MARINE DRILLING APPARATUS

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The present invention relates generally to a marine drilling operation and more particularly to a string of buoyant marine conductors through which a drill pipe and control lines may extend and connect to a submarine well head. Also the present invention includes a string of buoyant marine conductors in which each conductor has a net positive buoyancy and the connecting means between conductors also provides connection for the control lines so that the control lines are totally enclosed within the conductor string.

Prior to the present invention marine conductors used in marine drilling have been suspended from the surface by counterweights over a sheave mounted on the drilling barge or vessel or by special floats. Generally the control lines and other lines such as the choke and kill lines have been connected to the submarine well head by flexible hoses extending from the submarine well head to the barge or vessel on the surface of the water. The connection of these lines is generally accomplished by a diver who descends to the submarine well head and manually makes the connections. Also, if desired these connections can be made to the equipment at the surface prior to it being landed on the well head. The hoses are generally slightly longer than the depth of the water so that they do not support any of the weight of the submarine equipment when landing. It is a general practice to bundle such lines to attempt to eliminate tangling of the lines with the submarine equipment. In deep water drilling the lines have to be installed at the surface before lowering the submarine equipment. The necessary slack on these lines can interfere with the proper landing of the equipment on the well head and lowering or installing these lines improperly can affect the lines so that they may become inoperative, due to fouling, kinking or actual damage or rupture.

Difficulty has been encountered with these prior structures in providing float supports for the marine conductors in addition to the difficulties caused by the tangling of the flexible hoses. In some cases it has been known that floats supporting a string of marine conductors have caused a section of the conductor because of inadvertent disconnection from the string to shoot up out of the water with considerable velocity and force. Such uncontrolled force is dangerous and can cause considerable damage.

It is therefore an object of the present invention to provide a conductor for marine drilling in which the conductor has a net positive buoyancy when submerged in water.

Another object of the present invention is to provide a buoyant conductor for marine drilling having a drill casing and a buoyant chamber which contains the control lines together with the kill and choke lines.

Another object of this invention is to provide a series of conductors for marine drilling which when connected to their latching mechanism for engagement with the submarine well head have a greater weight than buoyancy and when the weight of such latching mechanism is supported by the submarine well head have sufficiently more buoyancy than weight to maintain a substantially upright, stable position in the water.

Another object of the present invention is to provide an assembly of buoyant marine conductors having stab-in joints for connection of control lines to the submarine well head equipment and a buffer plate protecting the stabbers of said joints.

Another object of the present invention is to provide a series of buoyant conductors for marine drilling in which each conductor contains a plurality of lines which are all connected to the fixed submarine lines when a connection is made between the buoyant conductor and the submarine well head.

Another object of the present invention is to provide a series of buoyant conductors for marine drilling which contain the drill casing and a plurality of control lines wherein the conductors have a greater weight than buoyancy when being lowered for connection with a submarine well head and after such connection is made said conductors have a greater buoyancy than weight resulting from the weight supported by the submarine well head.

A further object of the present invention is to provide a buoyant conductor string in which each conductor has a net positive buoyancy and when seated on a submarine well head installation each chamber of the string and the whole string is stable above a misalignment joint since the string has a net positive buoyancy when secured to the submarine well head.

A still further object of the present invention is to provide a series of buoyant conductors for marine drilling which may be readily connected and disconnected to the submarine well head by remote control from the surface of the water.

A still further object of the present invention is to provide an assembly of buoyant conductors for marine drilling having a misalignment joint and a remotely actuated latching mechanism in which the assembly has greater weight than buoyancy and in which the individual conductors have a greater buoyancy than weight.

Another object of the present invention is to provide a string of marine conductors for marine drilling including means for attaching control lines to the marine conductors and to protect the control lines.

These and other objects of the present invention are clearly explained and described in the following specification and are illustrated in the accompanying drawings wherein:

FIGURE 1 is a schematic view of the present invention used for marine drilling showing portions of the device from above the surface of the water to below the surface of the floor of the water.

FIGURE 2 is a longitudinal cross-sectional view of a buoyant chamber for marine drilling constructed in accordance with the present invention.

FIGURE 3 is a longitudinal cross-sectional view of a joint between buoyant chambers constructed in accordance with the present invention.

FIGURE 4 is a partial cross-sectional view taken along lines 4—4 in FIGURE 3 of the joint between buoyant chambers.

FIGURE 5 is a partial cross-sectional view of the joint between buoyant chambers taken along lines 5—5 in FIGURE 3.

FIGURE 6 is a detailed sectional view of the joint connections taken along lines 6—6 in FIGURE 5.

FIGURE 7 is another detailed sectional view similar to FIGURE 6 taken along lines 7—7 in FIGURE 5.

FIGURE 8 is a detailed sectional view of the remote control latching joint of the present invention showing the joint in unlatched position.

FIGURE 9 is a detailed cross-sectional view of the remote control latching joint illustrating the joint in the locked position.

FIGURE 10 is a partial detailed cross-sectional view similar to FIGURE 9 but showing the details of the connection of control lines.
In the apparatus of the present invention and its relation to a marine platform illustrated is shown. Submarine well head 20 is shown at the floor of the body of water in which the well is to be drilled. Well head 20 and its platform 21 are located on the floor and the blowout Preventers 22 are secured to well head 20 by a suitable remote control latch mechanism 23. Remote control latch mechanism 24 secures to the upper portion of blowout Preventers 22 and connects to a swivel or ball-in-socket misalignment joint 25. The upper end of misalignment joint 25 is secured to marine conductor 26 which connects through other marine conductors 26 up to the slip joint 27 above the surface 29 of the water. Barge 29 with derrick 30 thereon is positioned around slip joint 27 and jumper hoses 31 connect from the upper end of the top marine conductor 26 to the surface equipment 32 on barge 29. Surface equipment 32 would comprise pumps and valves for actuating the hydraulic controls and the blowout Preventers 22. In addition provision is made for mud circulation including outlet 33 from the upper end of slip joint, shale shaker 34, mud tanks 35 and mud pumps (not shown).

As in other drilling operations, drill pipe 36 is supported by derrick 30 and the usual rotary table and other equipment for drilling and mud circulation are provided. Drill pipe 36 extends downward through slip joint 27, marine conductors 26, misalignment joint 25, blowout Preventers 22 and well head 20 into the bore of the well for drilling.

Control lines 37 are contained within marine conductors 26 in an annular chamber which provides the buoyancy for the marine conductors 26 as hereinafter more fully explained. Control lines 37 are connected at the surface to the jumper hoses 31 which are flexible to take care of the relative movement of the barge 29 in relation to the top of the upper marine conductor 26. At each joint between connected marine conductors 26 provision is made for connection of all of control lines 37. Jumper hoses 38 connect from the lower end of the lowest marine conductor 26 to latch mechanism 24 to provide sufficient flexiblity to allow movement in misalignment joint 25. Provision is made for connection through latch mechanism 24 to control lines 39 which are permanently installed on that portion of the well head equipment and blowout Preventers 22 above well head 20. Such control lines therefore have a direct connection to the surface equipment and thereby all of the valves, the blowout Preventers 22, and latch mechanisms 23 and 24 are remotely controlled from barge 29.

Marine conductors 26, misalignment joint 25, latch mechanisms 23 and 24, blowout Preventers 22 and well head 20 all provide an annular space surrounding drill pipe 36 through which drilling fluid and mud may be circulated. Each of marine conductors 26 is provided with an outer annular space through which control lines 37 extend and such outer annular space is sized to provide the desired amount of buoyancy for each individual marine conductor 26 so as to maintain more fully explained.

When commencing operations, the well head 20 and table 21 are located at the floor with guide wires 40 extending up to barge 29 from table 21. Next blowout Preventers 22 and their associated equipment such as control lines 39 are lowered onto well head 20 and are guided to proper position by lower portion of guide wires 40 which on slindingly engage by guide arms 41 extending from blowout Preventers 22. A suitable hose connection will be used to actuate latch mechanism 23 whereby blowout Preventers 22 are secured to well head 20. Next latch mechanism 24, misalignment joint 25 and marine conductors 26 are deployed in layers, being guided by the engagement of guide arms 42 which are secured to latch joint 24 and slindingly engage guide wires 40. When latch mechanism 24 is properly seated it is latched by controls on the barge 29. With this equipment all connected and with connections made for mud circulation and connection of jumper hoses 31, drilling may be commenced.

As often happens in marine drilling operations, bad weather arrives suddenly and it is necessary to disconnect the series of marine conductors 26 from the submarine well head equipment to avoid damage to the equipment. This damage may result from too wide a misalignment of the angular relationship that may be allowed by misalignment joint 25 or it may result from high waves and tides which cannot be compensated for by slip joint 27 and jumper hoses 31. Disconnection may be quickly accomplished by engaging drill pipe 36 with the blowout Preventers 22 and disconnecting drill pipe 36 immediately above blowout Preventers 22. When the disconnected portion of drill pipe 36 is raised and removed then latch mechanism 24 may be actuated from barge 29 and released, allowing marine conductors 26, misalignment joint 25 and latch mechanism 24 to be raised a distance above the submarine well head equipment. In this position barge 29 with conductors 26 suspended therebelow may ride out the storm without fear that any damage may occur. As soon as the danger has passed the connection to the well head equipment may be made quickly, drill pipe 36 connected and drilling operations resumed.

In the event that it is desired to move barge 29 from the location then drill pipe 36 may be pulled or disconnected at the blowout Preventers 22 and latch mechanism 24 released allowing all of marine conductors 26 to be lifted to the surface and disconnected for storage on the barge. Guide arms 42 will have to be disengaged from guide wires 40 and on departing from the location floats should be attached to guide wires 40 so that they may be easily located and recovered on return.

In FIGURE 2 the marine conductors 26 are shown in detail. In FIGURE 3 the details of the joint connections between marine conductors 26 are illustrated. Marine conductors 26 comprise an inner tubular member 43 extending through an outer tubular member 44 with an annular space 45 between members 43 and 44. Annular space 45 is closed at the upper end by top closure member 46 and at the lower end by bottom closure member 47. As shown in FIGURE 3, bottom closure member 47 is designed to engage with the top closure member 46 to provide a secure and easily assembled joint between marine conductors 26. Reinforcing spacers 48 are positioned within annular space 45 and have an I-shaped section with suitable holes 49 extending through them. A plurality of spacers 48 through which control lines 37 extend.

If it is desired that marine conductors 26 not be buoyant then they may be constructed in a manner similar to the illustration in FIGURE 2 or outer tubular member 44 may be omitted and collars or other suitable means such as spacers 48 provided to secure control lines 37 to marine conductor 26 and to provide a measure of protection for control lines 37. If outer tubular member 44 is omitted care should be taken in the attaching of closure members 46 and 47 to inner tubular member 43 to assure that closure members 46 and 47 are properly secured to maintain the connections of control lines 37 therebetween.

It is suggested that it might be desirable to fill annular space 45 after the installation of control lines 37 with a foamed plastic to assure the buoyancy of marine conductor 26 even though it might be punctured or otherwise ruptured whereby water could enter the space filled with a foamed plastic even a puncture of outer tubular member 44 would not let in sufficient water to completely destroy all buoyancy of the section of annular space which is punctured. However, care should be taken to assure the strength of both inner and outer tubular members 43 and 44 since a puncture at a substantial water depth could cause the portion or section to completely lose its buoyancy even when filled with a plastic foam as the water pressure could be sufficient at such depths to crush some types of plastic foam and flood the annular space. Puneture of inner tubular member 43...
will have the same result as it would allow the annular space to fill with mud or drilling fluid which will be circulated within the interior of inner tubular member 43. Pad eyes 51 are secured by welding to the exterior of outer tubular member 58 and are preferably at a position near the upper end of marine conductor 26 and at a position which is reinforced by a spacer 48. Pad eyes 51 are suitable for use in lifting and handling marine conductors 26.

Referring to the joint between marine conductors as shown in FIGURE 3 it may be seen that the lower end of inner tubular member 56 is connected to hub 52 by a bottom closure member 47 and the lower end of outer tubular member 44 is welded to lip 53 which extends upward from web 54 of bottom closure member 47. The interior of bottom closure member 47 has a bore 55 of substantially the same diameter as the inner diameter of inner tubular member 43. Hub 56 extends downwardly from member 47 and is provided with conical sealing surface 57 around its exterior. Groove 58 in seating surface 57 is adapted to contain O-ring 59 whereby surface 57 will engage the mating conical surface 60 on closure member 46 for sealing engagement when closure members 46 and 47 are held in engagement by clamp ring 61. Clamp ring 61 engages the outwardly extending annular flanges 62 and 63 on members 46 and 47 respectively and is of any suitable design which will hold members 46 and 47 in sealing engagement. Preferably clamp ring 61 will be of the design with suitable means for tightening clamp ring 61 on flanges 62 and 63 whereby members 46 and 47 are forced into sealing engagement.

Internal bore 64 of member 46 is substantially the same as bore 55 of member 47 and as the internal diameter of inner tubular member 43. Hub 65 which extends from member 48 is secured to inner tubular member 43 by welding. Closure member 46 is provided with web 66 between hub 65 and flange 62 and lip 67 depends from the outer portion of web 66. The outer tubular members 44 are suitably secured to closure members 46 and 47 as by welding to lip 53 of member 47 and lip 57 of member 46 as shown.

Wells 54 and 66 of members 47 and 46 are provided with suitable openings for receiving fittings for the connections of control lines 37 from one marine conductor to another marine conductor or to the jumper hoses 31 or 33. Control lines 37 will be comprised of at least two sizes of lines which are preferably metal tubing and will be contained within annular space 45. The smaller size line 68 is a control line which connects to the submarine valves and blowout preventers 22 and the larger lines 69 will be connected to the choke and kill connections at well head 20. As used herein choke and kill are used in the common meaning in drilling operations. The choke line is a line which is used to bleed off the pressure of the well when the blowout preventers have been shut and the kill line is a line for introducing a heavy mud into the well to reduce the pressure within the well bore to assist in controlling the well.

The connecting joints for control lines 37 between marine conductor sections are shown in FIGURES 3, 4, 5, 6 and 7. Basically such joints comprise male sections in threaded engagement to the lower ends of lines 68 and 69 and extending through web 54 of bottom closure member 47 and a female section for receiving the male section which is within web 66 of upper closure member 46. The female sections are in threaded engagement to the upper ends of lines 68 and 69. FIGURES 4 and 5 are partial sections looking upwardly at bottom closure member 47 and downwardly at upper closure member 46 to illustrate the positioning of the joints in webs 54 and 66 and to illustrate the blocks hereinafter more fully described which retain the male and female sections of the joint within their respective webs. It should be noted that any number of control lines 37 may be used but care should be taken to assure that there is sufficient space in the webs 54 and 66 for the joints and that

the weight of the lines does not overcome the desired net positive buoyancy of each individual marine conductor 26.

As shown in FIGURE 6 small lines 68 may be of different sizes or of the same size. It is preferred that they be within a range of small sizes so that a single joint connection may be used for all of the small sizes. Stabbersons 70 (the male section of the joint) are generally tubular in shape and are provided with a groove 71 in which O-ring 72 is positioned to seal against the interior of bore 73 in web 54. Stabberson 70 defines a bore 74 extending longitudinally therethrough and are threaded internally to engage lines 68. Stabberson 70 defines an annular groove 75 in which plate 76 fits to retain stabberson 70 within bore 73 in web 47. It should be noted that the length of groove 75 is longer than the thickness of plate 76 whereby allowance is made for slight movement of stabbersons 70 which may be caused by thermal expansion or other reason. Complete restriction of stabbersons 70 within bores 73 could cause buckling of lines 68. Plate 76 is held in position against web 54 by screw 77. The lower exterior stabberson 70 is cylindrical in shape and is adapted to be received within bore 78 of bushing 79 (the female section of the joint). The upper portion of bore 78 is recessed to receive packing 80 which is held in place by Packing follower 81 which is threaded into bushing 79. The lower portion of bore 78 is threaded for engagement with line 82. Bushing 79 is provided with groove 83 in which O-ring 85 is received for sealing against the interior of bore 84 in web 86. Bushing 79 has an external annular slot 85 near its upper end which is engaged by plate 86 to retain bushing in position within bore 84 of web 86. The height of slot 85 is substantially the same as the thickness of plate 86 so that when screw 87 clamps plate 86 to web 86 bushing 79 is securely fixed in position within bore 78. Also, external shoulder 88 on bushing 79 engages the upper surface of web 66 of member 46.

Referring to FIGURE 7, substantially the same construction is used in providing a connection for large lines. Stabberson 89 is threaded for engagement with the lower end of lines 89 and has with groove 91 and O-ring 92 to provide a seal against the interior of bore 90. Stabberson 89 also is provided with groove 93 which is engaged by plate 94 but groove 93 is longer than the thickness of plate 94 to allow for small movement of stabberson 89 within bore 90. Plate 94 is secured to web 54 by screw 95. As best seen in FIGURE 4 plate 95 is arcuate in shape and surrounds a little more than half of stabberson 89. Bushing 96 is positioned within bore 97 in web 66 and is sealed thereto by O-ring 98 within groove 99 in the exterior of bushing 96. Bore 100 through bushing 96 is recessed to receive packing 101 which is held in position by packing follower 102. Follower 102 is threaded into bushing 96. Slots 103 in bushing 96 engage plates 104 which are held against the upper surface of web 66 by screws 105. Bushing 96 has external shoulder 106 which engages the upper surface of web 66 whereby bushing 96 is securely held in place within bore 97 in web 66. The lower ends of stabbersons 70 and 89 should be rounded or tapered so that they will easily move into packing 80 and packing 101 since the packings will be tightened by followers 81 and 102 into position to seal against stabbersons 70 and 89 before the stab-in connection is made. The lower interior of bushing 96 is threaded to the upper end of line 66. Packing 80 and 101 may be of any suitable type which will provide an adequate seal to prevent leakage of the fluid flowing through lines 68 and 69 and is shown as a Chevron packing for purposes of illustration.

In FIGURES 8, 9, 10 and 11 the details of construction of remote control latch mechanism 24 are shown. The upper end of latch mechanism 24 comprises upper mandrel 107 having a clamping flange 108 for engagement with the lower portion of misalignment joint 25. The
lower end of latch mechanism 24 comprises lower mandrel 109 having bolting flange 110 for engagement with the upper end of blowout preventers 22. Mandrels 107 and 109 both have substantially the same diameter bores. The upper end of mandrel 109 has an upwardly projecting tooth 111 and the remainder of the upper end of mandrel 109 is substantially flat for the reasons as will hereinafter be more fully explained. Flange 112 extends from mandrel 109 and bracket 113 having the flanging holes 114 therein is secured as by welding to the underside of flange 112 and the exterior of mandrel 109. Bracket 113 is provided to secure guide arms 41 to mandrel 109 to guide blowout preventers 22 into proper position on well head 20. Groove 115 is provided in the exterior of lower mandrel 109, at a position above flange 112 and below exterior taper 116. Taper 116 extends from a position a short distance above groove 115 upward to cylindrical surface 117. Surface 117 extends to the top of lower mandrel 109. Upper mandrel 107 is provided with external recess 118 having downwardly facing shoulder 119 which engages the upper portion of carrier ring 120 when carrier ring 120 is properly seated in recess 118. The lower end of carrier ring 120 is engaged by the upper end of ball tube 121 which is threaded to the exterior of upper mandrel 109. Bracket 122 is welded to carrier ring 120 and supports actuating cylinder 123 by receiving piston rod 125. Piston rod 125 abuts the lower end of upper mandrel 109 and is fixedly secured to ball tube 121 by pins 126. The installation of pins 126 is hereinafter more fully explained. The lower edge of orientation piece 125 is recessed at 127 to mate with tooth 111 on lower mandrel 109. The interior bores of upper mandrel 107, lower mandrel 109 and orientation piece 125 are substantially the same and should be approximately the same interior diameter as the interior diameter of inner tubular member 43 of marine conductor 26 since drill pipe 36 will have to extend through each and drilling fluids and mud circulated in the annular area between the exterior of drill pipe 26 and the interior of these members. The interior of ball tube 121 contains groove 128 receiving O-ring 129 which is adapted to seal on cylindrical surface 117 of lower mandrel 109. Immediately below groove 128 the interior of ball tube 121 is tapered outwardly at 130 to mate with taper 116 on the exterior of lower mandrel 109. Below taper 130 ball tube 121 has a plurality of holes 131 adapted to receive ball tube inserts 132 containing balls 133. Buffer plate 134 is secured to the lower end of ball tube 121 as by screws 135 or any other suitable means. The inner corner of buffer plate 134 is beveled as at 136 to assist in the sliding of ball tubes 121 over the exterior of lower mandrel 109. Key 137 is secured to the lower exterior of ball tube 121 by screws 138. It is preferred that a plurality of keys 137 be used to assure vertical movement of cam member 139. Cam member 139 is generally cylindrical in shape and is provided with interior cam surface 140 which tapers outwardly and downwardly. Flange 141 is welded to the lower portion of cam member 139 and extends outwardly therefrom. Bracket 142 is welded to the exterior of cam member 139 and to the upper surface of flange 141. Bracket 142 is provided with holes 143 which are to be used for connecting guide arms 42 to latch mechanism 24. Bracket 142 is also provided with another hole through which clevis pin 144 extends to connect the piston end of actuator 123 to cam member 139. Slots 145 are provided in the lower interior surface of cam member 139 for sliding engagement with keys 137. Flexible annular washers are applied between the upper end of cam member 139 in contact with the exterior of ball tube 121. Male tubing connections or stubbers 147 are supported by flange 141 in a manner similar to the construction shown in FIGURES 3 through 6 in relation to stubbers 75 and 93 and are threaded for attachment of jumper hoses 38. Female tubing connections or bushings 148 are supported in flange 112 in a manner similar to the construction shown in FIGURES 3 through 6 in relation to bushings 79 and 96 and are suitably threaded for attachment of control lines 39. The circumferential arrangement of stubbers 147 and bushings 148 allows the placement of three actuating cylinders 123, spaced 120 degrees apart around latch mechanism 24 in order to assure that movement of the latch mechanism 24 is uniform and to avoidwanting of the parts which could prevent proper latching.

As best shown in FIGURES 8 and 9, orientation piece 125 is fabricated with recess 127 to mate with tooth 111 of lower mandrel 109 but it is not secured to ball tube 121 until the assembly shown in FIGURES 8 and 9 is completely assembled. With all stubbers 147 secured in their respective bushings 148 and with cam surface 140 holding balls 133 in groove 115 then holes are drilled through ball tube 121 and into orientation piece 125. Pins 126 are then inserted in the drilled holes and are secured therein by welding. In this manner, the orientation of the components attached to upper mandrel 107 will then be after mate exactly with the components attached to lower mandrel 109. This manner of assembling simplifies the construction as the orientation of the components may be carefully laid out to assure mating but any minor misalignment will be corrected on final assembly by allowing orientation piece 125 to be assembled to the lower end of lower mandrel 109 and the unit actuated to cause latching. It should be understood that no configuration which will provide orientation between upper mandrel 107 and lower mandrel 109 may be used in place of tooth 111 and recess 127 without departing from the spirit of the present invention.

As previously stated well head 20 and platform 21 are positioned on the floor of the body of water in which drilling is to be undertaken. With well head 20 in position, blowout preventers 22 are positioned theron by lowering the assembly onto well head 20 with suitable guiding by guide arms 41 and guide wires 40 and latch mechanism 23 is latched. Next latch mechanism 24 is assembled on the barge 29 and sections of marine conductors 26 are secured in series over latch mechanism 24 to the upper portion of misalignment joint 25. As each marine conductor section 26 is added the connected portion of the marine conductor 26 is lowered into the water with guide arms 42 engaging guide wires 40 to guide the assembly down in the water. Also, as each marine conductor section 26 is added to the assembly a connection is made of the joint so that all of the control lines 37 are connected throughout the assembly. When the assembly reaches its position on the uppermost marine conductor section 26 and the device is ready for attachment by actuation of latch mechanism 24.

Latch mechanism 24 is secured by transmitting actuating pressure (preferably hydraulic pressure) through one of control lines 37 and jumper hoses 38 to actuating cylinder 123. When tooth 111 on lower mandrel 109 properly engages recess 127 in orientation piece 125 then the actuation of cylinder 123 will cause cam member 139 to move downwardly with relation to ball tube 121 and inner cam surface 140 will engage ball tube 121 and force them into groove 115. With balls 133 seated in groove 115 latch mechanism 24 has been secured. At the same time that cam member 139 is being moved downward, its flange 141 carries stubbers 147 into engagement with bushings 148 whereby connections are completed for all control lines from barge 29 to control assembly 22 and to the choke and kill connections. With upper mandrel 107 resting upon lower mandrel 109, the weight of latch mechanism 24 and of misalignment joint 25 will be carried by lower mandrel 109 and then the buoyancy of marine conductors 26 will be sufficient that marine conductors 26 will tend to stand in an upright position. This tendency to remain upright results from the net positive buoyancy of the marine con-
ductors 26 having a greater buoyancy than weight but the total of the net positive buoyancies must be less than the combined weight of latching mechanism 24 and misalignment joint 25 so that the assembly may readily be lowered into position.

It should be noted that the individual marine conductors 26 which are of full length will have a net positive buoyancy, i.e., less weight than the water weight displaced. Most often it will be necessary to include one or more marine conductors 26 which are shorter than the full length marine conductor so that the upper end will rise to the desired level in relation to the water level 28 and the barge 29. Such shorter sections will have a greater weight than buoyancy since the connections will have to be of the same size and weight and due to the shorter length the sections will not displace a sufficient amount of water to achieve a net positive buoyancy. For this reason it is preferred that all short sections of marine conductors be positioned at the lower end of the marine conductor string and immediately above misalignment joint 25. In this position the upsetting force of such sections is minimized due to the short moment arm and the marine conductors 26 will tend to remain upright as described.

When latch mechanism has been secured the slip joint 27 and the remainder of the surface equipment on barge 29 may be placed in position. In this position the apparatus is ready for drilling operations. Drill pipe 36 can be lowered through interior of inner tubular members 43 with a suitable drilling bit thereon and it will pass through misalignment joint 25, latch mechanism 24, blowout preventers 22 and well head 20 for drilling. The annular area immediately surrounding drill pipe 36 is used for the circulation of drilling fluids and mud as in other drilling operations.

It should be noted that buffer plate 134 protects stabbers 147 from damage at all times. Until stabbers 147 are engaged with bushings 148 they are withdrawn as shown in FIGURE 8 and buffer plate 134 will protect them from contact with equipment as the assembly is being lowered into position. It is important that stabbers 147 be protected so that they will properly align with bushings 148 when connection of latch mechanism 124 is made and also to assure that proper sealing is provided when they are engaged within bushings 148.

Once latching of latch mechanism 24 is believed to be accomplished it may be checked by lifting on the assembly of marine conductors 26. If lower end not properly aligned with the lower mandrel 109 then actuation of cylinder 123 will only lift the whole assembly and will not latch and therefore the assembly may easily be lifted. If latch mechanism 24 has been properly aligned with tool 111 in recess 127 and all of stabbers 147 aligned with bushings 148 then lifting of the assembly will not be possible and a great increase in weight can be noted in the lifting apparatus on the barge 29 which will indicate that proper latching has been attained.

Unlatching is readily accomplished by transmitting actuating pressure (hydraulic pressure) to cylinder 123 to cause retraction. On retraction of cylinder 123 cam member 139 will be lifted whereby cam surface 140 no longer engages balls 133 and stabbers 147 will be pulled from engagement with bushings 148. Lifting of the assembly will cause balls 133 to move from groove 115 and return to ball tube inserts 132 whereby all of marine conductors 26, misalignment joint mechanism 24 may be lifted and disassembled on barge 29.

In cases of emergency the assembly may be unlatched after the removal of drill pipe 36 and the closing of blowout preventers 22 and picked up and suspended from barge 29 by unlatching latch mechanism 24. This is especially convenient in the event that some which could be sufficiently violent to cause damage by exceeding the allowable movement in misalignment joint 25 or otherwise. In such event the drill pipe 36 does not have to be pulled but may be unthreaded immediately above blowout preventers 22 with blowout preventers closed on drill pipe 36 and then latch mechanism 24 released and the whole assembly raised and suspended from barge 29 until the storm has passed. The lower end of the uppermost marine conductor 26 may be joined to the upper end of the next lower marine conductor 26 and remote control latch mechanism (not shown) similar to latch mechanism 24. With such remote control latching the upper marine conductor 26 may be quickly released and raised onto barge 29 in case of violent weather or wave action. With the top marine conductor 26 removed then the remainder of the marine conductors 26 will be substantially below the water surface 28 and will not be subject to the violent wave action. It is preferred in such cases that at least ten feet of clearance be maintained between the top of the marine conductors remaining in the water and the lowest point the barge 29 would reach in a wave trough.

The connection between the lowermost marine conductor 26 and the top of misalignment joint 25 is made with a short section 149 as shown schematically in FIGURE 1. Section 149 is provided with gussets 150 for strength but should not be over-strengthened as it will generally be desired that section 149 be the weakest part of the complete structure. Thus, any failure due to an exceeding of the angle allowable with misalignment joint 25 will occur in section 149 and thereby prevent a failure at or below well head 20 which would mean the loss of the well.

Latch mechanism 24 will not latch unless all components are properly positioned and therefore it is impossible to obtain an indication of latching if latching has not been accomplished. Also, it has been described that the individual marine conductors are designed to provide a greater buoyancy than weight so that when they are assembled for a marine drilling operation they will remain erect in the water but will not have sufficient buoyancy to support the weight of the latch mechanism 24 and the misalignment joint 25. A net positive buoyancy of the complete assembly is not desired as it would be necessary to force the assembly into the water rather than simply lowering into the water and supporting only the excess weight. This greatly facilitates the landing of the apparatus on the submarine well head equipment and includes a safety factor since it assures that the buoyant force will not be sufficient to cause damage due to the releasing of a highly buoyant conductor section from the assembly under water. The apparatus makes provision for the containing of all of the control lines within the marine conductor and for the quick connection of such control lines between adjacent sections of the marine conductors and also for the quick connection of such control lines to the submarine well head equipment which allow the well head to be completely controlled from the surface of the water without fear of flexible hoses becoming fouled or damaged.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof, and various changes in the method, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:
1. A buoyant marine conductor for marine drilling comprising:
   an inner tubular member,
   an outer tubular member,
   closure means secured to said members at each end securing said inner member within said outer member and closing the annular space between said members,
   a plurality of control lines extending longitudinally through said annular space,
   a plurality of stabbers extending through the closure means at one end of said conductor and each of said stabbers being connected to a control line,
a transverse slot in the exterior of each of said stabbers, a plurality of blocks engaging said slots, means securing said blocks to the closure means through which said stabbers extend, and a plurality of bushings positioned within the closure means at the opposite end of said conductor defining a stabber receiving bore and each of said bushings being connected to a control line.

2. A buoyant marine conductor for marine drilling according to claim 1 wherein said slots in said stabbers have a greater height than the thickness of said blocks to allow limited movement of said stabbers relative to the closure means through which said stabbers extend.

3. A buoyant marine conductor for marine drilling according to claim 1 including, a plurality of blocks engaging said bushings, and means securing said blocks to the closure means in which said bushings are positioned whereby said bushings are securely held in position.

4. A buoyant marine conductor for marine drilling according to claim 1 including, packing means within the stabber receiving bore of said bushings.

5. A marine conductor string comprising, a plurality of buoyant marine conductors, said conductors being connected in series to form a buoyant marine conductor string, a misalignment joint connected to the lower end of said series of marine conductors, a remote control latch mechanism connected to said misalignment joint, the total net buoyancy of said conductors in water being greater than the weight of said conductors and less than the weight of said conductors, said misalignment joint, and said latch mechanism, a plurality of control lines contained within and connecting through said series of connected marine conductors to said latch mechanism, a plurality of stabbers actuated by said latch mechanism, and each of said stabbers being connected to one of said control lines.

6. A marine conductor string according to claim 2 including, a buffer plate attached to said latch mechanism in protective relation to said stabbers.

7. A buoyant marine conductor for marine drilling comprising, an inner tubular member, an outer tubular member, closure means secured to said members at each end securing said inner member within said outer member and closing the annular space between said members, whereby said annular space extends throughout the length of said conductor and is of sufficient volume to render said conductor buoyant in water.

8. In combination with a submarine well head having blowout preventers secured thereon and a marine drilling barge, a plurality of buoyant marine conductors, each of said conductors defining an annular chamber extending along the length of said conductor and having sufficient volume to render said conductor buoyant in water, means connecting said conductors to form a string of marine conductors extending down from said barge, a remote actuated latch mechanism connected to the bottom of said string of marine conductors and adapted to engage and latch onto the upper part of said blowout preventers, a plurality of control lines contained within said annular chambers and connecting through said series of connected marine conductors to said latch mechanism, said connecting means also connecting said control lines between connecting conductors, whereby said control lines are totally enclosed from the uppermost conductor to the lowermost conductor, and said string of marine conductors having a net positive buoyancy.

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