Aug. 21, 1962 W. J. HAYES 3,050,140

METHOD AND APPARATUS FOR INSTALLING GUIDE LINES AT UNDERWATER WELLHEADS

Filed July 18, 1960 6 Sheets-Sheet 1

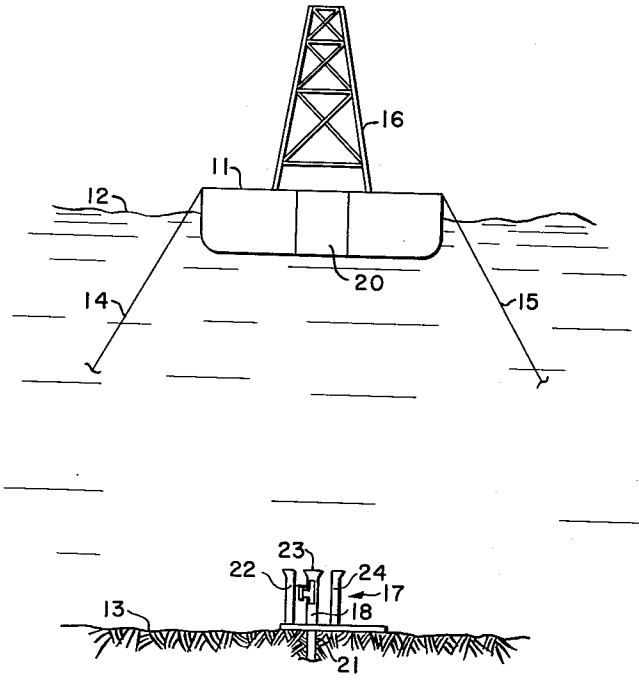


FIG. 1

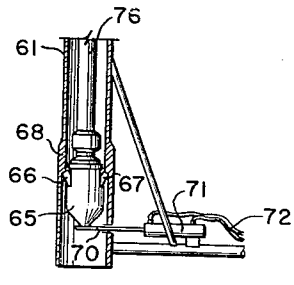


FIG. 7

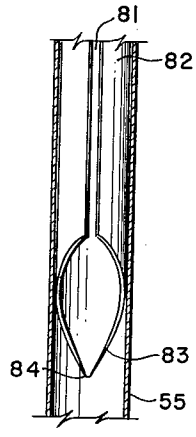


FIG. 6

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METHOD AND APPARATUS FOR INSTALLING GUIDE LINES AT UNDERWATER WELLHEADS

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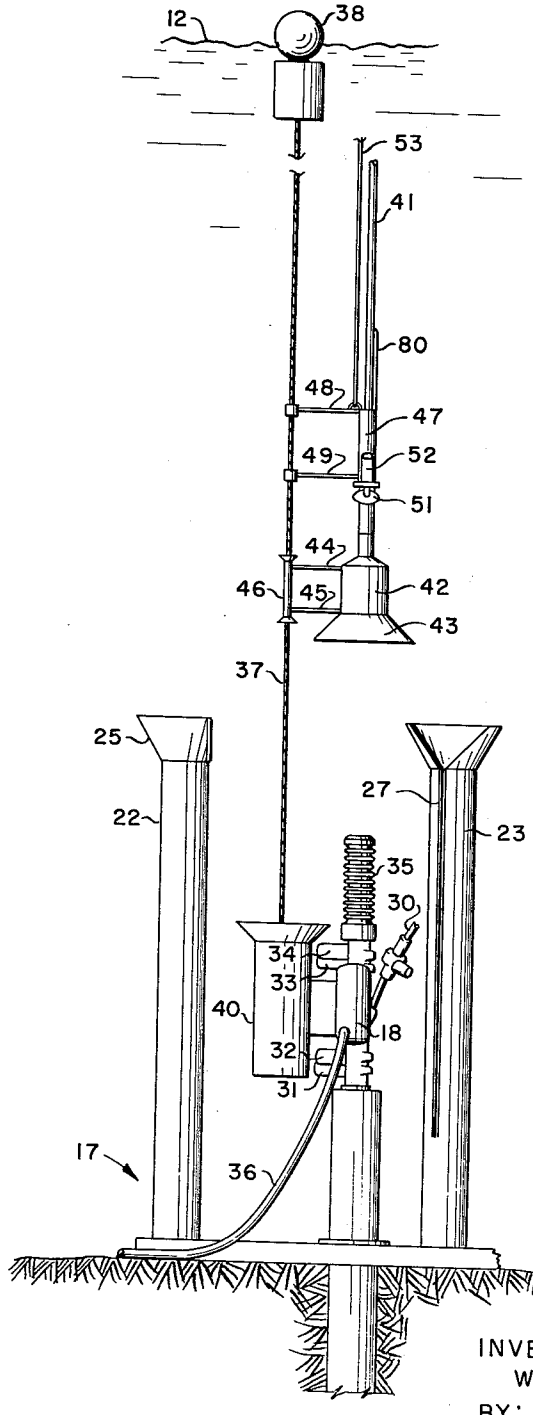


FIG. 2

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METHOD AND APPARATUS FOR INSTALLING GUIDE LINES AT UNDERWATER WELLHEADS

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6 Sheets-Sheet 3

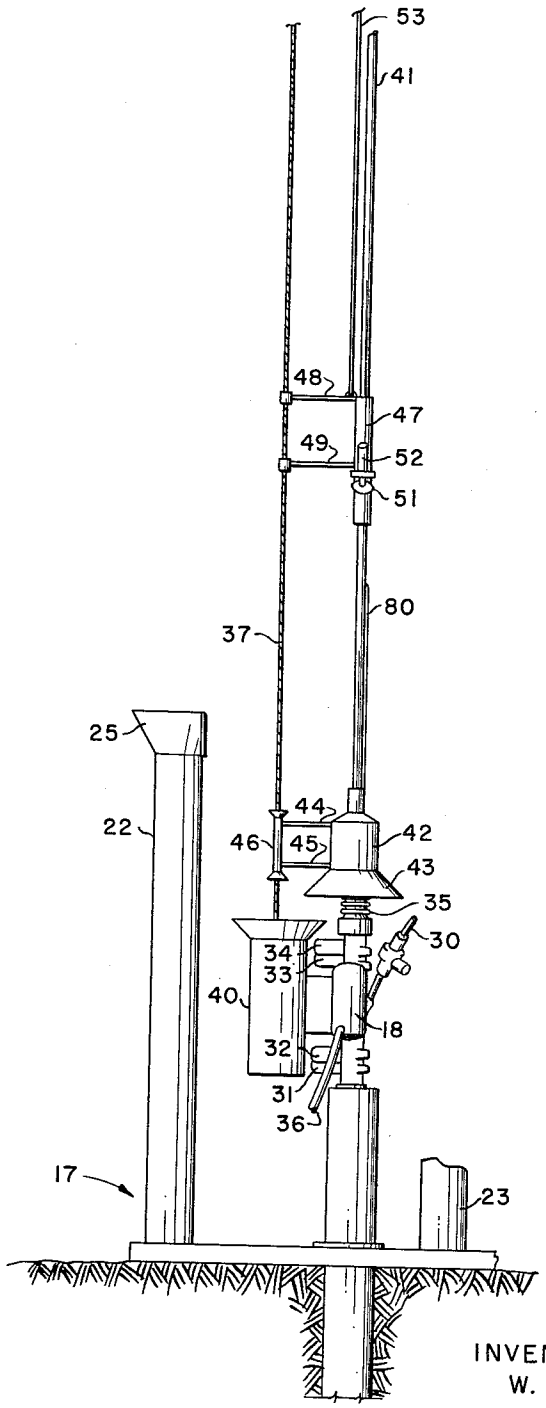


FIG. 3

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METHOD AND APPARATUS FOR INSTALLING GUIDE LINES AT UNDERWATER WELLHEADS

Filed July 18, 1960 6 Sheets-Sheet 4

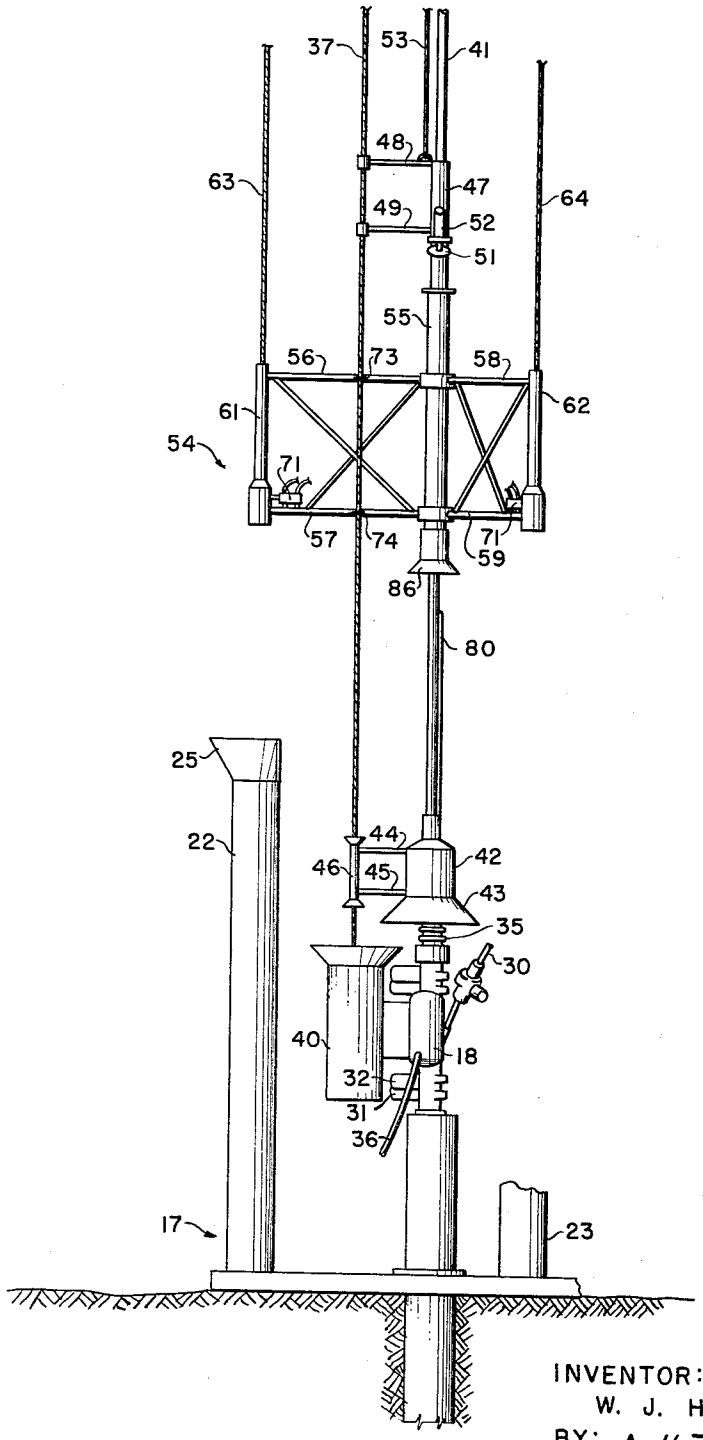


FIG. 4

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METHOD AND APPARATUS FOR INSTALLING GUIDE LINES AT UNDERWATER WELLHEADS

Filed July 18, 1960 6 Sheets-Sheet 5

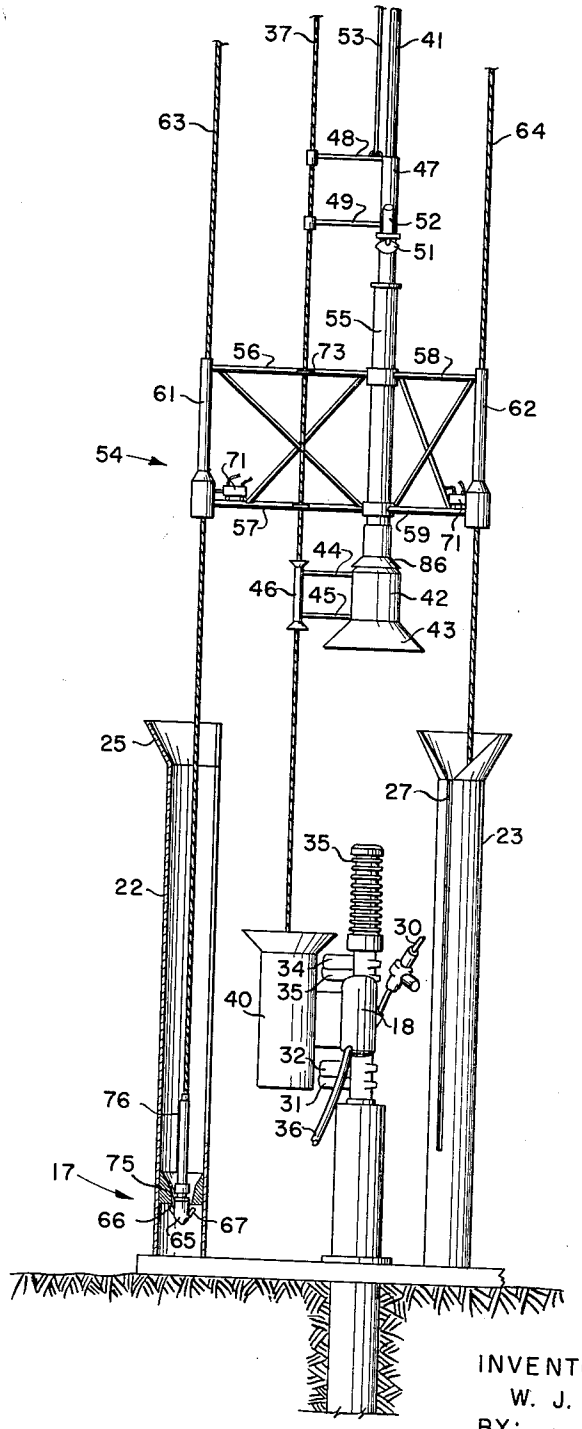


FIG. 5

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METHOD AND APPARATUS FOR INSTALLING GUIDE LINES AT UNDERWATER WELLHEADS

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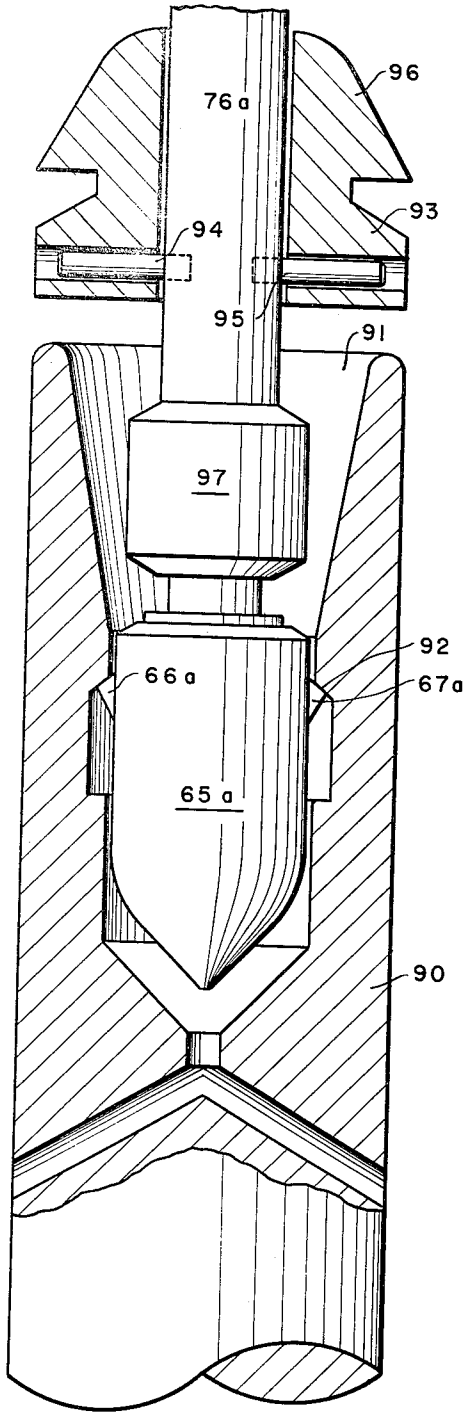


FIG. 8

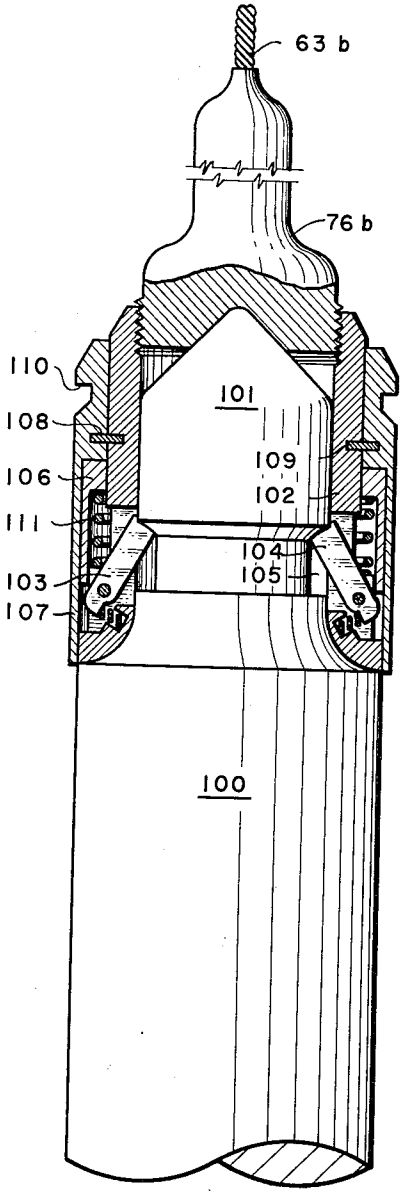


FIG. 9

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United States Patent Office 3,050,140 Patented Aug. 21, 1962



3,050,140

# METHOD AND APPARATUS FOR INSTALLING GUIDE LINES AT UNDERWATER WELLHEADS

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Filed July 18, 1960, Ser. No. 43,577
11 Claims. (Cl. 175—7)

This invention relates to offshore operations concerned with drilling, producing, servicing, and maintaining underwater wells, and pertains more particularly to methods and apparatus for making contact with an underwater wellhead positioned on or near the ocean floor and attaching to said wellhead, from a remote location such as a vessel on the surface of the water, a plurality of guide lines by which tools, instruments, or other equipment can be lowered into contact with the wellhead assembly or raised therefrom.

A method of drilling and completing an underwater well on the ocean floor is described in copending application, Serial No. 830,538, filed July 30, 1959, to Haeber et al. In the described method a wellhead assembly is permanently positioned on the ocean floor and a series of guide lines extend from the wellhead assembly on the ocean floor to a drilling barge or other drilling vessel floating on the surface of the water. Through the use of the guide lines various pieces of equipment are raised and lowered between the wellhead assembly on the ocean floor and the vessel on the surface. After well drilling operations have been completed, the guide cables are left permanently attached to the wellhead assembly at their lower ends and are secured preferably to a buoy, at their upper ends, which floats on the surface of the water. Alternatively, the cables are dropped to the ocean floor from which they are subsequently recovered by means of grappling hooks or other suitable means. Since cables lying on the ocean floor tend to become entangled with each other and with the wellhead assembly and since guide cables attached to a floating buoy also have a tendency to become entangled as well as constituting a hazard to sea traffic, it is desired that these guide cables be removed when drilling operations have been completed.

It is therefore an object of the present invention to provide a method and apparatus for establishing contact with an underwater well or other underwater installation and installing a plurality of guide lines between the installation on the ocean floor and a vessel on the surface of the water by remote means.

A further object of the present invention is to provide a method and apparatus for locating an underwater wellhead and lowering thereto for connection thereon a series of guide cables by which equipment can be lowered to and raised from the wellhead.

These and other objects of this invention will be understood from the following description taken with reference to the drawing, wherein:

FIGURE 1 is a diagrammatic view illustrating a floatable drilling barge anchored over a wellhead assembly that is positioned on the ocean floor;

FIGURES 2 to 5 are schematic views showing the installation of guide lines on an underwater wellhead assembly positioned on the ocean floor;

FIGURE 6 is a longitudinal view of an orienting means contained within the guide frame of FIGURE 4;

FIGURE 7 is a longitudinal view taken in enlarged cross-section of one leg of the guide frame of FIGURE 4 when it contains a cable latching means; and

FIGURES 8 and 9 are schematic views, taken in partial longitudinal section, of a portion of the top of a guide column or post with cable latching means secured thereto.

Referring to FIGURE 1 of the drawing, a drilling barge 11, of any suitable floatable type is illustrated as



floating on the surface of a body of water 12 and substantially fixedly positioned over a preselected drilling location, as by being anchored to the ocean floor by suitable anchors (not shown) at the ends of anchor lines 14 and 15. Equipment of this type may be used when carrying on well drilling operations in water varying from about 100 feet to 1500 feet or more in depth. The drilling barge is equipped with a suitable derrick 16 as well as other auxiliary equipment needed during the drilling, completion or maintenance of a well. The derrick 16 on the drilling barge is positioned over a drilling slot or well 20 which extends vertically through the barge in a conventional manner. When using the equipment of the present invention, the slot 20 in the barge may be either centrally located or extend in from one edge. However, well location and maintenance operations may be carried out over the side of the barge without use of the slot.

An equipment base assembly 17 including a wellhead assembly 18 is shown as being positioned on the ocean floor 13 and being anchored fixedly thereto by a conductor pipe or well casing 21 which extends into the ocean floor 13 and is preferably cemented therein. For ease of operation the slot 20 of the barge 11 is positioned substantially directly over the equipment base 17 on the ocean floor. The equipment base 17 of FIGURE 1 is provided with two or more guide columns 22, 23 and 24, only two of which are shown in FIGURE 2 for ease of illustration. Preferably, each of the guide tubes 22 and 23 has a cone-shaped flange 25 and 26 attached to its upper end which serves to align elements that enter the open upper ends of the guide columns 22 and 23. Each guide column is provided with a longitudinal slot 27 in the wall thereof extending downwardly from the open upper end of the column and is preferably positioned in line with the center line through the wellhead assembly 18. The wellhead assembly may be of any suitable type, the one being illustrated is shown as being provided with a flowline 30, control valves 31, 32, 33 and 34, and a top closure 35 on the wellhead assembly which provides entry into the wellhead assembly by remote operations from the drilling barge, if desired. The various valves and control units of the wellhead assembly 18 are either electrically, pneumatically or hydraulically actuated through a series of individual power transmission lines which are grouped together in one or more bundles 36.

Fixedly secured to the equipment base 17 or to the wellhead assembly 18 is a buoy line 37 of a length sufficient to extend from the underwater installation to the surface of the water 12 where a buoy 38 is attached thereto. The buoy line 37 may be in its normally extended position as illustrated in FIGURE 2, or a buoy container 40 may be provided in which the buoy line and its buoy 38 may be stored, to be brought to the surface when it is desired to regain contact with the underwater equipment base 17 and wellhead assembly 18. The buoy 38 can be released from its container 40 in any suitable manner, by power supplied through one of the control lines in the transmission bundle 36 or by an electric signal transmitted through the water to actuate a release mechanism in the container or in the buoy which would release the buoy from the container.

In practicing the method of the present invention, the mooring or buoy line 37 (FIGURE 2) serves as a guide line by which a string of tubing 41 or drill pipe is guided down to the wellhead assembly 18. The lower end of the tubing string 41 is provided with a latching tool 42 of any suitable type by which a rigid connection may be made with the top of the wellhead assembly 18. The form of the latching tool 42 illustrated is such that it is adapted to fit over the wellhead closure 35 and be locked thereon in any suitable manner, as by rotating or recip-

rocating the pipe string 41 or by applying hydraulic pressure therethrough. The lower end of the latching tool 42 is preferably provided with a guide cone 43 to facilitate aligning the latching tool 42 on the top of the wellhead closure 35. The latching tool 42 is attached to a pair of guide arms 44 and 45 which in turn are secured to a guide tube 46 which is slidably mounted on the buoy line 37.

At the start of the operation of regaining contact with the underwater wellhead assembly 18, the buoy 38 and the upper end of its line 37 would be suitably anchored to the barge 11 at the surface in a manner such that the guide tube 46 can be readily slipped over it for movement therealong. Throughout the operation an attempt is made to maintain the buoy line 37 in a position as close to the vertical as possible. With the guide tube 46 attached to the buoy line, the latching tool 42 and the pipe string 41 are lowered in a conventional manner, as by means of a hoist of the derrick 16 on the barge 11 down through the water until it is within the equipment base 17. The distance down to the wellhead 18 from the surface of the water is normally accurately known from previous work on the well or by means of depth marks which could be contained on the buoy line 37. Thus, since the distance to the top 35 of the wellhead 18 is known, the guide cone 43 of the latching tool 42 would be expected to contact the top 35 of the wellhead 18 when the predetermined length of tubing string 41 had entered the water. If no contact was made at that depth, the tubing string 41 and its latching tool 42 is slowly moved in a circle or in any other desired pattern about line 37 until contact is established between the latching tool 42 and the top of the wellhead assembly. With the latching tool 42 aligned over the top 35 of the wellhead assembly 18, continued lowering of the tubing string seats the latching tool 42 over the top of the wellhead assembly 18 where it can be locked into position.

If desired, in order to facilitate the alignment of the latching tool 42 over the top 35 of the wellhead assembly 18, a light carrier 47 may be employed which could be in the form of a tubular member of a diameter so that it could slide over the tubing string 41 and have a pair of guide arms 48 and 49 that would be slidably mounted on the buoy line 37. One or more lights 51 and one or more television cameras 52 are suitably arranged on the light carriage 47 so as to observe operations at the wellhead. The light carriage 47 is arranged for movement independent of the buoy line 37 or the tubing string 41 and may be raised and lowered by a hoist line 53. In FIGURE 2, the tubing string 41 and its latching tool 42 are shown as being lowered through the water over the wellhead assembly 18. In FIGURE 3 the latching tool 42 at the lower end of the tubing string 41 is illustrated as being locked into place with the light carriage 47 being raised to the surface again by means of hoist line 53.

With the buoy line 37 and the tubing string 41 extending from the wellhead assembly 18 to the drilling barge 11 (FIGURE 1), a guide frame 54 (FIGURE 4) is lowered down through the water from the barge using the buoy line 37 and the tubing string 41 as guides. The guide frame 54 comprises any suitable frame constructed around a tubular central column 55 from which guide arms 56, 57, 58 and 59 extend radially. Positioned at the end of the guide arms 56–59 are vertical tubular legs or containers which are disposed in a manner and at distances from the central column 55 so as to register with the axes of the guide columns 22 and 23 when the frame 54 is lowered on top of the guide columns 22 and 23 of the equipment base 17. Extending into the open tops of the vertical legs 61 and 62 of the guide frame 54 are guide cables 63 and 64 which are to be installed in the guide columns 22 and 23 of the equipment base 17 and releasably anchored thereto.



Contained within each of the vertical legs 61 and 62 and attached to the lower end of the guide cable 63 or 64 therein is a latching mechanism 65 (FIGURE 7) of any suitable type for latching the lower end of the guide cable 63 first in the vertical legs 61 of the guide frame 54 and subsequently in the bottom of the guide column 22 of the equipment base assembly on the ocean floor. The particular form of latching mechanism 65 illustrated in FIGURE 7 is provided with a pair of latching dogs 66 and 67. When the cable 63 and its latching mechanism 65 are originally inserted into the upper end of the vertical leg 61, while the guide frame 54 is above the surface of the water, the latching mechanism 65 moves downwardly through the tubular leg 61. As the spring-loaded dogs 66 and 67 pass a shoulder 68 formed on the inner surface of the tubular leg 61, the dogs 66 and 67 move outwardly thus preventing the latching mechanism 65 from being removed from the vertical leg 61 on an upward pull by the guide cable 63. When the latching mechanism 65 is positioned within the vertical leg 61, as shown in FIGURE 7, the lower end of the latching mechanism 65 rests on any suitable stop element 70 which extends into the bore of the vertical leg 61 sufficiently to lock the latching mechanism 65 from falling therethrough. The stop element 70 may be either hinged within the tubular leg 61 or retractable therefrom, as being connected to an air or hydraulic cylinder or a solenoid valve 71 which is powered through power transmission lines 72 from the vessel on the surface of the water.

As illustrated in FIGURE 4, the guide frame 54 is lowered down over the tubing string 41 with the tubing string 41 passing up through the central column 55 of the guide frame 54. The buoy line 37 may be secured to the frame 54, as by U-bolts 73 and 74, so that the buoy line 37 is in spaced relationship with the tubing string 41. The guide frame 54 is lowered through the water by unreeling the guide cables 63 and 64 from their hoists (not shown) on the vessel above the surface of the water. If desired, the light carriage 47 with its lights 51 and television camera 52 may follow the guide frame 54 down the buoy line 37 and the tubing string 41 to check the operation at the wellhead.

With a flexible connection between the barge and the wellhead assembly on the ocean floor formed by the buoy line 37, and a rigid connection formed by the tubing string 41, the guide frame 54 may be readily lowered into place with the vertical legs 61 and 62 of the guide frame 54 registering with the tops of the guide columns 22 and 23 of the equipment base assembly 17 on the ocean floor. At this time the power cylinders 71 are energized from the surface to retract the stop elements 70, thus allowing each latching element 65 and cable 63 to fall downwardly out of the vertical leg 61 of the frame 54 (FIGURE 7) and down through the guide columns 22 (FIGURE 5) to a point where the latching mechanism becomes firmly anchored to the guide columns 22. As shown in FIGURE 5, one means of anchoring the cable 63 in place is to provide a hold-down shoe 75 in the bottom of the guide column 22 through which the lower end of the latching mechanism 65 can pass so that dogs 66 and 67 can lock below it. Preferably, a weight bar 76 is positioned between the latching mechanism 65 and the lower end of the cable 63 so as to cause the lower end of the cable to fall freely through the guide column 22.

FIGURE 5 of the drawing illustrates that time during the method of the present invention after which all of the cables 63 and 64 have been anchored within the guide columns 22 and 23 and removal of the guide frame 54 is being carried out by raising it by means of hoisting up on the tubing string 41. The buoy line 37 and its buoy 38 are left connected to the wellhead assembly for a time sufficient to use them to replace another buoy in the buoy container 40, as described in co-pending application, Serial No. 43,578 filed July 18, 1960. Although in the preferred practice of the present invention a tubing string

41 is employed as a second guide for guiding the frame 54 down to the top of the equipment base assembly on the ocean floor, in some locations it will be found sufficient to employ merely the buoy line 37 as a guide line by which the guide frame 54 may be guided into position at the wellhead. In the event that only the buoy line 37 is employed as a guide, it is essential that a television camera 52 be employed to properly align the frame 54 on top of the guide columns 22 and 23.

Alternatively, after the lower end of the tubing string 41 has been locked on the top of the wellhead assembly as shown in FIGURE 3, the buoy line 37 need not be employed any further as a means of guiding equipment.

As shown in FIGURE 4, a long key 80 is preferably welded to the outer surface of the tubing string 41 just above the latching tool 42 and it is designed to cooperate with a keyway 81 (FIGURE 6) formed in a tubular guide liner 82 which is fixedly positioned within the central guide column 55 of the frame 54. The lower end of the guide liner 82 is cut in a manner illustrated in FIGURE 6 at 83 so as to form a shoulder 83 extending from each side of the slot or keyway 81 down to a point 84. Thus it will be seen that as the top of the key 80 on the tubing string 41 contacts any point of a shoulder 83 of the guide liner 82 carried within the central column 55 of the frame 54, the frame will be caused to rotate until the key 80 slides along the shoulder 83 and enters the keyway 81. The key 80 and the keyway 82 are positioned with regard to the equipment base assembly 17 and the guide columns 22 and 23 in a manner such that when the key 80 is within the keyway 81 the vertical legs 61 and 62 of the guide frame 54 are positioned vertically over the guide columns 22 and 23 of the equipment base assembly. A shoulder 85 may be formed between the bottom of the tubing string 41 and the latching tool 42 in order to more accurately centralize the guide frame 54 around the drill pipe 41. The lower end of the central guide column 55 of the frame 54 may also be provided with an aligning cone 86.

While the present invention has been described with regard to an equipment base assembly 17 (FIGURE 1) having guide columns or tubes 22 and 23 attached thereto, the term column is also used to include guide posts of the type shown in FIGURES 8 and 9.

In FIGURE 8, the top of a guide post 90 is illustrated as having a recess 91 formed in the top thereof, with a lip 92 in the recess 91 forming a hold-down shoe similar to shoe 75 of FIGURE 5. When the cable-latching mechanism 65*a* is dropped into the recess 91, the dogs 66*a* and 67*a* latch in the shoe 91. The weight bar 76*a*, which forms the top of the guide post, is provided with a protective cap 93 which is secured by shear pins 94 and 95. The top of the protective cap 93 is in the form of a fishing neck 96. In order to retrieve the cap 93, an annular fishing tool (not shown) is dropped down to engage the fishing neck 96 of the cap which is pulled upwardly after shearing shear pins 94 and 95. An annular weight (not shown) is then dropped down the cable and over the weight bar 76*a* to depress the releasing sleeve 97 of the latching mechanism 65*a* and retract the dogs 66*a* and 67*a*. An upward pull on the cable then releases it from the post 90. Preferably, drain ports 98 and 99 are provided through the wall of the post 90 from the bottom of the recess 91 to allow any foreign material to drain away.

In FIGURE 9, the top of a guide post 100 is shown as having a top portion 101 of smaller diameter and preferably having a pointed top for receiving thereover an annular latching mechanism 102, attached to the lower end of a weight bar 76*b*, the latching mechanism having dogs 103 and 104 which are arranged to latch in an annular recess 105 in the top of the post, which recess forms a hold-down shoe. A spring-loaded releasing sleeve 106 is mounted on the outside of the latching mechanism and is normally protected against movement by a protective skirt member 107 releasably secured to the latching mechanism 102 in any suitable manner, as by shear pins 108 and 109. A fishing groove 110 is formed on the outside of the skirt member 107 near the top thereof for engaging a fishing tool (not shown) when the sleeve member is to be removed. Upon dropping an annular weight element (not shown) after removing the skirt member 107, the releasing sleeve 106 is forced downwardly compressing spring 111 and forcing the lower ends of the dogs 103 and 104 inwardly, thus retracting the dogs into the latching mechanism which can then be raised by an upward pull on the cable 63*b*. The weight bar 76*b*, if used, forms an upward extension of the guide post 100.

I claim as my invention:

1. Apparatus for remotely connecting a guide cable system to a subsurface structure from a remotely-located floating vessel on the surface of a body of water, said apparatus comprising a vessel having an operational base positioned above the surface of a body of water, an equipment base assembly fixedly positioned beneath the surface of said body of water, guide element means extendible and connectible between said base assembly and said vessel on the surface, a carrier frame slidable along said guide element means to said base assembly, said carrier frame supporting at least the lower end of at least a pair of guide cables of said system, aligning means carried by said carrier frame for aligning the lower ends of said cables over said base assembly, cable-latching means attached to the end of each cable and releasably carried by said guide frame, releasing means carried by said frame for remotely releasing the cable-latching means from said guide frame, and lock-down means on said base assembly of a size to receive vertically and lockingly engage said cable-latching means thereto.

2. Apparatus for remotely connecting a guide cable system to a subsurface structure from a remotely-located floating vessel on the surface of a body of water, said apparatus comprising a vessel having an operational base positioned above the surface of a body of water, an equipment base assembly fixedly positioned beneath the surface of the body of water, anchor means extending from said base assembly to anchor said base assembly to the earth formation beneath the body of water, a buoy adapted to float on the surface of the body of water, a buoy line extendible between said base assembly and said buoy, a carrier frame slidable along said buoy line to said equipment base assembly, said frame including a plurality of spaced cable-holding means each containing the lower end of a guide cable of said system, aligning means carried by said carrier frame for aligning the lower ends of said cables over said base assembly, cable-latching means attached to the end of each cable and releasably carried by said guide frame, means for remotely releasing the cable latching means from said guide frame, and lock-down means carried in spaced relationship by said base assembly of a size to receive vertically and lockingly engage said cable-latching means thereto.

3. Apparatus for remotely connecting a guide cable system to a subsurface structure from a remotely located floating vessel on the surface of a body of water, said apparatus comprising a vessel having an operational base positioned above the surface of a body of water, an equipment base assembly fixedly positioned beneath the surface of the body of water, a plurality of guide columns extending upwardly from said equipment base assembly, anchor means extending from said base assembly into said floor to anchor said base assembly thereto, a buoy adapted to float on the surface, a buoy line extendible between said base assembly and said buoy on the surface, a pipe string lowerable through said water to said base assembly, connector means carried by the lower end of said pipe string connectible to said base assembly, a guide frame affixed to said pipe string and slidable along said buoy line, a carrier frame slidable along said buoy

line and said pipe string to said equipment base assembly, said carrier frame including a plurality of cable-holding elements disposed in a manner to register with the guide columns of said equipment base assembly, aligning means carried by said carrier frame for aligning the lower ends of said cables over said base assembly, cable latching means attached to the end of each cable and releasably carried by each of said cable-holding elements, releasing means carried by said carrier frame for remotely releasing the cable-latching means from said carrier frame, and lock-down means affixed to each guide column of said base assembly of a size to receive vertically and lockingly engage said cable-latching means thereto.

4. Apparatus for remotely connecting a guide cable system to a subsurface structure such as a wellhead assembly of an oil well drilled in the ocean floor and completed under water from a remotely located floating vessel on the surface of a body of water, said apparatus comprising a vessel having an operational base positioned above the surface of a body of water, an equipment base assembly fixedly positioned adjacent and including an underwater wellhead assembly on the floor of a body of water, a plurality of guide columns extending upwardly from said equipment base assembly, a string of pipe extending from said base assembly into said floor to anchor said base assembly thereto, a releasable buoy attached in a submerged manner to said base assembly and adapted to float to the surface when released, a buoy line extendible between said base assembly and said buoy when surfaced, a pipe string lowerable through said water to said base assembly, connector maens carried by the lower end of said pipe string connectible to said wellhead assembly of said base assembly, a guide frame affixed to said pipe string and slidable along said buoy line, a carrier frame slidable along said pipe string to said equipment base assembly, said frame including a plurality of vertically positioned tubular legs disposed in a manner to register with the guide columns of said equipment base assembly, aligning means carried by said carrier frame for aligning the legs of the frame over the guide columns of said base assembly, cable-latching means attached to the end of a cable and releasably carried within each of said tubular legs, releasing means carried by said frame for remotely releasing the cable-latching means from each of said legs of said guide frame, and lock-down means carried within each guide column of said base assembly of a size to receive vertically and lockingly engage said cable-latching means thereto.

5. A method of remotely installing and connecting a plurality of spaced guide cables to an equipment base positioned below the surface of a body of water and anchored to the floor thereof, said method being carried out from an operational base positioned above the surface of the water, said method comprising the steps of positioning said operational base in a disconnected manner substantially directly above said equipment base anchored to the ocean floor, extending and connecting a flexible element between said bases to establish a connection between said bases, lowering through the water between said bases a plurality of guide cables while guiding them alongside said flexible element, bringing the lower ends of said cables into contact with said equipment base and releasably latching the lower ends of said guide cables to said equipment base in spaced relationship to each other.

6. A method of remotely installing and connecting a plurality of spaced guide lines to an equipment base positioned below the surface of a body of water and anchored to the floor thereof, said method being carried out from an operational base positioned above the surface of the water, said method comprising the steps of positioning said operational base in a disconnected manner substantially directly above said equipment base anchored to the ocean floor, establishing a flexible connection between said bases by a buoy line, establishing a more rigid connection between said bases with an elongated pipe string guided along said flexible connection, lowering through the water between said bases a plurality of guide cables while guiding them alongside at least said rigid connection, bringing the lower ends of said cables into contact with said equipment base and releasably latching the lower ends of said guide cables to said equipment base in spaced relationship to each other.

7. A method of remotely installing and connecting a plurality of spaced guide cables to and subsequently disconnecting them from an equipment base positioned below the surface of a body of water and anchored to the floor thereof, said method being carried out from an operational base positioned above the surface of the water, said method comprising the steps of positioning in an anchored and disconnected manner said operational base substantially directly above said equipment base anchored to the ocean floor, establishing a flexible connection between said bases by a buoy line, establishing a more rigid connection between said bases with an elongated pipe string guided along said flexible connection, lowering through the water between said bases a plurality of guide cables while guiding them alongside said flexible and rigid connections, bringing the lower ends of said cables into contact with said equipment base releasably latching the lower ends of said guide cables to said equipment base in spaced relationship to each other, and subsequently removing said flexible and rigid connections between said operational base and said equipment base.

8. A method of remotely installing and connecting a plurality of spaced guide cables to an equipment base positioned below the surface of a body of water and anchored to the floor thereof, said method being carried out from an operational base positioned above the surface of the water, said method comprising the steps of positioning said operational base in a disconnected manner substantially directly above said equipment base anchored to the ocean floor, establishing a flexible connection between said bases by a buoy line, lowering a pipe string through the water and guiding it along said buoy line to said equipment base, orienting the lower end of said pipe string in register with the top of said equipment base, lowering through the water and guiding along said buoy line and said pipe string a frame carrying the lower ends of a plurality of guide cables, orienting said frame to a predetermined position above and in contact with said equipment base, transferring the lower ends of said guide cables from said frame to said equipment base, and releasably anchoring in spaced relationship said lower ends of said guide cables to said equipment base.

9. A method of remotely installing and connecting a plurality of spaced guide cables to and subsequently disconnecting them from an equipment base positioned around a wellhead below the surface of a body of water on the floor thereof, said method being carried out from an operational base positioned above the surface of the water on a floating vessel, said method comprising the steps of positioning in an anchored manner said operational base substantially directly above said equipment base anchored to the ocean floor, establishing a flexible connection between said bases by a buoy line, lowering a pipe string through the water and guiding it along said buoy line to said equipment base, orienting the lower end of said pipe string in register with the top of said wellhead on said equipment base, seating the lower end of said pipe string on the upper end of the wellhead, lowering through the water and guiding along said buoy line and said pipe string a frame carrying the lower ends of a plurality of guide cables, orienting said frame to a predetermined position above and in contact with guide columns on said equipment base, transferring the lower ends of said guide cables from said frame to the guide columns of said equipment base, releasably anchoring said lower ends of said guide cables within the guide columns of said equipment base, raising the frame and pipe string

to the surface of the water and removing the buoy line extending to the surface of the water.

10. Apparatus for remotely connecting a guide cable system to a subsurface structure from a remotely-located floating vessel on the surface of a body of water, said apparatus comprising a vessel having an operational base positioned above the surface of a body of water, and equipment base assembly fixedly positioned beneath the surface of said body of water, guide element means extendible and connectible between said base assembly and said vessel on the surface, a carrier frame slidable along guide element means to said base assembly, said carrier frame supporting at least one guide cable, aligning means carried by said carrier frame for aligning the lower end of said cable over said base assembly, cable latching means attached to the end of the cable and releasably carried by said guide frame, releasing means carried by said frame for remotely releasing the cable latching means from said guide frame, and lock down means on said base assembly of a size to receive vertically and lockingly engage said cable latching means thereto.



11. A method of remotely installing and connecting a guide cable to an equipment base positioned below the surface of a body of water and anchored to the ocean floor thereof, said method being carried out from an operational base positioned above the surface of the water, said method comprising the steps of positioning said operational base in a disconnected manner substantially directly above said equipment base anchored to the ocean floor, extending and connecting a flexible element between said bases to establish a connection therebetween, lowering through the water between said bases a guide cable while guiding it along side said flexible element, bringing the lower end of said cable into contact with said equipment base, and releasably latching the lower end of said cable to said equipment base.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,808,229 | Bauer et al. | Oct. 1, 1957 |
| 2,891,770 | Bauer et al. | June 23, 1959 |
| 2,923,581 | Bauer et al. | Feb. 2, 1960 |