

April 9, 1968

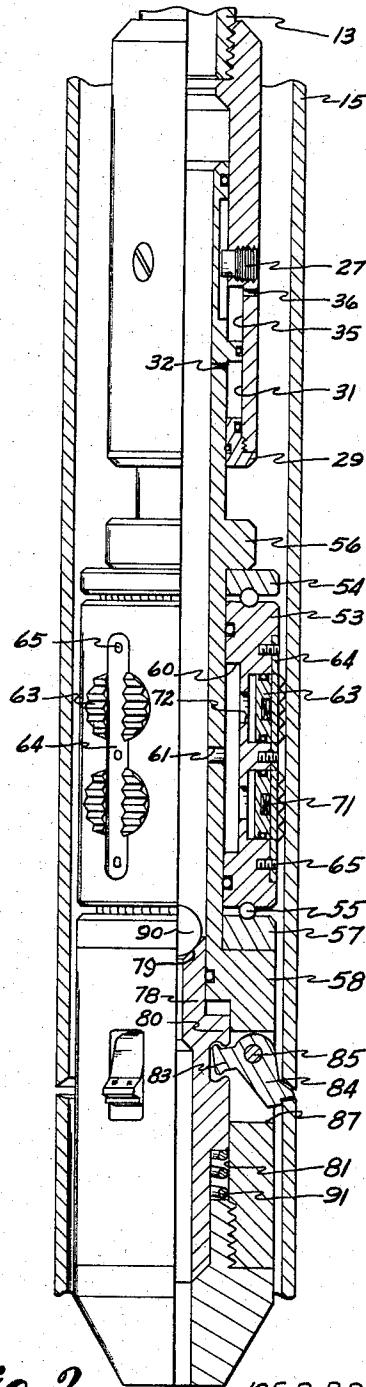
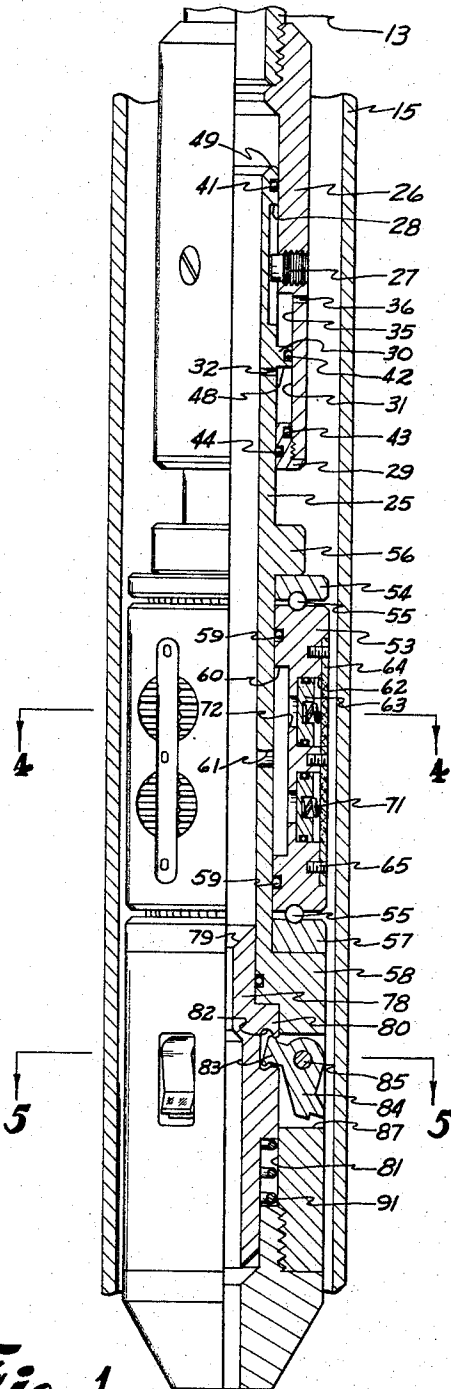
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3,376,927

PIPE CUTTING APPARATUS AND METHODS

Filed Nov. 29, 1965

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

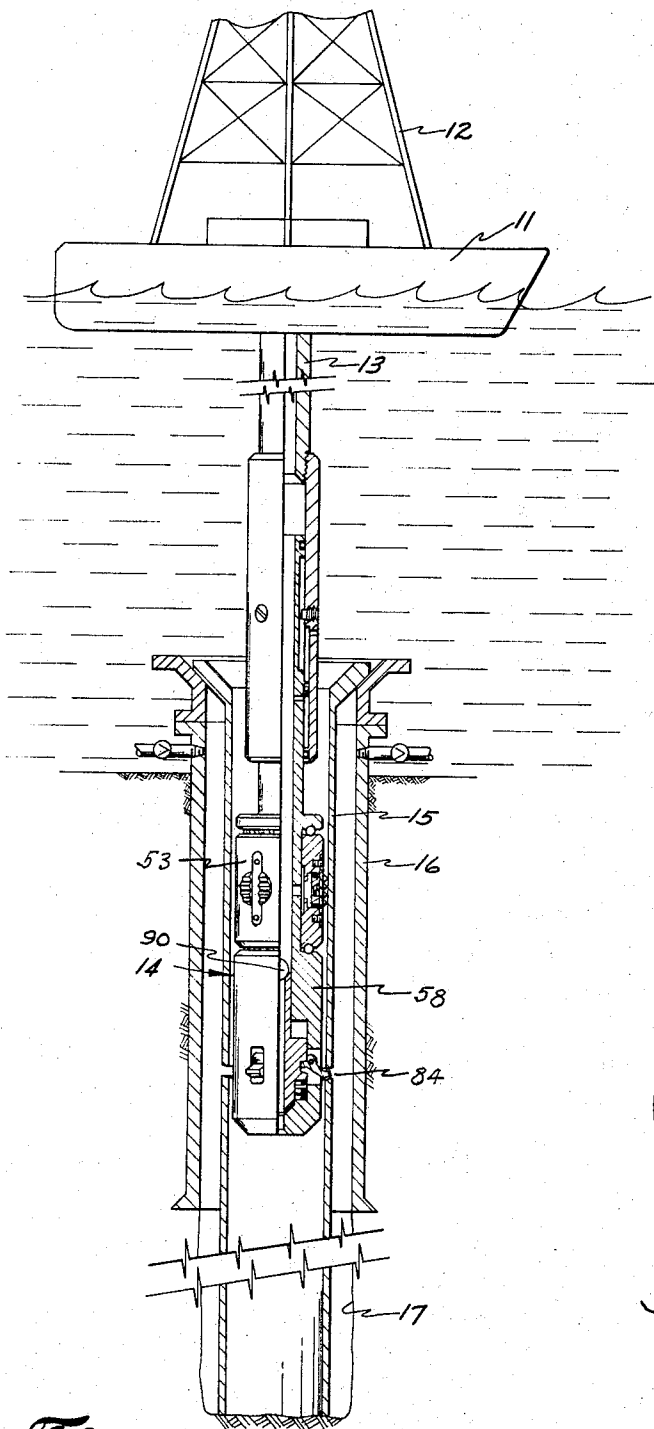


Fig. 3

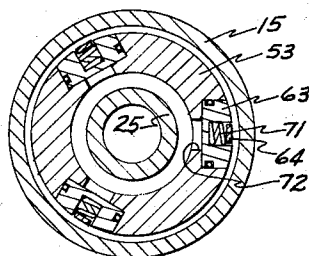


Fig. 4

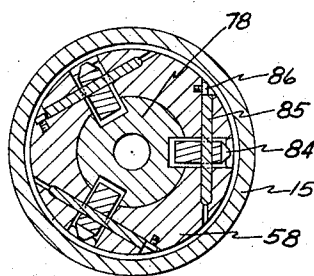


Fig. 5

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PIPE CUTTING APPARATUS AND METHODS

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ABSTRACT OF THE DISCLOSURE

An apparatus and method for cutting or severing a string of submerged pipe from a floating platform employing means for fixing the location of the cut irrespective of the movements of the platform.

This invention relates to pipe cutting apparatus and methods. More particularly, this invention relates to apparatus and methods for cutting a submerged pipe from a floating platform such as a drilling barge or the like.

Often times during the process of recovering pipe, such as casing, from a submerged well, it becomes necessary to cut the casing. If the cutting operation is conducted from a floating platform movement imparted by the action of waves against the floating platform renders the operation difficult.

More specifically, in carrying out a cutting operation from a land based platform, it has been standard practice to suspend a cutter from a string of pipe which is positioned inside the casing. The string is, of course, provided with enough joints to place the cutter adjacent the position at which the cut is to be made. It has been standard practice to suspend the string in such a manner that it may be rotated from the surface, as for instance, by a rotary table or the like. As the pipe is rotated, cutting means are driven against the pipe, and the pipe string is rotated until the cutting means sever the casing.

For land based wells this system of cutting has long been successful, but it has not been successful for offshore operations. This lack of success is occasioned by the wave action on the drilling barge or platform which causes the cutters to move vertically within the casing which cuts spirals on the inside of the casing. Obviously, cutting cannot be effectively accomplished when the cutting means are moving in a spiral pattern.

It is therefore, an object of this invention to provide an improved method and apparatus that may be used from a floating platform in making an inside cut.

Another object is to provide means for compensating for the wave action that causes the platform to rise and fall to prevent spiral cutting of a casing or pipe.

Summary

Briefly stated, the apparatus of this invention which is adapted to be operated from a floating platform includes rotatable cutting means adapted to be positioned inside of the pipe to be served. It also includes support means for suspending the cutting means below the platform and in the pipe. Means are provided for selectively axially fixing the cutting means relative to the pipe. In addition, means are provided for permitting relative movement between the cutting means and the support means when the cutting means is axially fixed whereby compensation is made for the movement of the platform. Finally, means are provided for selectively extending the cutting means into engagement with the pipe and rotating the cutting means relative thereto to permit the pipe to be severed from the inside.

The method in accordance with this invention contemplates the steps employed in operating an apparatus of the kind described for cutting submerged pipe from a floating platform, the steps comprising positioning the cut-

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ting tool at a selected point in the pipe; axially fixing the cutting tool at the selected location; and severing the pipe by rotation of the cutting tool.

It is to be understood that the term "axially fixing," as applied to the cutting means, indicates that the cutting means are held from relative axial movement but not from rotational movement.

More specifically, one embodiment of the invention includes a generally tubular member connected to the lower end of a support pipe by means of a telescoping joint. Radially extendable and rotatable cutting means are connected to this tubular member. Means are provided for selectively extending the cutting means into engagement with the pipe to be cut and for rotating the cutting means relative to the pipe. Anchor means are connected to the tubular member for securing the cutting means from axial movement with respect to the pipe to be cut upon actuation of the cutting means so that the cutting means may be rotated in a fixed axial position.

Briefly stated, the method of this invention provides a method for cutting a pipe at a remote position located below a floating platform and includes the steps of suspending a rotatable pipe cutter from the floating platform and into the pipe to be cut. The pipe cutter is then supported in the pipe at a fixed axial position. The pipe cutter is rotated while being held in the fixed axial position to thereby cut the pipe. Hence, the cut is accomplished at one location inside the pipe without the spiralling action that has heretofore been present when utilizing prior art methods.

Reference to the drawings will further explain the invention wherein like numerals refer to like parts and in which:

FIG. 1 is a side elevation view partially in central vertical section showing the tool of this invention supported in a pipe or casing.

FIG. 2 is a view similar to FIG. 1 showing the tool in the fixed axial cutting position.

FIG. 3 is a side elevation view partially schematic and partially in central vertical section illustrating one manner in which the tool of this invention may be suspended from a floating platform.

FIG. 4 is a cross-sectional view taken at line 4—4 of FIG. 1.

FIG. 5 is a cross-sectional view taken at line 5—5 of FIG. 1.

Referring now to FIG. 3, a floating platform such as drilling barge 11 carries a derrick 12 from which is suspended support means such as drill string 13. Drill string 13 is adapted to be raised, lowered and rotated by conventional means (not shown) mounted on drill barge 11. The tool of this invention, which is generally indicated by numeral 14, is connected to the lower end of string 13 and positioned inside of casing 15 which is to be cut. In certain instances, casing 15 may be supported inside another large pipe such as casing protector pipe 16 which extends only to a minimum depth to prevent incursion of silt and the like into the bore hole 17.

The tool, as illustrated in better detail in FIGS. 1 and 2, is provided with a generally tubular member in the form of mandrel 25, the upper end of which is telescopically received in tubular spline housing 26 to which string 13 is threadably attached.

Spline housing 26 threadably carries a plurality of plug shaped splines 27 which project inwardly, to be received in longitudinal slots 28 provided about the upper end of mandrel 25. The telescopic movement of mandrel 25 relative to spline housing 26 is thus limited by the length of slots 28, the ends of which are adapted to contact splines 27 for restricting longitudinal movement beyond the desired limits.

The lower end of spline housing 26 is provided with an

enlarged axial bore into which is threaded end ring 29. The upper portion of mandrel 25 is provided with an external annular flange 30 which, together with mandrel 25, spline housing 26 and end ring 29 form pressure equalization chamber 31 which communicates with the axial bore of mandrel 25 through a plurality of pressure ports 32.

A second chamber 35 is formed above flange 30. Chamber 35 communicates to the outside of the tool through venting ports 36 which extend through the wall of spline housing 26.

Appropriate sealing means in the form of O-ring seals 41, 42, 43 and 44 provide fluid-tight seals between mandrel 25 and spline housing 26.

When pressurized fluid is applied downwardly through string 13, it passes into the axial bore of mandrel 25 and through ports 32 to chamber 31 where it exerts an upward force on shoulder 48 of flange 30. The area of shoulder 48 is selected to permit balancing of the force applied against the shoulder 49 of mandrel 25. Thus, the fluid pressure directed downward on mandrel 25 at shoulder 49 is equal to upward force applied to shoulder 48. Thus, the tool is not extended by application of pressurized fluid down through the tool.

When relative movement is caused between mandrel 25 and spline housing 26 by wave action, any fluid contained in upper chamber 35 is exhausted through ports 36.

The tool is also provided with anchor means for axially fixing the cutting means of the tool. These anchor means take the form of tubular slip housing 53 which is mounted around mandrel 25 and is of standard construction and design. As illustrated, it is supported at its upper end by upper support ring 54 which also serves as a race for ball bearings 55 mounted between housing 53 and ring 54. Ring 54 is mounted around mandrel 25 and is held against upward movement by an enlarged portion of mandrel 25 forming flange 56. Similarly, the lower end of housing 53 is supported by the lower ring 57 which serves as a race for ball bearings 55 mounted between housing 53 and ring 57. Ring 57 is supported on its lower side by externally enlarged lower portion 58 of mandrel 25. Slip housing 53 surrounds mandrel 25 in sealing relationship, which sealing is accomplished by a pair of O-ring seals 59.

Slip housing 53 is provided with an internal annular recess which forms a pressure chamber 60 that communicates with the inside of mandrel 25 through one or more ports 61. Housing 53 is also provided with a plurality of pairs of cylindrical recesses 62, each of which has received therein a bifurcated slip 63 having external surfaces adapted for gripping the inside of casing 15. The radial extension of slips 63 beyond a predetermined limit is restricted by retaining strap 64 secured to the outside of housing 53, as by screws 65. Slips 63 are normally held in a radially retracted position by compression springs 71 mounted beneath strap member 64.

When it is desired to place the tool in an axially fixed position, fluid pressure is applied downwardly through string 13, mandrel 25, and into ports 61 and pressure chamber 60 where the fluid through openings 72 applies pressure to the radially inward surfaces of slips 63. This pressure is sufficient to overcome the bias of spring 71, thereby urging the slips 63 into contacting relationship with the inside of casing 15. Thereafter, when it becomes desirable to rotate mandrel 25, the slips 63 will remain in a fixed position, thereby holding the tool from axial movement relative to casing 15.

The rotatable cutting means of this invention can take many different forms. One convenient form is illustrated in FIGS. 1 and 2. Referring now to FIGS. 1 and 2 in particular, the lower end of mandrel 25 receives a tubular shaped blade actuator 78. Actuator 78 has beveled upper edge 79 and an externally enlarged intermediate portion 80 which is received in annular recess 81 provided in the enlarged lower portion 58 of mandrel 25. Enlarged por-

tion 80 is adapted for axial movement in annular recess 81 within defined limits and has circumferentially spaced thereabout a plurality of blade arm recesses 82 in which are received blade arms 83 of cutter blades 84. Blades 84 are mounted on pivot pins 85 which are held in locked position by lock screws 86, as shown in FIG. 5. Blades 84 are adapted for positioning in cutting blade openings 87 provided in lower portion 58 of mandrel 25.

Cutter blade actuator 78 is normally held in an up position relative to mandrel 25 and in the position shown in FIG. 1 by spring means 91. In this position, the tool may be run downwardly into the casing or pipe to be cut without the cutter blades 84 prematurely engaging the inside of casing 15.

In operation, the tool is suspended from the drilling barge or platform in the manner shown in FIG. 3. The tool may be positioned at any point in the casing 15 by regulating the length of string 13 in the conventional manner. Once the tool is positioned against the point where the casing 15 is to be cut, steel ball 90 is dropped through the axial bore of string 13. It passes through the axial bore of mandrel 25 and comes to rest on beveled edge 79, thereby sealing off the lower end of the tool bore.

Fluid pressure is then applied through string 13 and mandrel 25. The pressurized fluid passes out through ports 61 to chamber 60 and through openings 72 to radially extend slips 63 into a fixed or locking engagement with casing 15.

Simultaneously, cutter blade actuator 78 is forced downwardly by the pressure on ball 90 to force blade arms 83 downwardly. Downward movement of arms 83 pivots or extends the cutting edges of cutter blades 84 radially outwardly into engagement with the internal surface of casing 15, as shown in FIG. 2.

With slips 63 engaged, as shown in FIG. 2, and with the cutter blades 84 extended, as shown in FIG. 2, the cutting operation is accomplished by rotation of string 13 from above, which turning can be accomplished as explained above, by a rotary table or the like mounted on drill barge 11.

Since mandrel 25 is connected to housing 26 by means of the plug shaped splines 27, the rotational force imparted to string pipe 13 is imparted to mandrel 25 which imparts rotation to cutter blades 84. Since mandrel 25 is secured against axial movement relative to casing 15, the cutting of casing 15 is carried out in an axially fixed position without the spiraling action which has heretofore resulted from wave action on barge 11.

During the cutting operation any movement imparted to drilling barge 11 by waves or the like, is compensated for by the telescopic movement of mandrel 25 relative to spline housing 26. The pressurized fluid inside of the axial bore of mandrel 25 will pass outwardly through ports 32 to equalization chamber 31 to permit the mandrel 25 and spline housing 26 to move freely relative to one another.

When the cutting operation is complete, then pressure can be terminated in the axial bore of support pipe 13 which then results in slips 63 being retracted by springs 71 and cutter blades 84 being retracted by the spring means 91 acting upwardly on actuator 78 such that the tool may be removed from the casing and the casing thereafter removed from the well bore. Thus, the art has been provided with a highly practical tool and method for performing the cutting operation without adverse effect from wave action on the drilling barge or platform.

Further modifications may be made in the invention, as particularly described without departing from the scope of the invention. Accordingly, the foregoing description is to be construed illustratively only and is not to be construed as a limitation upon the invention as defined in the following claims.

What is claimed is:

1. A pipe cutting tool adapted for attachment to the

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lower end of a support pipe depending from a floating platform, comprising:

- a tubular housing;
 - anchor means carried by the housing for anchoring the same in fixed relation against longitudinal movement in both upward and downward directions in a pipe to be severed;
 - a tubular body member rotatably supported in said housing;
 - cutter means carried by the body member for severing the pipe, and
 - a torque-transmitting telescoping coupling member secured to the body member and connectible to said support pipe.
2. The apparatus as claimed in claim 1 wherein: said anchor means and cutter means are adapted to be selectively actuated by pressurized fluid introduced into the body and housing from the support pipe.
3. The apparatus as claimed in claim 1 wherein: said torque-transmitting telescoping coupling member includes a pressure balanced slip joint for preventing extension of the telescoping coupling member due to the pressure of fluid in the support pipe.
4. A pipe cutting adapted for attachment to the lower end of a support pipe suspended from a floating platform and for insertion into the pipe to be cut, the tool comprising:
- a generally tubular member;
 - a telescoping joint secured to the tubular member and connectable to the lower end of the support pipe;
 - radially outwardly extendable and rotatable cutting means connected to the tubular member;
 - means for selectively extending the cutting means into engagement with the pipe to be cut and rotating the cutting means relative thereto;
 - anchor means connected to the tubular member for securing the cutting means from axial movement in both upward and downward direction with respect to the pipe to be cut upon actuation thereof whereby the cutting means may be rotated in a fixed axial position.
5. The tool as claimed in claim 4 wherein:
- the anchor means is actuated by pressurized fluid applied down through the support pipe and the tubular member, and
 - the telescoping joint is provided with pressure balancing means whereby the pressurized fluid is applied to prevent extending of the joint by the pressure of the fluid.

6. The tool as claimed in claim 4 wherein: the telescoping joint is provided with means for transmitting rotational forces between the support pipe and the tubular member.
7. The tool as claimed in claim 4 wherein: the anchor means and the means for extending the cutting means are actuated by pressurized fluid applied down through the support pipe and the tubular member;
- the telescoping joint is provided with means for transmitting rotational forces between the support pipe and the tubular member, and
- the means for rotating the cutting means include the tubular member and the support pipe, whereby rotation applied to the support pipe causes the cutting means to rotate.
8. The tool as claimed in claim 4 wherein: the anchor means and the means for extending the cutting means are actuated by pressurized fluid applied down through the support pipe and the tubular member;
- the telescoping joint includes a pressure balancing chamber surrounding the tubular member, passage means for communicating the pressurized fluid to the chamber, and means for transmitting rotational forces between the support pipe and the tubular member;
- and the means for rotating the cutting means include the tubular member and the support pipe, whereby rotation of the support pipe causes the cutting means to rotate.
9. The tool as claimed in claim 8 wherein: the telescoping joint includes seal means to provide a fluid tight seal between the support pipe and the tubular member.

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