

Aug. 28, 1945.

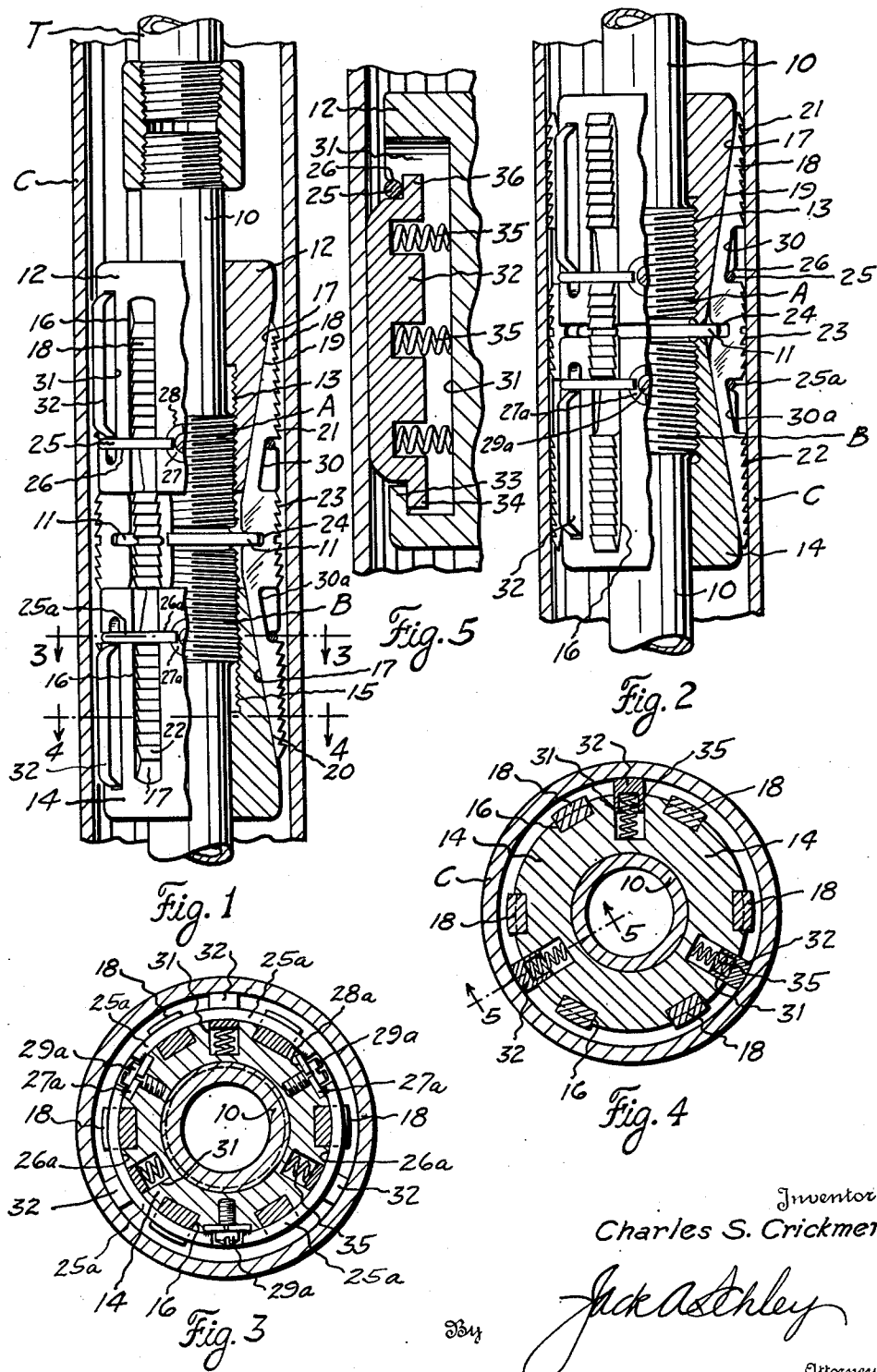
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2,383,453

ANCHORING DEVICE

Filed June 29, 1942

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

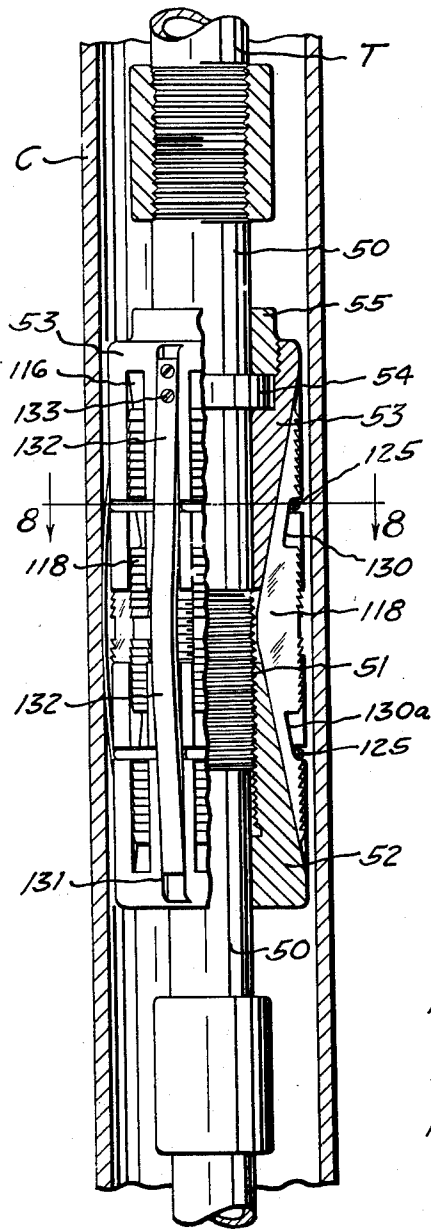


Fig. 6

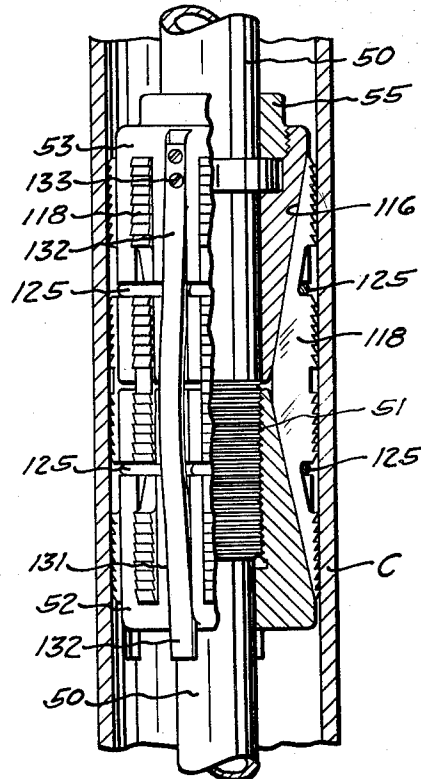


Fig. 7

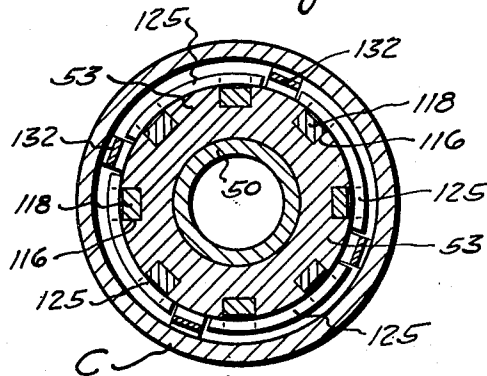


Fig. 8

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ANCHORING DEVICE

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1 Claim. (Cl. 166—1)

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

One object of the invention is to provide an improved anchoring device which is adapted to be connected to a well tool, well tubing, pump barrel or other apparatus and which functions to efficiently lock or anchor said apparatus within the well bore against movement in either direction, whereby danger of the apparatus being dislodged from its proper set position is obviated.

An important object of the invention is to provide an improved anchoring device which when in a set position, is anchored or locked against movement in either direction, the device being actuated from the surface and being so constructed that it may be readily released when desired, whereby said device may be retrieved after use.

A particular object of the invention is to provide an improved anchoring device, of the character described, wherein a pair of inclined expanding elements are mounted for movement relative to each other, with locking members adapted to coact with said elements, whereby said members are expansible and retractable by the movements of said elements with respect to each other; each locking member being elongate and coacting with both of the expanding elements whereby a simplified and more efficient locking arrangement is had.

Another object of the invention is to provide an improved anchoring device, of the character described, wherein an axially extending rotatable mandrel is utilized to impart relative movement to the expanding elements or cones, said mandrel being arranged to be connected with a well tubing or pipe, whereby the mandrel may be rotated from the surface, the device also including improved means for holding the locking members and the expanding elements against rotation, whereby rotation of the mandrel effects expansion and retraction of said locking members by imparting movement to the expanding elements with respect to each other.

Still another object of the invention is to provide an anchoring device, of the character described, wherein either one or both of the slip expanding elements or cones may be movable to expand and retract the locking members or slips, together with an improved means for mounting and retaining the locking slips, as well as for guiding the slips, whereby binding or hanging of said slips is prevented and efficient operation is assured.

A further object of the invention is to provide an improved anchoring device of the character

described, having its locking elements or slips retained on the assembly by positive, non-resilient means, and also being arranged so that the slips may be readily moved to a retracted position to permit removal of the device from the well bore at any desired time.

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:

Figure 1 is a view, partly in section and partly in elevation of an anchoring device, constructed in accordance with the invention and showing the locking elements in a retracted position,

Figure 2 is a similar view, with the locking elements moved to a gripping position,

Figures 3 and 4 are horizontal, cross-sectional views, taken on the lines 3—3 and 4—4 respectively, of Figure 1,

Figure 5 is an enlarged, vertical, sectional view of one of the friction shoes of the device,

Figure 6 is a view, similar to Figure 1, of a modified form of the invention,

Figure 7 is a view, similar to Figure 6, with the locking elements in an expanded or gripping position, and

Figure 8 is a horizontal, cross-sectional view, taken on the line 8—8 of Figure 6.

In the drawings, the numeral 10 designates a tubular mandrel or support which is provided with a series A of screw threads and a second series B of similar screw threads intermediate its ends. The series A comprises right hand threads, while the series B comprises left hand threads, the two series of threads being separated or spaced from each other, as is clearly shown in Figure 1. An annular ring 11 is secured to the mandrel and is located between the screw threads A and B. The ring may be either made integral with the mandrel or may be formed separately and then welded or otherwise secured thereto. The mandrel may be of any desired length and may have its extremities formed with the usual coupling screw threads, whereby it may be connected to a well tubing T or to a suitable well tool, as will be hereinafter explained.

An upper expanding element 12 surrounds the upper portion of the mandrel or support 10 and has the lower end of its bore provided with internal screw threads 13 which are complementary to the screw threads A on said mandrel. A lower

expanding element 14 encircles the lower portion of the mandrel 10 and has the upper end of its bore formed with screw threads 15 which are complementary to the screw threads B on said mandrel. The expanding elements 12 and 14 are identical in construction and are disposed in inverted relation to each other. Obviously, since the upper screw threads A of the mandrel are right hand threads and the lower threads B are left hand, a rotation of the mandrel or support 10 will result in a movement of the expanding elements 12 and 14 toward and away from each other, depending upon the direction of rotation of the support. When the support is turned to the left in Figure 3, the expanding elements 12 and 14 are moved inwardly toward each other; a reverse rotation of the mandrel, that is, to the right in Figure 3, will result in the expanding elements being moved outwardly away from each other to a spread position.

As pointed out, the expanding elements are constructed in identically the same manner and each includes a plurality of recesses or grooves 16 which are formed in its outer surface, each groove having its bottom inclined as illustrated at 17. Six grooves or recesses 16 have been illustrated in each expanding element, but obviously, any desired number may be employed.

The grooves 16 which are formed in the expanding elements 12 and 13 are adapted to receive elongate locking members 18, the upper end of each locking element engaging within one of the grooves of the upper element 12 while the lower end of each locking member engages one of the grooves 16 in the lower expanding element 14. Each locking member 18 comprises an elongate bar which has the upper portion of its rear surface inclined at 19, such inclination being complementary to the inclination of the base 17 of the groove 16 within which this upper end engages. The lower end of the locking member has its rear surface inclined as indicated at 20, such inclination being also complementary to the bottom of the groove 16 within which it is disposed. Upper gripping slips or teeth 21 are formed in the outer surface of each locking member, while similar lower gripping teeth 22 are provided at the lower portion of the member. If desired, intermediate slips or gripping teeth 23 may be provided at the central portion of said member. When the locking member 18 is disposed within the respective grooves of the upper and lower expanding elements 12 and 14, the annular collar or guide ring 11 which is secured to the mandrel 10 engages within a groove or recess 24 provided in the rear wall of said locking member (Figure 1).

For retaining the upper portion of the locking members 18 on the expanding elements 12, a trio of retaining rods 25 is provided. Each rod engages within an annular groove 26 formed in the outer surface of the element 12 and the ends of each rod are welded or otherwise secured to one half of a split washer 27. The split washers 27 are arranged to engage within recesses 28, also formed in the outer surface of the element 12. Manifestly, when the washers 27 are within their respective recesses 28, the retaining rods 25 are disposed within the annular groove 26 and the three rods form, in effect, a single annular retaining rod which encircles the locking members and expanding element. Each washer is held within its recess by a suitable cap screw 29 which is threaded into the body of the expanding element 12. This particu-

lar arrangement of forming the annular retaining rod of three pieces is provided so as to facilitate the mounting and removal of the retaining rod but any other suitable arrangement could be employed.

The retaining rods 25 encircle the locking members 18 and are received by elongate recesses 30 which are formed in the exterior surface of each locking member. By observing Figure 1, it will be seen that the provision of the elongate recess 30 provides a means whereby the rods 25 may retain the locking elements on the assembly and yet, the locking members may undergo vertical as well as radial outward movement relative to the rod.

The lower portion of the locking members 18 are maintained on the lower expanding element 14 by retaining rods 25a which are constructed in the same manner as the rods 25. The rods 25a engage within a groove 26a in the element 14 and have their ends secured to split washers 27a, which washers are retained by cap screws 29a. Each locking member is formed with an elongate recess 30a for receiving the rods 25a and the function of the recesses 30a is substantially the same as that of the recesses 30 in the upper portion of the locking members.

Between the grooves 16 of each expanding element, said element is provided with additional grooves or recesses 31 and these recesses are adapted to receive elongate friction shoes 32. Referring to Figure 5, one end of each recess 31 is provided with a retaining flange 33 and each friction shoe has a complementary flange 34 which coacts therewith. A plurality of coiled springs 35 constantly urge the friction shoes 32 outwardly into engagement with the wall of the well casing or other pipe in which the device is disposed. The coaction between the retaining flange 33 and the flange 34 on each shoe maintains one end of said shoe against complete outward displacement from its groove 31, while the opposite end of said shoe is retained against outward displacement by the retaining rods 25 on the element 12 and the retaining rods 25a on the element 14. As is clearly shown in Figure 1, the retaining rods 25 and 25a overlie one end of each of the friction shoes, this end of each shoe being formed with a flange 36 which engages the rod. In this manner, the rods 25 and 25a not only function to maintain the locking members 18 on the assembly but also prevent outward displacement of the spring pressed friction shoes 32.

The device is illustrated as being connected to a well tubing T but it is pointed out that it may be connected to any desired well tool, such as a well packer or the like and it is specifically noted that the invention is not to be limited to use with any particular apparatus.

In operation, the parts are in the position shown in Figure 1 and the assembly is lowered into the well casing C or any other well pipe. The upper expanding element 12 is nearer the upper end of the threads A, while the lower expanding element 14 is nearer the lower end of the threads B on the mandrel, whereby the elements 12 and 14 are separated or spaced apart. In this position, the coaction between the inclined bottom 17 of the grooves 16 with the inclined rear surfaces 19 and 20 of the locking elements 18, maintains the locking elements in a retracted or non-engaging position. The spring pressed shoes 32 on the expanding elements 12 and 14 engage and ride upon the inner surface of the well pipe C and the device is

lowered to the position at which it is to be set in said pipe.

When it is desired to anchor the device, it is only necessary to rotate the mandrel or support 10 to the left in Figure 3 and such rotation will impart an upward movement to the lower element 14 and a downward movement to the upper expanding element. Thus, the two elements 12 and 14 are moved toward each other and such inward movement results in an outward radial movement of the locking members 18, this radial movement being caused by the coaction of the grooves in said elements with the inclined rear surfaces of said locking members. Outward radial movement of the locking members is permitted because of the elongate recesses 30 and 30a in each member since said recesses permit the locking members to change their positions relative to the retaining rods 25 and 25a. Each locking member is positively guided in its radial movement by the guide ring 11 which is secured to the mandrel and which prevents any mis-alignment of said locking member, whereby binding or hanging of said member during operation is prevented. Obviously, the expanding elements 12 and 14, as well as the locking members are held against rotation during the rotation of the mandrel by the engagement of the friction springs 32 with the wall of the well pipe, whereby positive operation is assured. After the locking members move into engagement with the pipe the upper gripping teeth 21 prevent downward displacement of the assembly, while the lower gripping teeth 22 prevent upward displacement thereof, and therefore, the assembly is locked against movement in either direction within the pipe.

When it is desired to remove the device, a reverse rotation is imparted to the mandrel or support 10, such rotation being to the right in Figure 3. When the mandrel is so rotated, the screw threads A and B coact with the expanding elements 12 and 14 to return them to their original or spaced positions. At this time, rotation of the elements 12 and 14 is prevented by the engagement of the locking members and friction shoes with the wall of the pipe. It is noted that since the mandrel is rotated to the right in Figure 3 to effect a retraction of the locking members 18, danger of breaking out or loosening the various tubing connections which are all right hand threads, is obviated. After the expanding elements 12 and 14 have been separated, the locking members 18 have been returned to a retracted position, the inward movement of said locking members being effected by the coaction between the elongate recesses 30 and 30a in each member with the retaining rods 25 and 25a. Of course, after the locking members are retracted and disengaged from the pipe wall, the device may be removed from the well.

As has been explained, the device may be used in combination with various types of well equipment and apparatus for anchoring the same against displacement within a well casing or pipe. For example, the assembly could be attached to the working barrel of a pumping well so as to anchor said barrel within the casing. It may be attached in the tubing string as shown, to prevent the tubing from falling downwardly into the well casing or from being blown from said casing by an excessive well pressure. Also, the assembly is adaptable for use with a packing element to provide a packoff within the well pipe or it could be combined with a packing element so as to be used as a retrievable cementing plug. From the

above, it becomes apparent that the invention resides in the particular anchoring assembly and is not to be limited to anchoring any particular device or apparatus within the well pipe.

In Figures 1 to 5, the assembly has been shown with both the upper and lower expanding elements movable toward and away from each other. The invention may be carried out by making only one of the expanding elements movable and this form of the invention has been illustrated in Figures 6 to 8. In this instance, a mandrel 50 is provided with a single series 51 of screw threads which are left hand threads and which are disposed intermediate the ends of the mandrel. A lower expanding element 52 is threaded onto the threads 51 so that a rotation of the mandrel 50 will result in a longitudinal or axial movement of the expanding element 52 on the mandrel. An upper expanding element 53 surrounds the mandrel 50 above the screw threads 51 and engages an integral collar 54 formed on the mandrel, being held against axial movement on the mandrel by a retaining collar 55 which threads into the upper end of the element 53. The expanding element is freely rotatable on the mandrel.

Each expanding element 52 and 53 is formed with vertically extending grooves 116 which are identical in construction to the grooves 16 in the elements 12 and 14 of the first form and said grooves 116 are adapted to receive locking members 118 which are similar in construction to the members 18. However, since the guide ring 11 shown in Figure 1 is omitted in the form shown in Figure 6, the recess 24 in the rear surface of each locking member is omitted. Instead of the retaining rods 25, retaining rods 125 are provided and these rods coact with grooves 130 and 130a formed in the locking members. The rods 125 are welded or otherwise secured directly to the outer surface of the expanding elements 52 and 53, the split washers 27 and 27a and their retaining screws 29 and 29a being omitted.

Instead of the grooves 31 which are formed in the elements 12 and 14 of the first form, the expanding elements 52 and 53 are provided with vertically extending grooves 131 which are adapted to receive curved friction springs 132. As is clearly shown in Figure 6, each friction spring has its upper end disposed in the groove 131 of the upper element 53 and is secured therein by screws 133. The lower end of the spring is disposed within the groove 131 in the lower expanding element 52 and is freely movable therein. It is obvious that the flat springs 132 function in the same manner as the spring-pressed friction shoes 32 of the first form, that is, said springs prevent rotation of the expanding element when the mandrel 50 is rotated.

The operation of this form of the invention is substantially the same as that of the first form hereinbefore described. When the device is lowered into the well, with the parts in the position shown in Figure 6, the locking members 118 are retracted or in non engaging position. The friction springs 132 are engaging the wall of the well pipe and when the mandrel 50 is rotated, the screw threads 51 coacting with the lower expanding element moves upwardly toward the upper expanding element, a radial movement is imparted to the locking members 118, whereby said members are moved outwardly into engagement with the pipe, as is shown in Figure 7. It is pointed out that the threads 51, being left handed screw threads, require that the mandrel 50 be rotated

to the left in order to effect upward movement of the lower expanding element.

The device may remain set in the well pipe for a desired length of time and when it is desired to remove the same, it is only necessary to rotate the mandrel in a reverse direction, that is, to the right in Figure 8. Such rotation will impart a downward movement to the lower expanding element 52, whereby the coaction between the inclined bottoms of the grooves with the inclined rear surfaces of the locking elements 118, together with the coaction between the retaining rods 125 and the recesses 130 and 130a of the locking members, will result in a retraction of said locking members. After the locking members are disengaged from the pipe, the device may be removed from the well. It is apparent that the form shown in Figure 6 may include the spring pressed friction shoes 32 in place of the flat friction springs 132; similarly, the flat springs 132 of the second form could be substituted for the friction shoes of the first form.

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 claim, without departing from the spirit of the invention.

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

A well anchoring device including, a rotatable mandrel, a series of screw-threads formed on the mandrel, a tapered expanding element threaded upon the screw-threads, a second series of screw-threads on said mandrel, a second tapered expanding element having its taper inverted with relation to the taper of the first element threaded upon the second series of screw-threads, one series of screw-threads being oppositely disposed to the other series, whereby the elements are moved relatively toward each other when the mandrel is rotated in one direction relative to said elements and are moved relatively away from each other upon rotation of said mandrel in the opposite direction relative to the elements, locking members mounted on said elements and co-acting therewith whereby the locking members are moved radially when the elements are moved with respect to each other, said members having external serrated gripping surfaces, and co-acting means on the mandrel and locking members for positively guiding said members in their radial movement and for preventing vertical movement of the members with respect to said elements and mandrel, and friction means carried by the elements for engaging a pipe through which the device is lowered to prevent rotation of said elements when the mandrel is rotated so as to permit independent rotation of said mandrel.

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