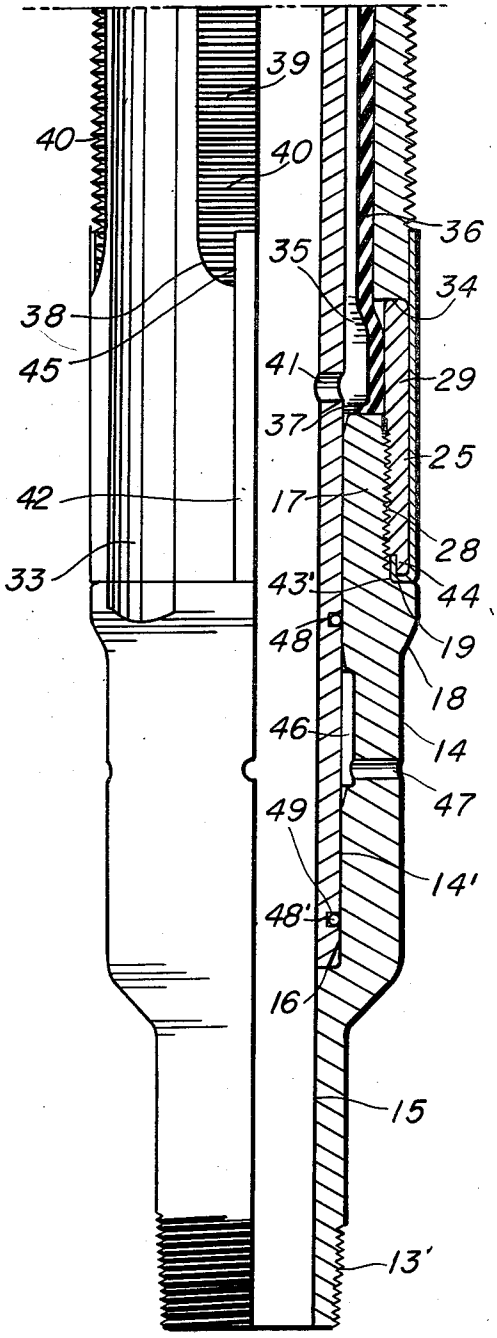

Fig. 5

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TUBING ANCHOR

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Application August 11, 1949, Serial No. 109,701

10 Claims. (Cl. 103—219)

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This invention relates to new and useful improvements in tubing anchors.

One object of the invention is to provide certain improvements upon the tubing anchor set forth in my Patent No. 1,941,813, issued January 2, 1934, and particularly to employ an elastic sleeve for expanding the slips in place of the pistons set forth in said patent, whereby more uniform distribution of the hydraulic pressure is obtained.

Another object of the invention is to provide, in connection with the slips, means for bleeding the liquid from the anchor and tubing thereabove disposed below the slips so that the liquid will wash up and between the slips, thus dislodging sand and any other accumulations and freeing said slips for retraction.

Still another object of the invention is to provide a tubing anchor having a body provided with an annular chamber and windows extending from the chamber together with elongate slips mounted in the windows and a fluid-responsive, elastic sleeve disposed in the body around the mandrel and in engagement with the slips so as to expand the latter when subjected to hydraulic pressure, thus providing an amplified pressure area for each slip, whereby said slips are moved radially and uniformly throughout their lengths.

Still another object of the invention is to provide an improved tubing anchor having slips actuated by an elastic, hydraulic sleeve mounted in a body which is provided with a liquid bleeding opening below the slips and a mandrel mounted within the body having means for normally sealing the bleeding opening and fastened to the body, whereby the body, upon being unfastened from the mandrel, may be moved vertically to expose the bleeding opening.

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 an elevation of a tubing anchor constructed in accordance with the invention,

Fig. 2 is an enlarged, horizontal, cross-sectional view taken on the line 2—2 of Fig. 1 and showing the slips retracted,

Fig. 3 is a similar view showing the slips expanded,

Fig. 4 is a view of the upper half of the anchor, half in section and half in elevation, and

Fig. 5 is a similar view of the lower half of the anchor.

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In the drawings, the numeral 10 designates an axial core or tubular mandrel. The upper end of the mandrel has a free sliding fit in a cap 11. A substantial distance from its upper end, the mandrel is formed with a circumferential enlargement or boss 12, which is externally screw-threaded and tapered downwardly. The upper end of the mandrel is provided with a screw-threaded pin 13. A tubular base 14 has an axial bore 14' in which the lower end of the mandrel is slidable and a counter bore 15 therebelow, whereby an annular shoulder 16 is formed between the bores and the lower end of the mandrel engages this shoulder. The upper end of the base is formed into an annular shank 17, the outer surface of which is tapered upwardly and screw-threaded. At the lower end of the shank the base is formed with an annular enlargement or boss 18 which extends radially of the shank so as to form a shoulder 19.

The mandrel is slidable in a thimble 20 just below the boss 12, and is formed with an upstanding, annular tongue 21 having its inner surface tapered and internally screw-threaded, as indicated at 22, to conform with the inclination of the outer surface of the boss 12, and to receive the screw-threads thereof. The outer surface of the tongue is also tapered upwardly and screw-threaded, as indicated at 23, to receive the screw-threaded box 24 at the lower end of the cylindrical cap.

A cage 25 is formed of an upper collar 26 and a lower sleeve 29 connected by webs or panels 33. The sleeve has a screw-threaded well 28 in its lower end into which the shank 17 is inserted. The collar has a screw-threaded well 30 in its upper end which is screwed onto the lower screw-threaded end of the thimble 20 below a shoulder 31 formed on an annular boss 32 which preferably has substantially the same diameter as the boss 18. The cap 11, base 14, thimble 20, and cage 25 constitute a body 27.

The vertical edges of the webs are cut on chords with respect to the mandrel 10 so as to provide spaced windows or openings 34. By observing Figs. 2 and 3, it will be seen that the inner curved surfaces of the webs 33 form the outer walls of an annular space or chamber 35 located between the webs and the mandrel 12 with its lower end defined by the lower end of the shank 17, and its upper end defined by the lower end of the thimble 20. Within this space is confined a cylindrical, elastic sleeve or hydraulic expanding member 36 having inwardly directed, annular lips 37 at its upper and lower ends engaging the top and bottom walls of said chamber.

These lips, when subjected to fluid pressure, form seals since the upper and lower ends of the sleeve engage the inner, annular surfaces of the collar 26 and sleeve 29, which overhang the annular space or chamber.

As indicated in Fig. 1, the upper and lower ends of the windows 34 are rounded, as is indicated at 38. Transversely curved slips or gripping members 39 conforming generally to the contours of the windows are arranged to slide radially therein. The outer faces of the slips are provided with arcuate, horizontal teeth 40. These teeth are V-shaped in cross-section so that upon biting into the inner wall of the well tubing (not shown) said teeth will hold equally as well against upward or downward movement of the acre. It will be observed that the thickness of each slip is greater than the radial width of its window so that when the slips are retracted, as shown in Fig. 2, the inner faces thereof will be in engagement with the outer cylindrical face of the sleeve 36, which will be unexpanded and spaced from the inner faces of the webs 33. The outer edges of the teeth 40 will lie substantially in a circle coincident with the outer edges of said webs.

A short distance above the lip 37, at the lower end of the sleeve 36, a horizontal row of spaced apertures 41 are provided in the mandrel 12 so that oil, gas or other fluid under pressure in the mandrel above said apertures will flow therethrough into the chamber 35 within the sleeve 36 and radially expand the latter. When this hydraulic expansion occurs and the sleeve is extended radially, the slips 39 will be moved radially so as to project from the windows 34 beyond the bosses 18 and 32, as is best shown in Fig. 3, and thus cause their teeth 40 to bite into the inner wall of the tubing. To limit the outward movement of the slips, and also to hold them within the windows 34, resilient retaining fingers 42 are provided with hooks 43' which are arranged to engage over a flange 43 at the upper end of the sleeve 27 and under a flange 44 on the bottom of the sleeve 29. The ends of the fingers are held positively between said flanges and the shoulders 19 and 31. These fingers extend along the outer surfaces of the sleeves 27 and 29 and have their free ends engaging in complementary recesses 45 in the upper and lower outer faces of the slips. The fingers being made of resilient metal and narrow will permit an ample, radial movement of the slips, but will prevent dislodgement of said slips from the windows.

It will be observed from the foregoing that the anchor includes certain main members or elements which may each be formed of various parts. The mandrel includes elements 10, 12 and 13. The cap 11 has its upper end closed and loosely surrounding the mandrel. The cage member or body includes the base 14 which is attached to the pump (not shown) or other connection and this base has the shank 17 whereby it is attached to the lower end of the cage 25, which latter has a collar 26 at its upper end screwed onto the thimble 20 which has the annular tongue 21 at its upper end. This tongue being internally and externally screw-threaded is screwed onto the boss 12 and into the bottom of the cap 11.

This invention being in some respects an improvement upon the tubing anchor set forth in my Patent No. 1,941,813, operates in a similar manner. When the anchor is being lowered in the tubing, the fingers 42 will hold the slips in a retracted position so that the anchor will have free movement downwardly in said tubing. A screw-threaded pin 13' on the lower end of the base 14 is usually connected with the upper end of the working barrel of a reciprocating pump (not shown) and the bore 15 and the mandrel 10 thus forms a part of the eduction conductor leading from said pump, and until the pump is placed in operation, the bore 15 and the mandrel will have fluid therein under static pressure, as is obvious. A particular advantage of the anchor herein set forth is that vertically, elongated, gripping areas are provided by the slips 39 and due to the hydraulic expansion of the elastic sleeve 36, the pressure is uniformly applied over the entire area of each slip; therefore a more efficient anchoring is achieved.

It is obvious that the mandrel 10 and the tubing, which is screwed onto the upper end of the cap 11 containing a column of liquid, which may extend several hundred feet above the anchor, the hydrostatic load created thereby must be relieved before the pressure within the chamber 35 can be reduced to permit the slips 39 to be retracted or released. In order to release this column of fluid, provision is made to lift the mandrel. Since the base 14 has its lower end fastened to the working barrel of the pump, rotation of the tubing will rotate the mandrel and consequently the boss 12 will be unscrewed (left hand threads) from the tongue 21 and the mandrel thus released; however the cage member is held stationary. The mandrel is free to be lifted until the boss 12 engages the top of the cap and further upward movement is arrested. An annular recess 46 is provided in the bore 14' of the base 14 below the boss 18 and radial ports 47 extend from this recess through the wall of the head. When the mandrel reaches the end of its upward movement, its lower end will be above the ports 47 and therefore, the column of fluid in the mandrel will bleed off through the recess 46 and the ports 47.

In order to prevent leakage of the liquid through the ports 47 when the anchor is in its normal, operating position, packing rings 48 are disposed in recesses 49 above and below said recess 46 so as to engage the wall of the bore 14', and a similar ring 50 is disposed in a recess 51 in the mandrel so as to engage the inner surface of the thimble 20. By bleeding the anchor below the slips, it is obvious that the released fluid washes upward between the slips because of the channel shape of the webs 33 and thereby, any sand which would otherwise bind the slips, is washed into the casing. This arrangement will quickly free the slips and permit the anchor to be raised in the well.

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. In a well having a casing therein, a tubing anchor including, a tubular body having windows therein, radially movable gripping members in the windows of said body having teeth for gripping the casing when actuated to hold said body against upward and downward movement, hydraulic means in the body engaging the gripping members and responsive to the pressure of the liquid from within the body, and a tubular mandrel within the hydraulic means having an open-

ing for supplying liquid to said means, the body having a liquid bleeding opening below the gripping members normally closed by the mandrel, the lower end of said mandrel being movable to a point above said bleeding opening to expose the bleeding opening at the lower end of said mandrel.

2. In a well having a casing therein, a tubing anchor as set forth in claim 1, with resilient retaining fingers carried by the body and having their ends overhanging the ends of the gripping members.

3. A well tubing anchor including, a tubular mandrel, an elongate cylindrical cage member surrounding the lower end of the mandrel and extending therebelow, the lower end of the mandrel having a flow connection, a screw-threaded connection between the mandrel and the cage member, whereby the mandrel may be disconnected from the cage member and moved vertically thereof, the cage member having windows, elongate slips movable radially in the cage windows, an elastic sleeve engaging the slips within the cage member surrounding the mandrel and having its ends above and below the windows, the mandrel having an opening located to supply a pressure fluid to the sleeve, the cage member having a fluid outlet normally closed by the mandrel and located to be exposed to fluid in the cage member when the mandrel is disconnected from the cage member and its lower end moved to expose said outlet.

4. A well tubing anchor including, a tubular mandrel, an externally screw-threaded boss surrounding the mandrel intermediate its ends, a cap slidable on the mandrel above the boss and having internal screw threads, a cage member having an annular tongue at its upper end provided with internal screw threads engaging the screw threads of the boss and external screw threads engaging the screw threads of the cap, whereby the boss may be unscrewed from the tongue and the mandrel moved upwardly through the cap and the cage member, the mandrel having a pressure outlet in its side wall, slips in the cage member exposed on the outer surface of said cage member, and an expanding element in the cage member engaging the slips and having an inner side exposed to fluid pressure from the mandrel.

5. A well tubing anchor including, a cage member having a connecting element at its lower end, the cage member having windows intermediate its ends, outwardly movable elongate slips confined in the windows of the cage member, expansible means in the cage member extending the lengths of the slips and free for uniform expansion throughout the lengths of the slips, whereby the slips are uniformly moved outwardly, a mandrel extending down into the cage member through the expansible means and having its bottom below said expansible means and terminating above the lower end of the cage member, the mandrel having a port constantly open to the expansible means, and a detachable connection between the mandrel and the cage member.

6. A well tubing anchor as set forth in claim 5, wherein the expansible means includes an elastic sleeve having its top and bottom sealed in the cage member above and below the upper and lower ends of the slips.

7. A well tubing anchor as set forth in claim 5, wherein the detachable connection includes an upstanding element on the upper end of the cage member screwed onto the mandrel and detachable therefrom.

8. A well tubing anchor including, a cage member having a base at its lower end connected with a thimble at its upper end by spaced panels, said cage member having elongate vertical windows between the panels, elongate vertical slips in the windows movable radially of the cage member, a tubular elastic sleeve in the cage member having its lower end supported on the base below the windows and its upper end engaging the thimble above the windows, a tubular mandrel having its lower portion extending through the cage member and into the base and exposed to the inner wall of the sleeve, the mandrel having a fluid opening to the elastic sleeve, and a detachable connection between the upper end of the cage member and mandrel.

9. A well tubing anchor as set forth in claim 8, and a cap surrounding the mandrel above the detachable connection and detachably connected at its lower end to the thimble of the cage member.

10. A well tubing anchor as set forth in claim 8, wherein an upper packing is interposed between the cage member and the mandrel above the fluid opening, an intermediate packing between the cage member and the mandrel below said fluid opening, and a lower packing between the cage member and the mandrel below the intermediate packing, the cage member having an outlet opening normally between the intermediate and lower packings located to be exposed when the mandrel is detached from the cage member and moved upwardly.

JEDDY D. NIXON.

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