

March 7, 1933.

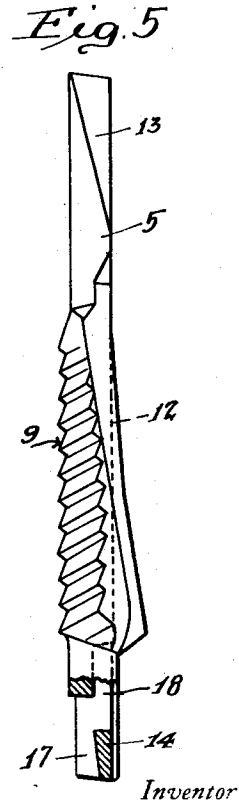
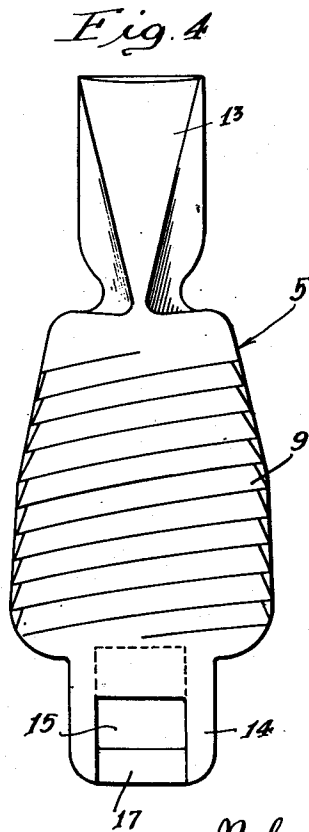
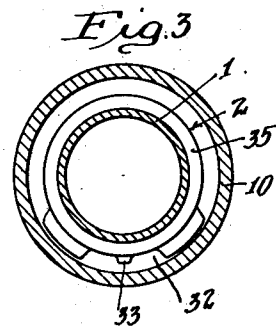
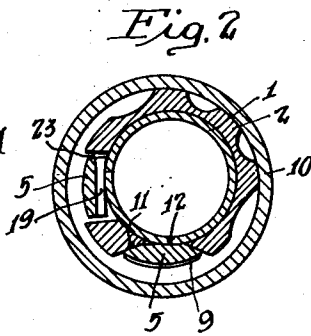
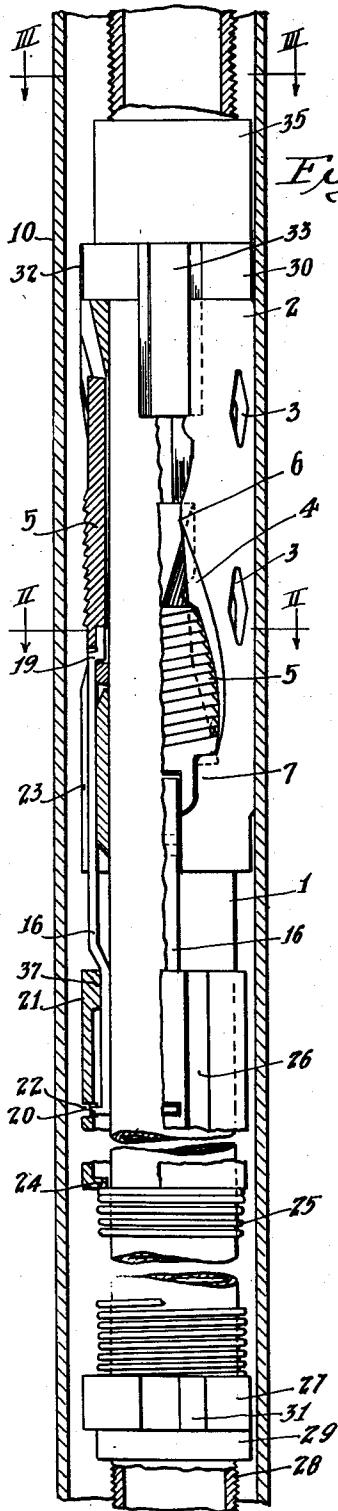
N. K. SMITH

1,900,371

TUBING CATCHER

Filed March 4, 1932

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

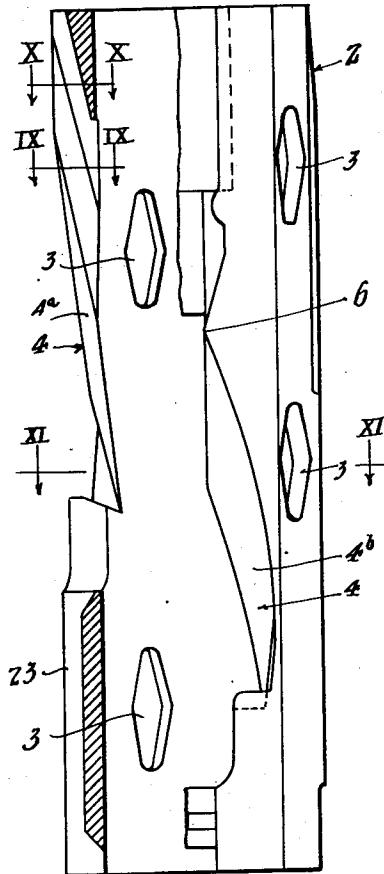
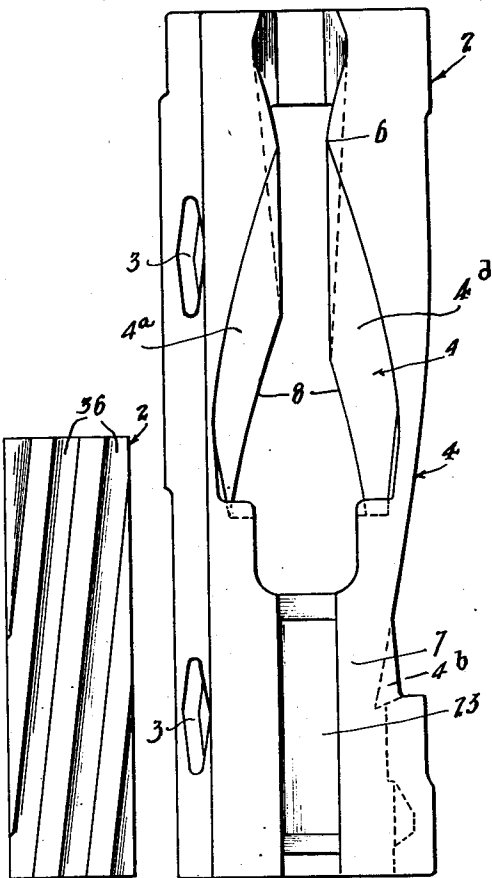
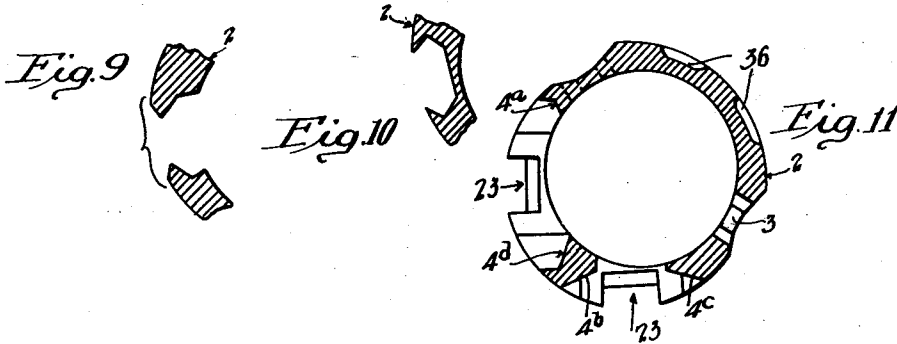


Fig. 6

Fig. 7

Fig. 8

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UNITED STATES PATENT OFFICE

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TUBING CATCHER

Application filed March 4, 1932. Serial No. 596,728.

This invention relates to tubing catchers involving casing-engaging slips, such as are employed in oil wells to prevent suspended oil tubing from dropping to the bottom of the well in the event the tubing should part, or break away from its supporting member. More particularly, the invention relates to a catcher to be employed in wells in which the clearance between the tubing and casing is so small that tubing catchers of the usual design must be made with very thin wall sections and very small slips in order to get the catcher inside the casing.

Oil wells are provided with casing throughout part or all of the length of the well. This casing is of various diameters according to the diameter of the well. In some instances the casing is of relatively small diameter, for example $4\frac{3}{4}$ inch casing. A well is "pumped" through a string of tubing of smaller diameter than the casing and which extends through the casing from the top of the well to a point below the oil level. To prevent the tubing from dropping to the bottom of the well in case of its accidental breakage or release during installation or removal, tubing catchers are inserted at various points in the string of tubing. The catching mechanism must be interposed between the outer wall of the tubing and the inner wall of the casing. This tubing is of various diameters, sometimes being nearly as large as the inside diameter of the casing. Examples of such tubing and casing are found in 2 inch or $2\frac{1}{2}$ inch tubing in $4\frac{3}{4}$ inch casing, in which case the space between the outer wall of the tubing and the inner wall of the casing is so small that if the usual type of catcher is employed it must be made with such thin wall sections that the catcher head is likely to "telescope" the slips when the weight of the tubing comes on the slips. Also the slips must be so small that the catcher cannot always be depended upon to withstand the great load which a catcher must withstand when called upon to do so.

The usual tubing catcher comprises a wedge shaped body or head carrying three or more wedge shaped slips partly sup-

ported on the head by a compression spring. If the tubing breaks and starts to drop, the energy in the partially compressed spring momentarily upholds the slips while permitting the tubing to drop slightly. The wedge faces on the head and slips coact to drive the slips outwardly against the casing, thus preventing the tubing from falling.

A problem in the design of tubing catchers is to provide slips with a large gripping area so that they will not distort the casing and will support a great load. The slips cannot be widened laterally because of the limitations imposed by the inside diameter of the casing and the necessity for leaving ample fluid passageway so that the catcher can be run in the hole rapidly without causing it to "set" prematurely. Neither can the length of the slips be increased because, in order to do so, the wedging angle of the slips must be decreased, thus causing the slips to grip so tightly that they can not be released after they have once been set. Neither can the thickness of the slips be increased because it is not permissible to encroach on the inside diameter of the tubing.

An object of the invention, therefore, is to provide a tubing catcher that is sufficiently strong to withstand the stresses to which it is subjected, that will not subject the casing to disruptive force or wedge so tightly it can not be released, and is at the same time capable of being run into casing only slightly larger than the tubing.

The above object is achieved by using an arrangement of the slips on one side only of the catcher head, the other side of the head resting against the inner wall of the casing. Thus a cross section taken through the well and catcher would show the catcher to be eccentrically positioned within the casing when the slips are set. The catcher head is of greatest thickness on the side which contains the slips, thus making the catcher head eccentric with respect to the tubing and providing adequate wall thickness for retaining the slips and preventing "telescoping."

While it is not essential, I prefer to stagger the slips in order to keep the slips as large in gripping area as possible and to

keep the catcher head as small as possible, as will be more fully explained hereafter.

In a co-pending application for patent filed in the names of Nelson K. Smith and Richard K. Hertel, Serial No. 531,718, filed April 2, 1931, there is disclosed a novel method of increasing the slip area. The present invention utilizes the improved slip construction as covered by the aforesaid co-pending application, although I may also use the conventional type of slip.

In the drawings:

Figure 1 is an elevation partly in section showing the entire catcher in position in a well casing;

Figure 2 is a section through the catcher taken on the line II—II of Figure 1, showing the slips;

Figure 3 is a section taken on line III—III of Figure 1, showing the eccentricity of the catcher with respect to the casing;

Figure 4 is a face view of one of the slips;

Figure 5 is an edge view of one of the slips;

Figure 6 is a rear view of the head of the catcher;

Figure 7 is a view of the catcher head showing a slip seat;

Figure 8 is a view of the catcher head, partly in section, taken at right angles to Figure 7;

Figure 9 is a detail sectional view in the plane IX—IX of Figure 8;

Figure 10 is a detail sectional view in the plane X—X of Figure 8; and

Figure 11 is a sectional view in the plane XI—XI of Figure 8.

Referring now to Figure 1, 1 designates a tubular nipple, threaded at each end. This nipple is of the same diameter as the tubing with which the catcher is to be used. A tubular head member 2 is secured to the upper portion of the nipple as by welding, suitable holes 3 being provided in the body for this purpose.

The head 2 is provided with one or more, but preferably two, longitudinal tapered grooves 4, each of the grooves having its surface tapering both inwardly and downwardly to form wedge seats 4_a, 4_b, 4_c, and 4_d for slips 5. The side walls of the grooves 4 overhang the grooves slightly at the upper and lower ends 6 and 7 to hold the slips from falling out (see Figure 7). Head 2 is provided on its rear face with fluid ways 36 specially disposed about the body to provide a large fluid area and also a large cross sectional area of metal in the head, for strength.

I prefer to form the slip seats 4_a, 4_b, 4_c and 4_d as described in the aforesaid co-pending application, Serial No. 531,718. Briefly, each groove has its surface tapering both inwardly and downwardly so that the lower ends 8 of the groove extend around

the outer surface of the nipple (Figure 7), however, the slip contacting faces 4_a, 4_b, 4_c and 4_d of the grooves 4 are not symmetrical with respect to each other because the groove 4 is slightly eccentric with respect to the longitudinal axis of the nipple 1. Stated in another way, each slip in the catcher shown in application Serial No. 531,718 reciprocates in a plane such that another plane passing through its center at a right angle to first plane (looking at the planes in vertical cross section) would pass through the center of the nipple, whereas in the present "eccentric" construction, a plane passing through the center of the slip at a right angle to the plane of reciprocation of the slip would pass to one side of the center of the nipple 1. The section XI—XI shown in Figure 11 is taken near the bottom of the top slip and near the top of the bottom slip, which also contributes to the difference in the size and shape of the faces 4_{ad} and 4_{bc}.

Each slip 5 (Figure 4) consists of a wedge shaped member of relatively hard material, having an arcuate outer face formed with teeth or wickers 9 cut horizontally or at a slight angle to the horizontal. I prefer to cut them at a slight angle as shown so that when the wickers engage the casing 10 they will dig into the casing with a slight spiral motion.

It will be observed that the inner face 11 of each of the slips 5 tapers outwardly and downwardly along substantially the same angle as do the outer surfaces of the slip seats 4 in the head 2 so that the slips 5 are relatively thin at their upper ends and relatively thick at their lower ends.

It will also be observed that a concave recess 12 (Figure 2) is formed within the rear surface of each slip 5 which permits the outer edges of the slip to extend around the nipple 1 so that when the slip is in its lowermost position relative to the slip seats 4, the slip partially surrounds the outer surface of the nipple. By reason of this construction, a relatively great length is permitted the slip 5 without reducing the taper of the wedge below the limit which has been found most desirable for the wedging action of the slips. It follows, of course, that the longer the slip is, the greater is the effective gripping area provided thereon and the greater the area of the casing that is engaged for the purpose of supporting the tubing below the catcher.

Referring particularly to Figures 4 and 5, it will be observed that each of the slips 5 is provided with a dovetail extension 13 at its upper end adapted to slide underneath the overhanging projections 6 at the upper ends of the slip seats 4. The lower end of each slip 5 is provided with a projection 14 having an opening 15 for the purpose of receiving therein a rein 16. The projection

14 is grooved on its outer face at 17 and on its inner face at 18 to receive the end of the rein 16.

The reins 16 serve to push the slips upwardly relative to the head 2 when the slips are to be set against the casing 10. Each rein consists of a strap or bar bent at each end to form hook-like members 19 and 20. Hook 19 engages slip 5, and hook 20 engages an actuator 21 through an opening 22. In this manner the rein is effectively engaged with the slip 5 but may readily be detached therefrom by swinging the upper end of the slip outwardly.

It will be observed that head 2 is provided with a pair of grooves 23 adapted to slidably receive reins 16 and protect them from injury, and also serving to prevent the actuator 21 from rotating with respect to head 2.

The actuator 21 is a tubular sleeve loosely and slidably mounted on nipple 1 below head 2. The lower end of the actuator is formed with an inwardly projecting radial flange 24 eccentric to the opening through the actuator. The actuator is provided with a series of longitudinal fluid ways one of which is shown at 26.

An actuator spring 25 surrounds nipple 1 and supports the actuator 21 by flange 24. Spring 25 is normally in compression and supports all or a part of the weight of the actuator, reins and slips.

A threaded eccentric collar 27 is screwed on the threads 28 on the lower end of nipple 1 and serves to support the actuator spring. The collar is provided with longitudinal fluid ways 31.

A threaded lock collar 29 is screwed on the lower end of nipple 1 below collar 27 and is jammed tightly against it to keep it from backing off.

Inwardly projecting bosses 37 are provided on the inner surface of the actuator sleeve 21, these bosses 37 being juxtaposed to the reins 16 and preventing the upper ends of the reins and the slips 5, attached thereto, from moving out away from the slip seats.

A loosely fitting eccentric collar 30 surrounds the upper portion of nipple 1 just above and supported by head 2, serving to keep the slips 5 from being pushed too far up on head 2. Collar 30 is provided with longitudinal fluid ways 32. I prefer to make collar 30 with a longitudinal depending finger 33 just long enough to contact the upper extension 13 on lower slip 5 when said slip is at the top of its upper or "set" position. The finger 33 thus serves as a stop to prevent both slips 5 from being pushed too far out of their seats 4. The finger 33 also serves to lock the collar 30 against rotation with respect to head 2 since

the head 2 is provided with a groove 34 to receive said finger.

A threaded locking collar 35 is screwed down tightly against collar 30 to hold the latter in place. Particular attention is called to the eccentricity of the head 2 with respect to nipple 1. By virtue of this construction that portion of the head which contains the slips can be made sufficiently thick and strong to carry the load imposed upon it, and likewise the slips can be made large and strong.

Attention is also called to the staggered arrangement of the two slips 5 whereby the slips may be made wide and yet the head kept compact in length. I find that this construction is most desirable, as either of the alternative constructions embodies certain disadvantages. For example, if the slips were positioned side by side they would extend past the diameter of head 2 and would reduce the eccentricity of the catcher with a consequent reduction in strength. If the slips were placed in vertical alignment "tandem" fashion, the construction would be complex, expensive and likely to fail in service.

The assembly of my device is as follows:

Head 2 is secured on nipple 1 by welding, as hereinbefore stated, these welds being made around the margin of the apertures 3. The reins 16 are then attached to the actuator 21 and the actuator is slid over the nipple 1. The slips 5 are next hooked on the free ends of reins 16 and are pulled down into place in their seats 4. Eccentric stop collar 30 is then dropped into place and locked by means of lock collar 35. Next the spring 25 is slipped over the lower end of nipple 1 and is secured in place by screwing on collar 27 and lock collar 29. The catcher is then placed in a string of tubing by attaching the ends thereof to the adjacent ends of the tubing sections by means of the usual pipe couplings, not shown.

The device operates as follows: Assuming that the string of tubing should break above the catcher while the tubing is being lowered into the well, or after it has been suspended in place, so that the tubing starts to fall freely in the casing, the tubing and head 2 of the catcher will fall at substantially gravity acceleration whereas the actuator 21, due to the upward force exerted thereon by the partly compressed spring 25, will be accelerated downward at a lesser rate and will move upwardly relative to head 2, pushing the reins 16 and slips 5 upwardly. The upward movement of the tapered slips 5 along the tapered seats 4 will force the slips outwardly, into engagement with the walls of casing 10. Of course, as soon as the wickers on the slips touch the casing they are frictionally engaged by it and continue to slide upward on their seats until

they are firmly wedged into engagement with the casing.

To release the catcher, the tubing to which it is attached is given a slight upward pull, thereby moving the head 2 upward relative to the casing and sliding the slips downward along their tapered guides in the head until they disengage the casing.

While I have shown the head 2 and nipple 1 formed of separate pieces welded together, it will be obvious that they might be fastened together by any other suitable means, such as threading, riveting, etc., or they might be made in a single piece.

The foregoing description is to be taken as illustrative only. The invention is of the scope defined by the following claims. It is to be noted, particularly, that although I have described a catcher having two slips, any number may be employed; in some instances, it may be desirable to employ only one slip, and in other instances, three or even more. The invention resides broadly in the eccentricity of the catcher head to provide a thick, strong wall on one side in which one or more slips can be mounted.

I claim:

1. In a tubing catcher, a body with a head having a slip-receiving groove therein, the upper end of said groove being provided with side walls which partly overhang said groove, a slip slidable in said groove, said slip having an upwardly extending projection adapted to make a dove-tail sliding fit in said overhanging portions of said walls, the lower end of said slip being provided with an opening, a rein engaging said opening at one end, an actuator collar mounted on the other ends of said rein, the actuator collar being provided with an opening to receive the end of the rein at a point substantially below the top of said actuator collar and being provided at the top thereof with an inwardly extending boss adjacent said rein adapted to hold the rein close to the body of the catcher.

2. In a tubing catcher, a head adapted for connection to a string of tubing and having a bore therethrough in concentric alignment with the bore of the tubing, the wall of the head being thicker on one side than on the opposite side, a slip in the thicker wall of said head, and means for actuating said slip.

3. In a tubing catcher, a head adapted for connection to a string of tubing and having a bore therethrough in concentric alignment with the bore of the tubing, the wall of the head being thicker on one side than on the opposite side, a tapered seat in the thicker wall of said head, a slip in said seat, and means for actuating said slip.

4. In a tubing catcher, a head adapted for connection to a string of tubing and having a bore therethrough in concentric alignment with the bore of the tubing, the wall of the

head being thicker on one side than on the opposite side, a plurality of slip-holding recesses in the thicker wall of said head, slips slidably mounted in said recesses, and means for actuating said slips.

5. In a tubing catcher, a head adapted for connection to a string of tubing and having a bore therethrough in concentric alignment with the bore of the tubing, the wall of the head being thicker on one side than on the opposite side, a plurality of vertically staggered slip-holding recesses formed in the thicker wall of said head, slips slidably mounted in said recesses, and means for actuating said slips.

Signed at Los Angeles, California, this 24th day of February, 1932.

NELSON K. SMITH.