

[54] METHOD OF RETRIEVING ANCHORS

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[22] Filed: Sept. 26, 1974

[21] Appl. No.: 509,573

[52] U.S. Cl. 114/206 R; 294/66 R

[51] Int. Cl.² B63B 21/26

[58] Field of Search 114/206 R, 230, 221 R, 114/50, 235 B, 235 F, 235 R, 210, 43.5; 24/241 PS:279; 294/83 A, 83 E, 84, 82 R, 66 R; 61/72.3, 69 R

[56] References Cited

UNITED STATES PATENTS

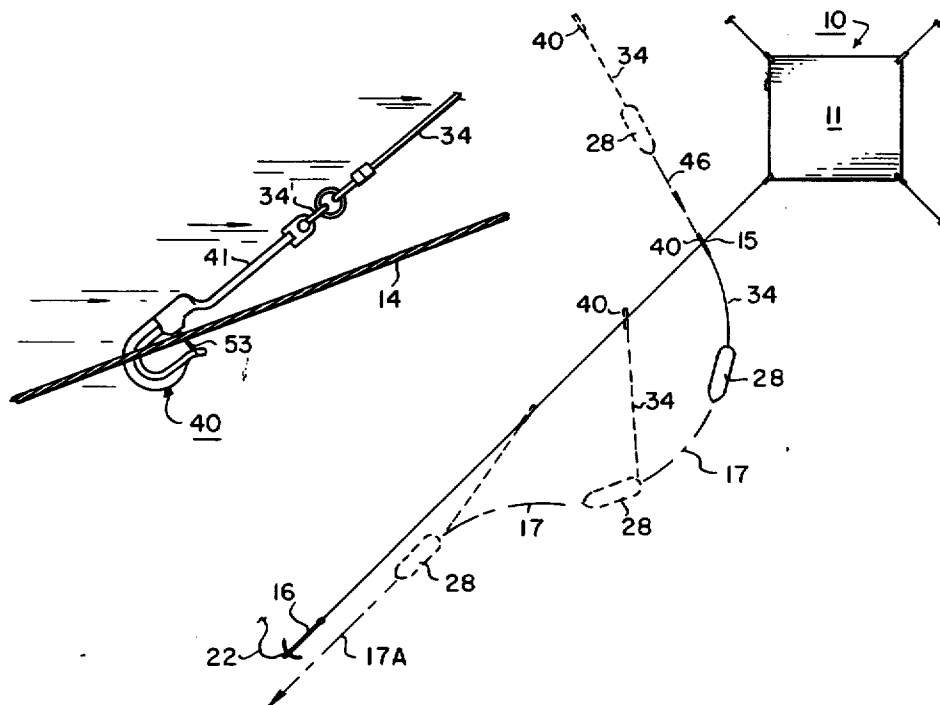
2,551,998	5/1951	DeGroot	294/66 R
3,097,495	7/1963	Laborde et al.	114/5 D
3,319,426	5/1967	Slonczewski	61/72.3

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[57] ABSTRACT

A method of retrieving an anchor buried in the sea bottom and attached by a long mooring line to a floating moored structure. A submerged remote-releasable hook, having a yieldable catch, is towed with a service line in a direction intersecting the mooring line at a point between the floating structure and the anchor until the hook catches the mooring line. The catch will automatically open to allow the hook to capture the mooring line. The service line is then moved in the direction of the mooring line with the hook sliding down on the mooring line until the hook arrives at or near the anchor. The service line is then pulled up to unseat the anchor. The hook's catch is remote operated to release the mooring line from the hook.

2 Claims, 6 Drawing Figures



METHOD OF RETRIEVING ANCHORS

REFERENCE TO RELATED APPLICATION

This application is related to application Ser. No. 522,395, assigned to the same assignee.

BACKGROUND OF THE INVENTION

Marine structures are frequently moored to the sea bottom by anchors connected to the structure by a spread of mooring lines. Drilling vessels are illustrative of such marine structures for which the mooring system is both critical and very expensive. With the greater emphasis on offshore exploration, drilling rigs will now be required to operate within water depths of up to and beyond 3,000 feet. The mooring system is designed to maintain the rig within certain horizontal limits from the center line of the well. Dynamic anchors are presently employed because they increase their holding power with horizontal pull provided by the rig, and because such anchors can become deeply buried in soft bottoms.

To prevent an uplifting force from becoming exerted on and unseating the anchor, a sufficient length of mooring line must be deployed, considerably greater than the water depth. Maximum holding power is obtained when the fluke angle is set at approximately 30° for sandy bottoms and 50° for muddy bottoms.

Mooring lines consisting of wire rope, chain, or a suitable combination of wire rope and chain have been successfully used in proportions depending on several factors which include: expected mooring line loads, water depth, handling equipment, storage facilities on board the drilling rig, and types of work boats available for assisting the rig during the deployment and retrieval process of the mooring system.

The location of each anchor in a spread mooring system is marked by a surface or marker buoy connected to the anchor by an anchor cable, known as a pendant line. A submerged assist or spring buoy can also be connected to the pendant line to provide additional buoyancy and/or protection to the pendant line. In practice, a portion of the pendant line drags over the sea bottom, especially when the surface buoy becomes subjected to strong winds. Abrasion resulting from such dragging can cause a pendant line to prematurely fail.

Various shackles are used to join sections of pendant lines, to attach chain to wire rope, and to attach chain or wire rope to anchors. When long pendant lines are reeled in, the various connecting devices have a tendency to squash and crush the wire rope. After considerable use, such chain links and damaged wire rope will rupture, resulting in the loss of one or more pendant lines. The work boat must "chase" the mooring line attached to the anchor whose pendant line fails in order to first locate and then retrieve the lost anchor.

The chasing of a mooring line was accomplished in prior practice with the use of a bridle at the end of a service line by: bridling the mooring line near the water surface, guiding the bridle on the mooring line down to or near the anchor, unseating the anchor by uplifting the service line, gradually reeling in the service line as the rig brings in the mooring line, and close to the water surface disconnecting the bridle when the end of the mooring line reaches the rig and is bolstered.

It will be appreciated that the semi-submersible rig after it is moored, extends a considerable distance below the water surface. The mooring line is paid out of

a chain locker, over a wildcat, and through a submerged fairlead down to the sea bottom. Since the mooring line must be manually bridled and unbridled in the known chasing process at a point below but close to the lowermost fairlead, which can be up to fifty or more feet below the water surface, there is a need to first deballast the rig in order to raise the fairlead to near the water surface, and then manually position the bridle on and removing it from the mooring line. These hand manipulations are very time consuming, not always successful, and expensive. They also require bringing the work boat dangerously close to the drilling rig, a maneuver that can damage the drilling rig, the work boat, as well as harm their respective crews.

It is an object of the present invention to avoid the need to deballast the rig and to have to bring the work boat too close to the drilling rig in order to position the bridle on and removing it from the mooring line near the water surface. It is a further object to considerably reduce the time required to carry out the anchor chasing process and to be able to perform such chasing in a more severe environment.

SUMMARY OF THE INVENTION

A method of retrieving an anchor and/or mooring line by towing a submerged remote-operated hook at the end of a service line, in a direction intersecting the mooring line and at a point remote from the moored structure. The hook has a catch with a remote releasable lock thereon. The catch is normally in a close-hook position. When the hook engages the mooring line at a point considerably below the water surface, the catch will pivot to its forced open-hook position to allow the hook to capture the mooring line. The service line is then moved in the direction of the mooring line toward the anchor. When the hook slides down to or near the buried anchor, the service line is raised and the hook unseats the buried anchor. When the anchor is already close to being bolstered on the rig, the lock is remotely released and the catch moves to its biased open-hook position. With the catch in its biased position, the hook is allowed to fall off from the mooring line by slackening the service line.

The hook preferably has a straight portion followed by an annular portion and then by a lip portion. The mouth between the straight and lip portions has a dimension which is greater than the maximum cross-sectional dimension of any section of the mooring line to allow the hook to slide down over the entire mooring line.

FIG. 1 shows various positions of the work boat during the anchor recovery process;

FIG. 2 illustrates a path traveled by the work boat;

FIG. 3 shows the position of the work boat when the hook is unlatched from the mooring line;

FIG. 4 illustrates the movement of the hook toward and just prior to engaging the mooring line;

FIG. 5 is a large detail view of the hook holding a captured mooring line; and

FIG. 6 is a view on line 6-6 in FIG. 5.

DETAILED DESCRIPTION OF THE INVENTION

Throughout the drawings the same numerals are used to designate the same or similar parts.

A floating structure 10 such as a submersible drilling rig 11 has a chain locker 12 and/or a wire rope winch which stores a very long mooring line 14 which may consist of wire, chain, or a combination of both. The mooring line is considerably longer than the depth of the body of water to allow for a nearly horizontal pull on the mooring line by the rig. This pull causes the anchor 16 to bite deep into the sea bottom 18. Mooring line 14 is paid out over a wildcat 19 (in the case of chain) which is mounted at an elevated position relative to chain locker 12. The mooring line extends below a bottom swivel fairlead 20 positioned at a considerable distance, say 50 feet, below wildcat 19. The crown 21 of anchor 16 is attached to a long pendant line 22 which is coupled to a marker surface buoy 24. When pendant line 22 is very long or is used in very severe environment, it is also typically coupled to a spring buoy 26. The spring buoy supports a considerable portion of the weight of the pendant line 22.

It quite frequently happens that the pendant line 22 ruptures at a point 27. The rupture of the pendant line can be caused by several factors including abrasion, corrosion, excessive winds hurling the surface buoy 24, mishandling of the pendant line 22 on the winches, etc. When the pendant line together with its spring and marker buoys become detached, anchor 16 is considered as being "lost."

In accordance with this invention there is provided a remote-release catch hook, generally designated as 40 (FIGS. 4-6). The hook can assume various geometric configurations. The preferred embodiment however consists of a straight portion 41, an annular portion 42 which is followed by a lip portion 43. The gap or mouth 44 between portions 41 and 43 has a width sufficient to allow hook 40 to grapple any section of mooring line 14. The hook's annular portion maybe provided with a reinforcing rib 45 which conveniently can have a rectangular cross-sectional area while the hook itself can have a circular cross-section. The dimensions and weight of hook 40 are such that it will retain its structural integrity under maximum pulling load. A service line 34 is connected by a suitable shackle 34' to the straight portion 41.

The release hook 40 is adapted for remote acoustic operation by an acoustic release mechanism, generally designated as 50. A catch 53 is mounted on a pivot pin 61 in lip 43. A spring 56 biases catch 53 to assume an open hook position 53C. A stop plate 58 locks catch 53 into its close-hook position 53A without preventing catch 53 from rotating counter-clockwise, as viewed in FIG. 5, into a forced open-hook position 53B when the mooring line exerts a downward force on catch 53. After the mooring line becomes captured by hook 40, spring 56 will cause catch 53 to return to its close-hook position. Thus, the mooring line by itself can move through but not out of mouth 44 of hook 40.

A suitable explosive bolt 52 secures stop plate 58 to the hook's straight portion 41 and prevents catch 53 from rotating clockwise (FIG. 5). The bolt 52 is fired by a coded acoustic signal. A control unit 54 forms part of the release mechanism 50 and may (not shown) consist of an acoustic detector such as a hydrophone, receive and decode electronics, and a rechargeable battery. Control unit 54 is housed in a pressure case 55. A pair of wires 57 connect the output from control unit 54 with the input to explosive bolt 52.

A surface command unit (FIG. 3), which could be suspended from boat 28, generates an acoustic teleme-

try signal, which is coded with an address-and-fire code. This acoustic signal travels through the water to become detected by the hydrophone in control unit 54. The hydrophone generates an electric signal which is decoded by the receive electronics. If this signal contains the proper code, the decode electronics forming part of control unit 54 will generate a release signal which will result in the firing of the explosive bolt or similar device 52. Stop plate 58 will now free catch 53 to rotate on its forced or pin 61 and assume its biased open-hook position 53C.

Underwater acoustic-operated explosives bolts 52, the control unit 54 and the command unit 60 are available from the Honeywell Marine Systems Division of Seattle, Wash., and in and by themselves form no part of this invention. It will be appreciated that the remote-operated control unit 54 functions without vulnerable electric cables or other connections, and that the coding permits positive identification of one specific beacon or signal among several such signals in the same area.

In operation, hook 40 is towed by the work boat's service line 34 in a direction 46 (FIG. 2) that intersects or is substantially perpendicular to the vertical plane containing mooring line 14. While being towed at the end of service line 34, hook 40 is submerged at a considerable distance below the water surface, say more than 200 feet. After hook 40 catches the mooring line at point 15, the work boat will swerve toward the general direction of the mooring line as indicated by the dotted line trajectory 17. As the work boat approaches buried anchor 16, it will move in a direction 17A substantially parallel to the mooring line, causing hook 40 to slide down on mooring line 14 until it stops at or near anchor 16. Then the service line is gradually reeled in through stern roller 36' by winch 36 on the deck of work boat 28 to thereby exert an uplift force F on the anchor 21 which unseats the anchor from the sea bottom 18.

Thereafter the work boat carries the anchor on its service line toward rig 11 and assists the drilling rig in the retrieval process of the mooring line and of the anchor. To disconnect hook 40 from the mooring line, bolt 52 is remotely exploded, as previously described, thereby allowing catch 53 to rotate about its pivot 61 into its biased open-hook position 53C. Service line 34 is slackened and hook 40 will fall off by its own weight from the mooring line.

Hook 40 is particularly adapted for very deep waters, say up to and beyond 3,000 feet, since it will continuously remain on the mooring line while it slides to the bottom 18.

Other advantages and modifications will readily suggest themselves to those skilled in the art and all such are desired to be covered by the claims attached hereto.

What is claimed is:

1. The method of locating and retrieving an anchor, buried in the seabed and being attached to the bottom end of an inclined mooring line whose upper end is attached to a submerged member of a structure floating in a body of water, by utilizing a surface ship and equipment, said surface ship being on the surface of the body of the water and having a service line, and said equipment including a remote-operated catch hook on the service line, and a control unit on said ship for remotely controlling the opening of the catch on said hook; said method being characterized by utilizing the following

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steps:

moving the ship near the structure,
submerging the hook and a portion of the service line
into the body of water;
towing the submerged hook in a direction intersect-
ing the mooring line until the mooring line forcibly
opens the catch and becomes hooked;
gradually swerving the service line in the direction of
the mooring line toward the buried anchor;
progressively lowering the service line as the ship
moves toward the anchor allowing the hook to slide
down on the mooring line;
uplifting the service line to retrieve the anchor from
the seabottom;
progressively taking in the mooring line into the
structure;

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progressively taking in the service line into the ship,
while supporting the anchor with the service line;
moving the ship toward the structure;
remotely releasing the hook's catch by actuating said
control unit; and
bolstering the anchor onto the structure.

2. The method of claim 1 wherein said control unit is
an acoustic transmitter and said hook comprises signal
responsive means responsive to a received acoustic
signal for opening said catch, and wherein the step of
remotely releasing the hook includes transmitting an
acoustic signal from said transmitter to said signal re-
sponsive means to open the catch on the hook, thereby
releasing the service line from the mooring line.

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