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E. F. AXELSEN

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CABLE RETRIEVING APPARATUS

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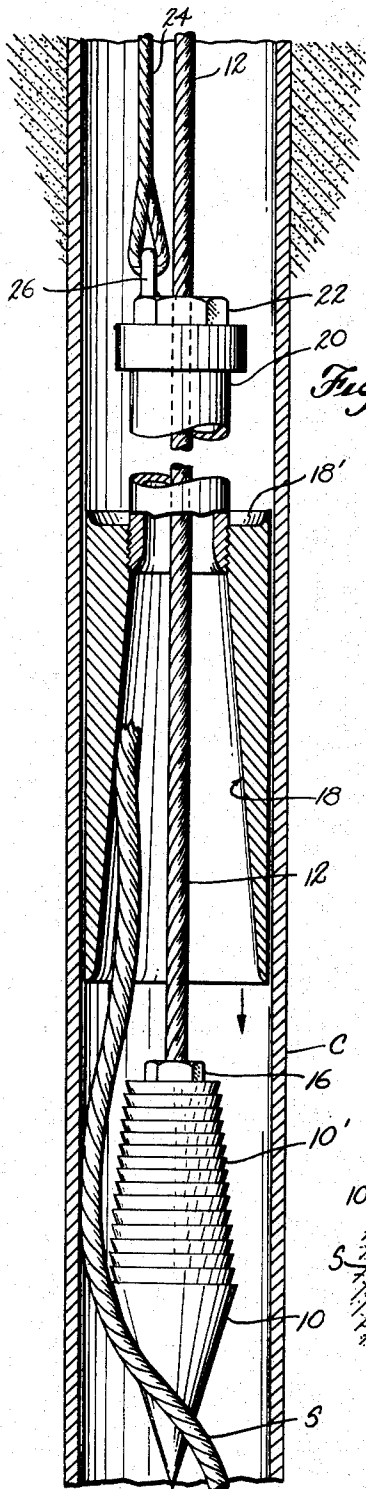


Fig. 1.

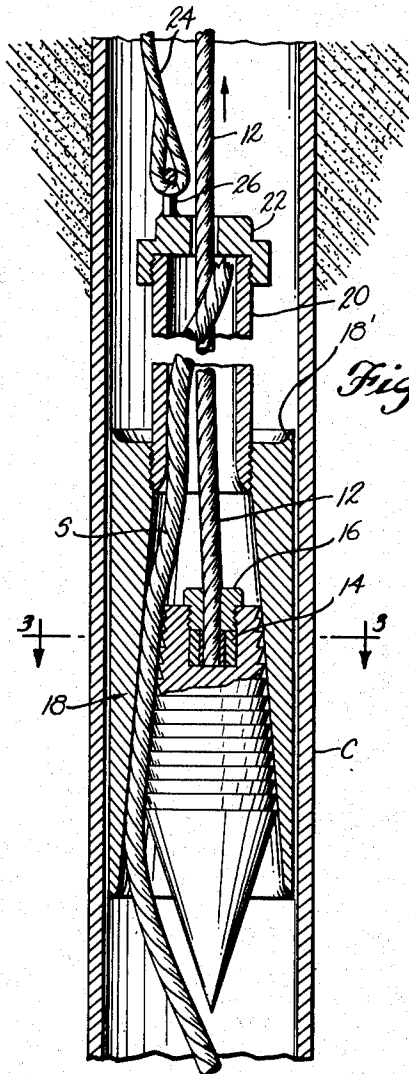


Fig. 2.

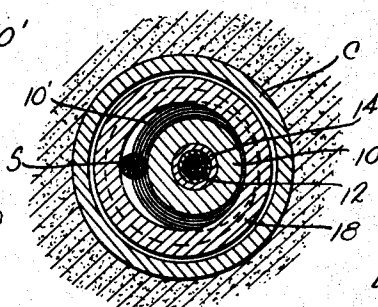


Fig. 3.

INVENTOR.
ERNEST F. AXELSEN

BY *Reynolds, Beach & Christensen*

ATTORNEYS

UNITED STATES PATENT OFFICE

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CABLE RETRIEVING APPARATUS

Ernest F. Axelsen, Seattle, Wash.

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8 Claims. (Cl. 294-102)

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This invention relates to the retrieving of cables from inaccessible locations, and more particularly concerns an improved method and apparatus for retrieving broken or dropped cables standing in well casings and the like.

A common mishap in the drilling of water and oil wells, for example, is the breaking of a drilling cable far down inside the casing. Moreover, it is not uncommon to have to abandon a partially complete well because the broken cable and the drilling apparatus connected thereto cannot be recovered. In such cases the financial losses may be great, especially if the well bore has been carried to a considerable depth. To my knowledge no satisfactory apparatus or method has been proposed heretofore to cope with this situation by enabling the operator to fish the broken cable section out of the casing.

The present invention is directed to a practical solution to the foregoing problem, and its general object is the provision of reliable and easily operated cable retrieving apparatus for fishing out broken cable sections from well casings and the like.

A more specific object is cable retrieving apparatus of a portable, compact, lightweight nature, which may be carried about conveniently by the drill operator from job to job, may be set up ready for use at a moment's notice, and may be operated to complete a retrieving operation in a relatively short time.

Still another object of the present invention is apparatus of the type indicated which may be used to retrieve cables lying at great depths with substantially the same ease and convenience and in the same manner as those at relatively shallow depths. In that connection, the cable gripping elements of the apparatus are so devised that they may be lowered into the well casing by means of retrieving apparatus cables until at the correct depth to obtain a hold on the broken cable end, whereby such gripping elements may then be manipulated or operated by means of the same retrieving apparatus cables to grip the broken cable and raise it out of the well casing. Thus the attainable operating depth of the apparatus is merely a matter of the length of retrieving apparatus cable which may be payed out into the well casing. No rigid supporting members are needed to lower and operate the retrieving apparatus.

With the foregoing in view, the invention features a wedging member of a materially smaller cross section than the well casing interior, to

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permit lowering of such member into the casing past the upper end of a broken cable section standing therein. A receiving bell having a downwardly open interior terminates in a lower rim extending around the inside of the casing with a slight clearance therebetween, to permit lowering of such bell down into the casing past the upper end of the broken cable section until such upper end is received in the bell. The wedging member, suspended from a retrieving cable, is then raised into the bell, to engage the broken cable therebetween. The interior of the bell is tapered upwardly, so that a further lifting force applied to the wedging member by the retrieving cable causes the wedging member to wedge upwardly into the bell and hence outwardly against the broken cable held therebetween. Thus as the retrieving cable is raised to exert increasing tension in the broken cable section gripped by the bell and wedging member, the frictional holding force exerted thereon correspondingly increases.

Preferably the inner or wedging member has an upper cable engaging portion which tapers upwardly at substantially the same angle as the bell interior, thereby to grip the cable uniformly therebetween over an appreciable portion of its length. At least one such wedging surface is provided with serrations which bite into the cable and oppose withdrawal thereof from the gripping elements.

The foregoing and other features, objects, and advantages of the invention will become more fully evident from the following detailed description thereof by reference to the accompanying drawings illustrating the preferred form of the apparatus for use in the retrieving of broken drilling cables lying in well casings.

Figure 1 is a sectional side elevation of the cable retrieving apparatus lowered into a well casing preparatory to gripping the broken cable section.

Figure 2 is a similar view illustrating the relationship of the gripping elements at the succeeding stage of operation in which the cable is actually gripped therebetween.

Figure 3 is a transverse sectional view taken on line 3-3 of Figure 2.

As illustrated in Figure 1, a broken drilling cable section S will not collapse limply in the base of the well casing C, but because of its stiffness and the lateral support afforded by the casing will stand more or less erectly therein, assuming a slow spiral up the interior of the casing, due to the inherent tendency of the cable

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to coil up. The upper or free end of the cable will then usually project upwardly either immediately alongside the well casing or at an angle thereto. Depending upon the location of the break, such upper end may lie several feet below the top of the ground or many hundreds of feet below.

The first step in retrieving such a broken cable section in accordance with the present invention is the lowering of a wedging member 10 down into the well casing C to a location somewhat below the upper end of the broken cable section, as shown in Figure 1. The wedging member 10 somewhat resembles a plumb bob, having a pointed lower end for guiding it downward through the open spaces around the collapsed cable. The wedging member is suspended from a retrieving cable 12. As shown in Figure 2, a sleeve 14 is brazed or welded on the lower end of the retrieving cable 12, and is received in a socket in the upper end of the wedging member 10. The socket interior is threaded, and a threaded cap 16, apertured to pass the retrieving cable, is threaded down into the socket to hold the sleeve 14 therein, and thereby complete a strong connection between the retrieving cable and the wedging member 10.

The second step in the operation of retrieving the cable S is the lowering of a bell 18 down into the well casing to a location just above the lowered wedging member 10. The depth to which the bell 18 is lowered is not critical, the object merely being to receive an appreciable portion of the upper end of the broken cable section S inside the interior of the bell, as shown in Figure 2. In Figure 1, as shown by the arrow, the bell is in the process of being lowered to receive the broken cable section therein. Whereas the wedging member piloting the operation is of a materially smaller cross section than the interior of the well casing, so that it may be lowered freely into the space below the upper end of the broken cable without crushing the latter or turning its upper end downward. The diameter of the lower rim of the bell 18 is just slightly smaller than the interior of the well casing, so that the upper end of the broken cable will not escape past the outer edge of such rim, but will be directed thereby to pass into the interior of the bell, as shown.

The interior of the bell 18 is tapered upwardly to form a conical wedging surface, preferably of about 5 degrees slope. Preferably the upper portion of the wedging member 10 is likewise tapered at about the same angle, complementally to the interior of the bell. Thus after lowering of the bell to receive the upper end of the broken cable section, the next step of raising the wedging member 10 into the interior of the bell, as shown in Figure 2, causes a wedging action in which the cable is gripped between the two tapered surfaces, that in the bell and that on the wedging member. As the retrieving cable 12 is raised further, the wedging force between the two gripping elements increases because of friction thereof against the gripped cable. Thus the frictional grip on the broken cable section established by the two wedging members increases with tension in the retrieving cable 12. Annular grooves or serrations 10' on the tapered portion of the wedging member 10, being directed upwardly, improve its grip on the cable to prevent the latter's withdrawal from between the gripping elements, while in no way interfering with establishment of their hold on the cable initially.

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In the illustrated case the broken drilling cable S may, for instance, be a $\frac{5}{8}$ -inch cable, whereas the well casing C is a 6-inch casing. Because the size of drilling cable, or other cable, used in a 6-inch casing may vary considerably, it is desirable to be able to provide retrieving apparatus which will accommodate cables varying in size. This is permitted by the illustrated apparatus, as the effective average diameter of the tapered cable-engaging upper portion of the wedging member 10 is sufficiently smaller than the maximum or rim diameter of the bell 18 that the wedging member may enter the bell alongside the largest cable to be received therein, whereas the upper end of the wedging member 10 will not strike the upper throated portion of the bell, even with the smallest diameter cable received in the bell alongside the wedging member. Of course, a range of sizes of retrieving bells and wedging members may be provided for operations in well casings of different sizes, as needed.

The upper end of the bell 18 has a central opening or throat which continues upwardly into a tubular extension 20 threaded into the bell as shown. An apertured cap 22 is threaded on the upper end of the extension 20, and freely passes the retrieving cable 12 through its aperture, as shown in Figure 2. A light cable 24 connected to a hook or eye 26 on the cap 22 permits raising and lowering the bell 18 independently of the wedging member 10. The only function of the cable 24 is to lower the bell into its correct initial position relative to the upper end of the broken cable section S, so that the latter may be gripped in the bell by raising the wedging member 10. After the broken cable section is gripped as in Figure 2, the entire raising operation is performed by reeling in the retrieving cable 12, which carries all of the load. The cable 24 is reeled in simultaneously merely to take up the slack therein. Obviously any attempt to reel in the cable 24 faster than the retrieving cable 12 would result in upward movement of the bell 18 relative to the wedging member 10, hence release of the broken cable section gripped between these members. As the retrieving cable 12 carries the load during actual raising operations, it is, of course, desirable to employ a retrieving cable which is at least as strong as the broken drilling cable S which is to be retrieved.

The cap 22 on the upper end of the tubular extension 20 serves the additional purpose of preventing the upper end of the broken cable section S from working out through the top of the bell when the latter is being lowered over it. If it were permitted to do so it might droop downward and become caught between the bell 18 and the casing, and thereby foul the apparatus. A lip 18' around the upper periphery of the bell 18 is intended to prevent any objects from becoming caught between the bell and the well casing as the bell is being raised.

It will be seen, therefore, that the entire retrieving operation may be carried out quickly in a few simple steps, commencing with the initial lowering of the wedging member 10 to the location of the broken cable section standing in the well casing. If desired, the correct depth to which such wedging member should be lowered may determined in advance by a sounding operation consisting of the lowering of a plumb bob or other object and measuring off the length of line from which the bob is suspended when it initially strikes the broken cable section. Such measured length of sounding line would then rep-

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resent the length of retrieving cable to be reeled off in lowering the wedging member 10 to its correct initial position in the casing. This initial sounding operation may be particularly desirable where the broken cable section lies at a great depth below ground level, and it becomes correspondingly difficult, because of the mass of retrieving cable payed out, to sense the point at which the wedging member begins to contact and rub along the broken cable section standing in the casing.

Because of the annular form of the bell 18 with its flared or scooplike lower end, the step of directing the upper end of the broken cable S into the interior of the bell on the first try is practically a certainty. Likewise the succeeding step of raising the wedging member 10 into the interior of the bell without ejecting the cable from the bell is also a simple matter. When the cable is gripped between the bell and wedging member it is more easily broken anew than released from between these elements, so firm is the hold caused by the wedging action. Moreover gripping pressure on the cable is evenly distributed over an appreciable portion of its length, that is between the tapered or conical wedging surfaces of the coaxing retrieving elements, so that the gripped cable is not weakened by localized biting action and concentrated stress.

If a steady upward pull on the retrieving cable 12 does not free the drilling cable S so that it may be raised in the casing without again being broken, the operator will usually be successful in freeing it if he intermittently relaxes and restores tension in the retrieving cable to work the broken cable or drilling apparatus carried by it free of any obstruction in the casing. If for any reason it becomes desirable to release the cable S during a retrieving operation this may be readily accomplished simply by slacking off tension in retrieving cable 12 and applying lifting force to cable 24.

I claim as my invention:

1. Cable retrieving apparatus for use in well casings and the like, comprising a wedging pilot member of a materially smaller cross section than the well casing interior less the cable thickness, to allow clearance for lowering of such member into the casing past the upper end of a broken cable section standing therein, a receiving bell having a downwardly open interior terminating in a lower rim portion extending around the casing interior with a slight clearance therebetween, means to lower such bell into the casing and past such upper end of the broken cable section to direct the same into said bell, means to lower said wedging member down into the casing in advance of said receiving bell and to raise said wedging member into said bell and against the cable received therein, thereby to grip the cable between said wedging member and bell, and wedging means automatically increasing the gripping pressure of such member and bell on the cable in response to increased lifting force applied by said raising means to said wedging member alone after the latter has been raised initially into said bell to grip the cable.

2. Cable retrieving apparatus for use in well casings and the like, comprising a wedging pilot member of a materially smaller cross section than the well casing interior less the cable thickness, to allow clearance for lowering of such member into the casing past the upper end of a broken cable section standing therein, a receiving bell having a downwardly open interior terminating

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in a lower rim portion extending around the casing interior with a slight clearance therebetween, means to lower such bell into the casing and past such upper end of the broken cable section to direct the same into said bell, and means to lower said wedging member down into the casing in advance of said receiving bell and to raise said wedging member into said bell and against the cable received therein, thereby to grip the cable between said wedging member and bell, the interior of said bell being tapered upwardly therein to constitute a wedging surface against which the cable is pressed by said wedging member subjected to increased lifting force by said raising means, thereby to increase the gripping pressure on said cable by wedging action accompanying such increase of lifting force.

3. Cable retrieving apparatus defined in claim 2, wherein the wedging member has an upper cable engaging portion which tapers upwardly at substantially the same angle as the bell interior to grip the cable wedgingly therebetween over an appreciable portion of its length.

4. Cable retrieving apparatus defined in claim 3 wherein at least one of the tapered wedging surfaces is serrated, the serrations being formed to bite into the cable and oppose withdrawal thereof from between such wedging surfaces while offering minimum resistance to wedging action thereof against the cable.

5. Cable retrieving apparatus defined in claim 3, wherein the wedging member has a downwardly tapered lower portion guiding such member to penetrate through the coiled upper portion of the broken cable standing in the casing when such member is lowered therein.

6. Cable retrieving apparatus for use in well casings and the like, comprising a retrieving cable, a wedging pilot member carried by such retrieving cable for raising and lowering thereof in the casing and being of a materially smaller cross section than the well casing interior less the cable thickness, to allow clearance for lowering of such member into the casing past the upper end of a broken cable section standing therein, an annular receiving member apertured to pass said retrieving cable for lowering of said wedging member thereby into the casing in advance of said receiving member, and a separate cable for raising and lowering of said annular member in the casing, said annular member having a lower rim extending around the casing interior with a slight clearance therebetween to permit lowering thereof freely into the casing and past such upper end of the broken cable section to direct the same into the interior of said annular member, whereby raising of said wedging member into said annular member by said retrieving cable effects gripping of the broken cable therebetween, the annular interior of said annular member being tapered upwardly therein to constitute a wedging surface against which the broken cable is pressed by said wedging member subjected to increased lifting force by said retrieving cable, thereby to increase the gripping pressure on said broken cable by wedging action accompanying such increase of lifting force.

7. Cable retrieving apparatus defined in claim 6, wherein the interior of the annular member tapers upwardly therein to a restricted throat and has a tubular upward extension thereon to receive the free end of the broken cable guided into the interior of such annular member and through such throat, the upper end of said extension being blocked off to prevent escape of

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the upper end of the broken cable and fouling the retrieving apparatus.

8. Apparatus for retrieving a broken cable standing in a well casing or the like, comprising a pilot member formed to be lowered into the casing past the upper end of the broken cable standing therein, a retrieving cable to raise and lower said pilot member in the casing, and broken-cable encircling means loosely slidable in the casing and provided with an opening to pass and be guided by the retrieving cable slidably, thereby permitting said encircling means to slide by gravity down into the casing along the re-

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trieving cable, said encircling means having an open lower end portion adapted to slip down over the upper end of the broken cable and encircle such broken cable together with the pilot member in lowered position thereof, said pilot member being formed to lodge in said opening and apply gripping pressure to the broken cable against a side of said opening automatically by exertion of lifting force on said pilot member by said retrieving cable.

ERNEST F. AXELSEN.

No references cited.