

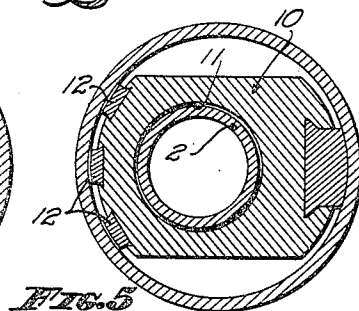
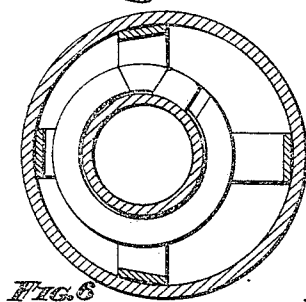
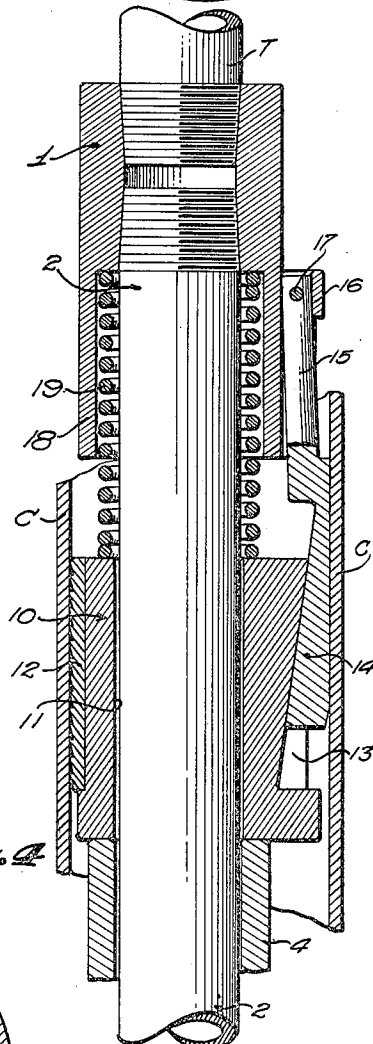
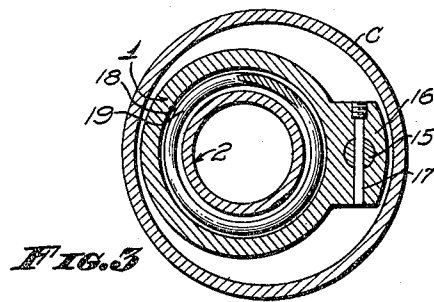
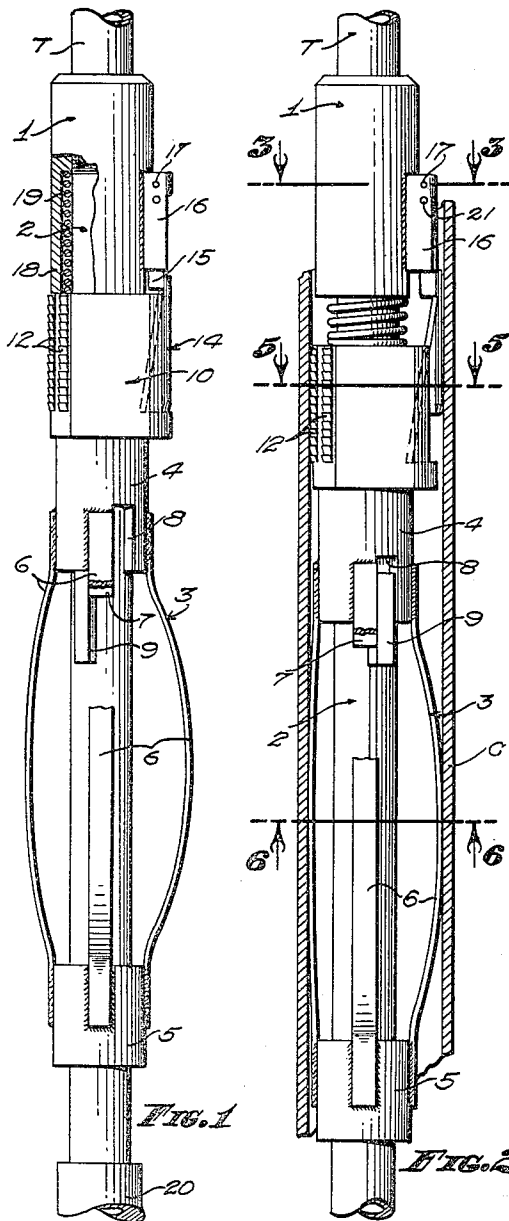
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TUBING ANCHOR

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TUBING ANCHOR

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This invention relates to tubing anchor, and included in the objects of this invention are:

First, to provide a tubing anchor wherein an anchoring slip is set by a coil spring upon predetermined relative movement of the tubing anchor body and a bow spring cage.

Second, to provide a tubing anchor of this type wherein the anchoring slip may be released by recompressing the coil spring upon predetermined relative movement of the tubing anchor body and bow spring cage, or, alternatively, by application of predetermined tension on the tubing to shear a shear pin initially securing the anchoring slip relative to the tubing anchor body.

Third, to provide a tubing anchor of this type which incorporates a jarring means, utilizing the elasticity of the tubing string, whereby upon shearing of the shear pin the tubing anchor is effectively jarred free of the casing.

Fourth, to provide a tubing anchor which, when set initially with insufficient tubing tension in a pumping well, tends to work down the casing, as the weight of the liquid is periodically carried by the tubing in the course of pumping the well, until the tubing is placed under proper tension, whereupon the tubing anchor tends to prevent further oscillation of the lower end of the tubing string.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings in which:

Figure 1 is a side view, partially in section, of the tubing anchor with adjacent portions of the tubing string shown fragmentarily, the tubing anchor being shown in the position assumed when free of a surrounding well casing;

Fig. 2 is a similar elevational view of the tubing anchor shown in its set position within a well casing, the casing being shown fragmentarily;

Fig. 3 is an enlarged transverse sectional view through 3—3 of Fig. 2;

Fig. 4 is an enlarged fragmentary sectional view in a plane parallel with Fig. 2, showing the tubing anchor in its set position;

Fig. 5 is an enlarged transverse sectional view through 5—5 of Fig. 2; and

Fig. 6 is an enlarged transverse sectional view through 6—6 of Fig. 2.

The tubing anchor is adapted to be joined to a tubing string T by means of a top coupling or adapter 1. The adapter is screw-threaded to an end of the tubing string, and screw-threaded into the adapter coupling is a tubular body 2 which may be equal in internal diameter to the tubing string T.

The lower portion of the tubular body 2 receives a cage 3 which includes an upper sleeve 4 and a lower sleeve 5 connected by bow springs 6 which frictionally engage the side walls of a surrounding casing. The lower axial end of the upper sleeve 4 is provided with an axially directed stop lug 7 bordered on one side by a slot 8 extending upwardly into the upper sleeve 4.

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Welded or otherwise permanently secured to the tubular body 2 is a vertically extending key boss 9. The lower axial end of the upper sleeve 4 is adapted to ride on the key boss 9 so that upon rotation of the tubular body 2, when the cage 3 is restrained within a casing, the key boss 9 may be moved between a position engaging the stop lug 7, as shown in Fig. 1, and a position in which the key boss 9 may enter the slot 8, as shown in Fig. 2.

Slidably mounted upon the tubular body 2, above the cage 3, is a slip collar 10 having an eccentric bore 11. At the minor radial side of the slip collar several slip inserts 12, having wicker teeth, are secured. The major radial side of the slip collar is provided with an inclined slip channel 13 of dovetail configuration.

The channel 13 slidably receives a correspondingly profiled traveling slip or wedge 14, the outer surface of which is preferably smooth and free of wicker teeth. The traveling slip 14 is provided with an upwardly directed stem 15 which extends axially upwardly into a side boss 16 formed at one side of the coupling or adapter 1. The stem 15 is secured to the side boss by a shear pin 17.

The lower portion of the coupling 1 is internally enlarged to form a skirt 18 surrounding the upper end of the tubular body 2. A compression coil spring 19 is contained within the skirt 18 and bears against the axially upper end of the slip collar 10.

The lower end of the tubular body 2 is joined by a conventional coupling or adapter 20 to an additional tubing string or to a well pump. In normal practice, the tubing anchor is placed in the tubing string close to the pump.

Operation of the tubing anchor is as follows:

The parts of the tubing anchor occupy the position shown in Fig. 1 when the tubing anchor is lowered into the well bore except that the bow springs 6 are compressed by the surrounding casing C. In this condition of the tubing anchor, the upper sleeve 4 of the cage 3 rests on the key boss 9 with the key boss adjacent the stop lug 7.

When the tubing anchor has been lowered to the required depth, the tubing string is rotated to the left, as viewed in Fig. 1, causing the key boss 9 to travel around the lower end of the upper sleeve 4 until the key boss registers with the slot 8. This relative movement is made possible by reason of the frictional engagement of the bow springs 6 with the surrounding well casing.

When the key boss 9 registers with the slot 8, the tubing string T may be pulled upward, causing the key boss to enter the slot 8, allowing the spring 19 to force the slip collar 10 away from the coupling 1 and set the traveling slip 14 against the surrounding casing. It should be noted that the frictional resistance of the bow springs 6 of the cage 3 against the surrounding casing is in excess of the force of the coil spring 19. In actual practice it is a comparatively simple manipulation to rotate the tubing string T in an amount in excess of that required to bring the key boss 9 into alignment with the slot 8 and then applying upward tension to effect movement of the key boss into the slot.

When an upward strain is taken on the tubing string T, the conventional weight indicator employed in such operations will indicate that the slip has set. The operator then places the tubing string under a predetermined tensional strain calculated to be in excess of the fluid load in the tubing string during the pumping stroke.

It should be pointed out that in the absence of a tubing anchor, the lower end of a long tubing string will stretch and retract as the weight of fluid is applied to the tubing string during the pumping stroke and relieved from the tubing string during the working stroke. It is to avoid this movement that a tubing anchor is employed.

Normally, to release the tubing anchor it is merely

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necessary to release the tension applied to the tubing string so as to allow the key boss 9 to move downwardly out of the slot 8.

As pointed out before, the friction of the bow springs 6 is sufficient to maintain the cage 3 in position within the casing until the coil spring 19 is compressed and the traveling slip 14 has moved to its retracted position, as shown in Fig. 1. The tubing string is then rotated to return the key boss 9 to the position shown in Fig. 1, so that the tubing string may be removed from the well.

If the normal manipulation fails to release the tubing anchor, the operator then places the tubing string under a predetermined tension in excess of that required for pumping operations so as to exert a shearing force on the shear pin 17 capable of shearing the pin. In compressing this, the tubing string is stretched sufficiently that upon release of the shear pin the tubing string snaps upwardly, causing the key boss 9 to act as a jar, striking the upper sleeve 4, which in turn strikes the slip collar 10, driving it upwardly with respect to the traveling slip 14 and thus releasing the tubing anchor.

It has been found that if the operator initially sets the tubing anchor with insufficient tension on the tubing string to prevent movement at the lower end, that upon initiating the pumping operation the fluid load applied to the tubing string will cause the lower end of the tubing string to move downward, but the tubing anchor will prevent return or upward movement so that only after a few strokes of the pump the lower end of the tubing string is firmly anchored at the desired point.

In order to facilitate removal of the shear pin 17 after the tubing anchor has been retrieved, a second hole 21 of somewhat larger diameter is provided in the side boss 16 so that that portion of the shear pin remaining in the stem 15 may be driven out.

It will be observed that the slip collar disposes the body of the tubing anchor eccentrically in the well casing, and that the bow springs 6 of the cage 3 are proportioned to permit such eccentric positioning of the body 2. Also, the slip collar is provided with opposed flat sides to permit flow of fluid past the collar when the tubing anchor is being raised or lowered in the well bore.

While a particular embodiment of this invention has been shown and described, it is not intended to limit the same to the exact details of the construction set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

I claim:

1. A tubing anchor, comprising: a tubular body adapted for connection with a tubing string; a cage slidable on said body having bow springs frictionally engageable with a surrounding casing; a slip secured to said body; a slip collar slidable on said body and having a slipway to receive said slip, said slip collar, on movement along said body, adapted to move said slip laterally to and from engagement with a surrounding casing; a spring member tending to urge said slip collar in a direction to set said slip against said casing; and latch means incorporated in said body and cage normally restraining said slip collar and operable on manipulation of said tubing string to release said spring member to set said slip.

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2. A tubing anchor as set forth in claim 1, wherein: a shear means is interposed between said slip and said body adapted, on application of predetermined tension on said tubing string, when said slip is set, to shear, thereby to release said slip.

3. A tubing string anchor, comprising: a tubular body; a coupling connecting said body to a tubing string; a slip secured to said coupling and depending alongside said body; a slip collar slidable on said body and having a slipway to receive said slip for lateral movement to and from setting engagement with a surrounding casing; a spring member interposed between said coupling and slip collar to urge said slip collar in a direction to set said slip against said casing; a cage slidable on said body having bow springs frictionally engageable with a surrounding casing; and latch means incorporated in said body and cage normally restraining said slip collar and operable on manipulation of said tubing string to release said spring member to set said slip.

4. A tubing anchor as set forth in claim 3, wherein: a shear means is interposed between said slip and said coupling adapted on application of predetermined tension on said tubing string, when said slip is set, to shear, thereby to release said slip.

5. A tubing anchor, comprising: a tubular body adapted for connection with a tubing string; a cage slidable on said body having bow springs frictionally engageable with a surrounding casing; a slip secured to said body; a slip collar having an eccentric bore to slidably receive said body, fixed slips at the minor radius side of said slip collar, a slipway at the major radius side thereof adapted to move said slip laterally to and from setting engagement with a surrounding casing; a spring member tending to urge said slip collar in a direction to set said slip against said casing; and latch means incorporated in said body and cage normally restraining said slip collar and operable on manipulation of said tubing string to release said spring member to set said slip.

6. A tubing string anchor, comprising: a tubular body; a coupling connecting said body to a tubing string; a slip secured to said coupling and depending alongside said body; a slip collar having an eccentric bore to slidably receive said body, fixed slips at the minor radius side of said slip collar, a slipway at the major radius side thereof adapted to move said slip laterally to and from setting engagement with a surrounding casing; a cage slidable on said body having bow springs frictionally engageable with a surrounding casing; a spring member tending to urge said slip collar in a direction to set said slip against said casing; and latch means incorporated in said body and cage normally restraining said slip collar and operable on manipulation of said tubing string to release said spring member to set said slip.

7. A tubing anchor as set forth in claim 6, wherein: a shear means is interposed between said slip and said coupling adapted on application of predetermined tension on said tubing string, when said slip is set, to shear, thereby to release said slip.

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