

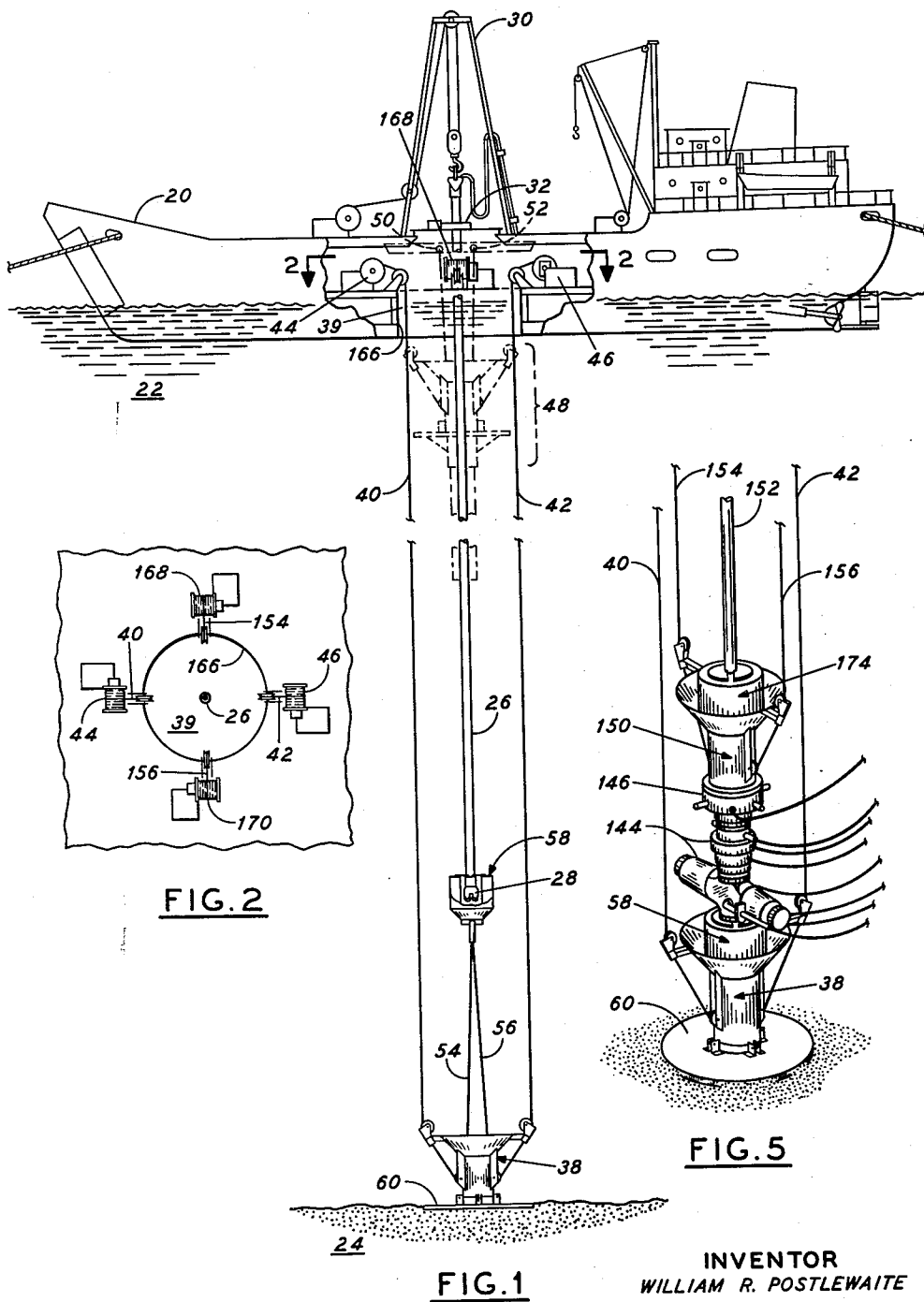
Feb. 20, 1962

W. R. POSTLEWAITE
MEANS FOR OFFSHORE DRILLING

3,021,909

Filed Oct. 1, 1958

3 Sheets-Sheet 1



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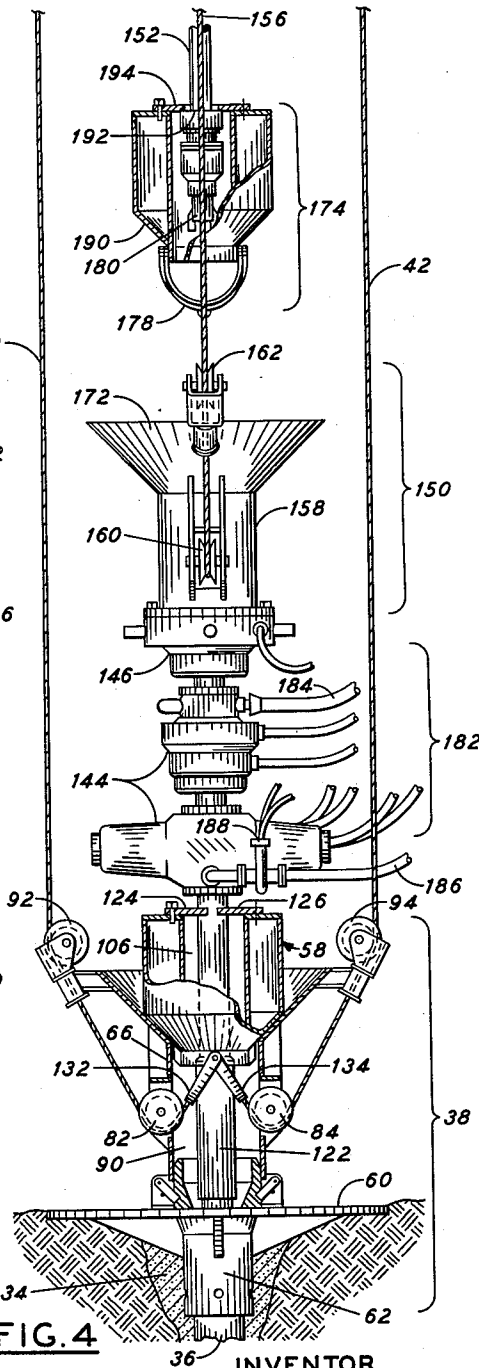
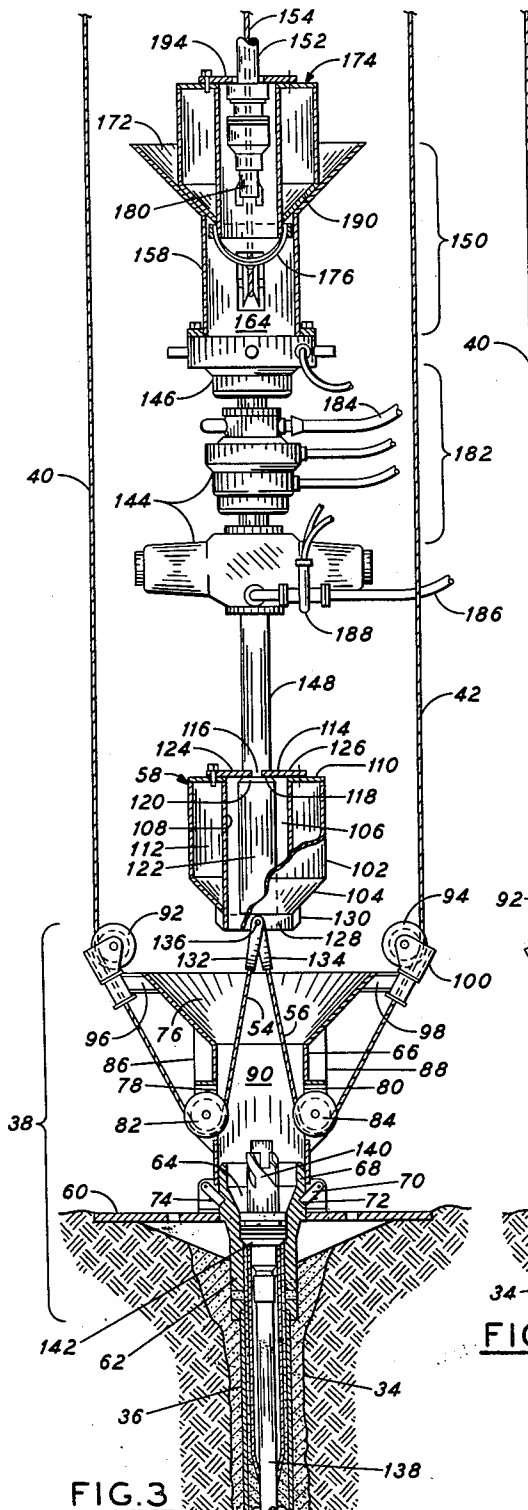


FIG. 4

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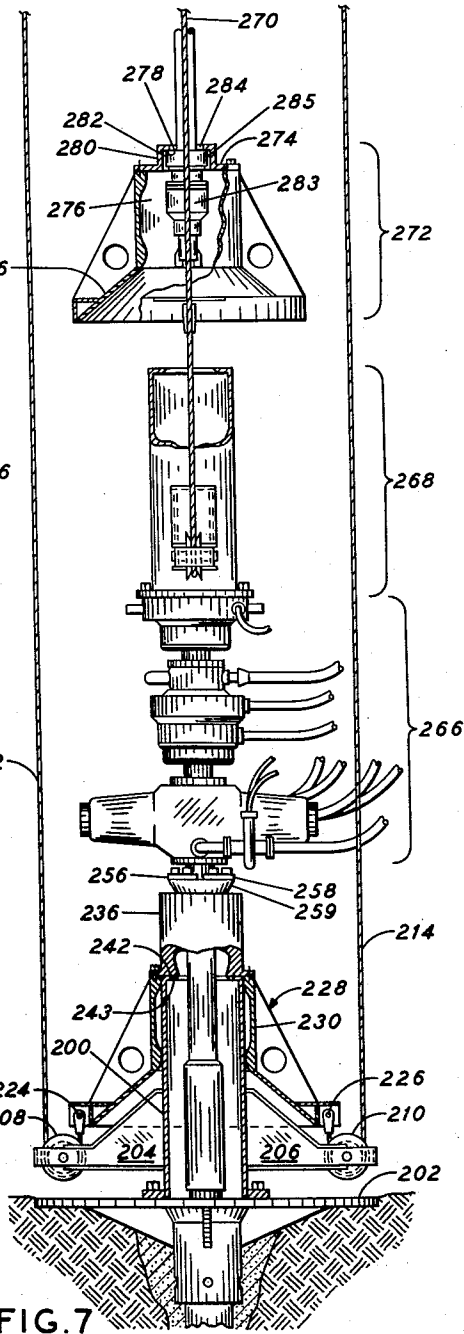
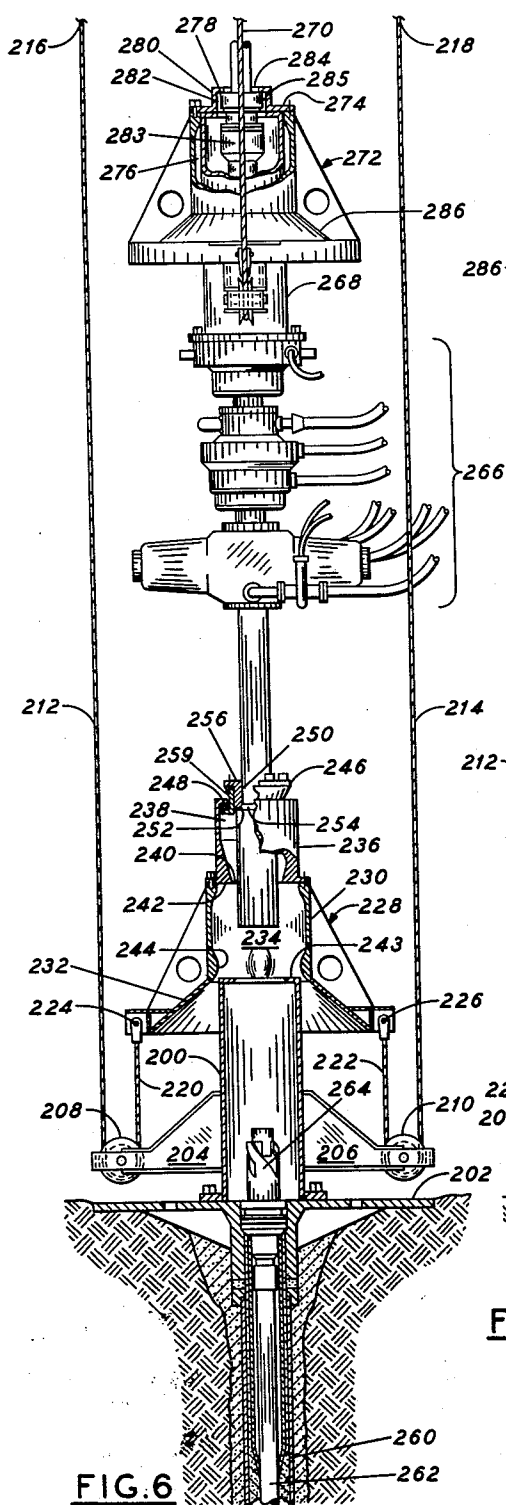


FIG. 7

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3,021,909

MEANS FOR OFFSHORE DRILLING

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6 Claims. (Cl. 175-7)

This invention relates to means for drilling and working offshore wells and more particularly to means for drilling a well bore from a floating drilling platform into a well site submerged below a body of water and subsequently for introducing apparatus into the well bore from the floating platform.

It has been suggested heretofore that well bores be drilled in submerged locations from floating drilling platforms by attaching the platform to a submerged well site by flexible guide lines, lowering the well drilling apparatus by gravity along the guidelines into contact with the submerged earth and subsequently drilling the well bore by operation of the drilling equipment from the floating vessel. The guidelines serve also as a means for guiding into the well bore apparatus used for servicing or surveying the well.

The guidelines used in the aforesaid method of drilling are flexible members which permit a displacement of the floating drilling platform with respect to the submerged well site and hence accommodate the motion of the platform while maintaining a connection between it and the submerged well opening. However, one difficulty experienced with this method of drilling results from the essential flexibility of the guidelines.

It has been found that subsurface water currents may bear against the guidelines, and the apparatus being guided along them, with such force that they will be displaced from alignment with the submerged well bore, even though the guidelines are held under tension. Hence the apparatus being lowered along the guidelines may engage the submerged wellhead equipment at an angle which makes it difficult, if not impossible, to introduce the apparatus into the well bore, or which may damage the submerged equipment. In waters too deep for divers to repair such damage, the result may be the forced abandonment of the well. It has been found also that subsurface water forces may bear against the apparatus being guided to the well bore with such force that the guide means connecting the apparatus with the guidelines may be broken, resulting in lost time on the drilling rig while the equipment is being repaired.

It is an object of this invention to provide a means for forcibly pulling drilling or other apparatus downwardly from a floating platform to a submerged well opening and into alignment with the well bore, wherein such means can exert enough force to overcome the effect of subsurface water currents and is not dependent on the use of guidelines.

A further object of this invention is to provide novel equipment for performing drilling and servicing operations on a submerged well bore from a floating drilling platform.

A further object of this invention is to provide apparatus for pulling or towing in a positive manner well working apparatus from a floating platform downwardly through a body of water to a submerged well site by a plurality of towlines which are connected between the lower portion of the well working apparatus and the submerged well opening and actuated by a winch means on the drilling platform to exert the force necessary to overcome the lateral displacement effects of the water currents and force the towed well working apparatus into alignment with the well bore.

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Other objects of this invention will become apparent as the description of it proceeds hereinafter.

The objects of this invention are achieved by affixing a base assembly structure to the submerged earth at the well site and mounting a plurality of towlines over pulley or sheave means which are part of the assembly. These pulley means are arranged symmetrically around the vertical axis of the base assembly, and a respective towline is mounted over each of the pulley means with one end of each towline attached to a winch mechanism on the vessel supporting the drilling platform and the other end attached to a towing head. Thus the operation of the winch mechanism pulls the towing head downwardly through the body of water and into engagement with the base assembly structure.

The towing head is constructed to be detachably connected to apparatus to be pulled down to the submerged well opening, and the towlines are connected to the towing head in a manner to exert a balanced pull on it. The towing head and the base assembly are constructed with complementary surfaces which will engage to center the towing head on the latter and force the towed apparatus into alignment with the well bore when the parts are pulled into engagement. Subsequently the towed apparatus is lowered through the towing head and the base assembly by manipulation from the drilling platform.

The following specification, together with the accompanying drawings which form part of it, describes several modifications of apparatus for accomplishing the objects of this invention.

With reference to the drawings:

FIG. 1 illustrates in side elevation, and partly in section, apparatus made in accordance with this invention being used in an offshore drilling operation.

FIG. 2 is a schematic illustration in plan view of an arrangement of winch mechanisms on the drilling vessel, as used in this invention, taken along the line 2-2 of FIG. 1.

FIG. 3 illustrates in side elevation and partly in section apparatus in accordance with this invention and shows a procedure for connecting wellhead control equipment to the submerged well opening.

FIG. 4 illustrates in side elevation and partly in section apparatus in accordance with this invention and shows the wellhead control equipment attached to the submerged well opening and drilling apparatus being pulled downwardly to the wellhead for insertion into the well bore.

FIG. 5 is an isometric illustration of an assembly employing the apparatus of this invention on a submerged wellhead while an offshore well is being drilled.

FIGS. 6 and 7 illustrate in side elevation and partly in section a modification of apparatus made in accordance with this invention.

Referring to the drawings, and particularly to FIGS. 1 and 3, there is illustrated an offshore drilling vessel 20 which has been anchored in a body of water 22 at a site where a well is to be drilled in the underwater bottom 24. A drill string 26 and bit 28 are suspended from the derrick 30 on the vessel and through a rotary table 32, and a hole 34 is drilled into the submerged earth of sufficient diameter and depth to accept a length of conductor casing 36. A base assembly 38 which forms part of the apparatus of this invention is connected to the top portion of the conductor casing.

In a preferred method for carrying out the positioning of the base assembly on the land surface at the bottom of the water, the base assembly with a length of conductor casing 36 attached thereto is suspended through a trunk 39 in the central portion of the drilling vessel by lines 40 and 42 which are wound on respective winches 44 and 46 as indicated by the phantom lines designated

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by the numeral 48 in FIG. 1. While the base assembly is thus suspended, the drill string with a bit attached to the end thereof is passed downwardly through it to drill the bore hole 34 for the conductor casing in the submerged earth.

With the drill string still remaining in the bore hole, the base assembly 38 is lowered along it by unreeling the lines 40 and 42 from their respective winch drums, while retaining the free ends of the lines on the drilling vessel, as indicated at 50 and 52, until the base assembly is seated at the ocean bottom. The conductor casing 36 is then cemented to the well bore by forcing a cementing material downwardly through the drill string and the base assembly is thus firmly secured to the earth at the submerged well site. Subsequently the free ends 54 and 56 of the lines 40 and 42 are connected to a towing head 58 which is detachably connected to the lower portion of the drill string 26. The lines 40 and 42 are then used to pull the towing head and the drill string downwardly through the water into engagement with the base assembly in a manner to be described hereinafter.

The drill string is then lowered by the derrick arrangement 30 on the drilling vessel until the drill bit 28 is in contact with the submerged earth. The drill string is rotated by the rotary table 32 to drill the well bore. When the drill string is retracted from the well bore, the towing head 58 is returned to the surface of the water with the drilling apparatus and is available for repeating the operation of pulling drilling or other equipment downwardly through the water to the submerged well opening.

Referring now to FIG. 3 of the drawings, the base assembly 38 comprises a base member 60 which is designed with sufficient lateral dimension to bridge over the opening of the bore hole which has been drilled to receive the conductor casing, and has sufficient bearing area to position the assembly on the surface of the land underlying the water to prevent it from being submerged in bottom sediments. The base member has a cylindrical projection 62 affixed to and extending downwardly from it which is rigidly connected to the conductor casing 36. There is a central opening 64 in the projection 62 in axial alignment with the conductor casing and hence with the well bore.

A hollow cylindrical support element 66 is affixed to the upper surface of the base member and projects upwardly therefrom in axial alignment with the conductor casing. This support element may be detachably connected to an upward extension 68 of the cylindrical projection 62 by latches 70 which engage a groove 72 in the circumferential surface of the extension. The latches are held in engagement with the groove by shear pins 74. The assemblage of these parts is made at the surface of the water, and the assemblage is lowered as a unit in the manner described heretofore. If it is desired to abandon the well or for some other reason remove the equipment from the submerged well opening, a sufficient tension is placed on the towlines 40 and 42 to cause the pins 74 to shear and release the support element 66 and the apparatus attached thereto from its connection to the base member.

The top portion of the cylindrical support member is flared in a conical form 76 which functions as a centralizing means for the towing head 58, and hence the apparatus towed by it, when the towing head is pulled into engagement with the base assembly. It will be understood that the cylindrical form of the support element 66 provides a simple structural shape for supporting the centralizing cone 76 of the sheave-and-pulley components of the apparatus to be described hereinafter. However, the concept of this invention is not limited to this specific structure but embraces other forms of support means which will perform the same functions.

A pair of diametrically opposite openings 78 and 80 are formed in the circumferential wall of the cylindrical support element, and a respective pulley 82 and 84 is

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mounted in each of said openings on respective bracket structures 86 and 88. The pulleys are disposed with at least a portion of the rim of each of them extending within the axial chamber 90 of the hollow support element 66. A respective sheave 92 and 94 is supported by a respective bracket 96 and 98 on the conical portion of the element with each pulley and its component sheave positioned in the same vertical plane.

The respective towlines 40 and 42 are mounted over each corresponding sheave-and-pulley set with one end, 54 and 56, of each towline disposed within and passing upwardly through the cylindrical chamber of the hollow support element and the other end disposed exteriorly of the apparatus. These latter ends of the towlines are connected to the respective winch mechanism 44 and 46 aboard the drilling vessel as explained heretofore. A line guard 100 surrounds each towline where it passes over its respective sheave 92 or 94 to prevent the towline from being disengaged from its component sheave.

At the beginning of a towing operation the ends 54 and 56 of the respective towlines pass upwardly through the base assembly to the surface of the water and aboard the drilling vessel. Subsequently these ends of the towlines are attached to the towing head in a manner to be described hereinafter.

One modification of a towing head 58 made in accordance with this invention is illustrated in FIGS. 3 and 4. This device is made with a cylindrical peripheral surface 102 which tapers at its bottom portion 104 in a conical form which is complementary to the conically flared portion 76 of the cylindrical support element 66 of the base assembly. The towing head has an inner cylindrical chamber 106 which is continuous through it and open at the top and bottom ends. The wall 108 of this cylindrical chamber is sealed to the top wall 110 and the bottom 104 of the towing head in a fluid-tight manner to form a symmetrical buoyancy chamber 112 within the towing head. The parts are proportioned to give the towing head positive buoyancy of sufficient force to pull the ends of the towlines from a submerged position to the surface of the water as the towlines are slacked off from their respective winches. This structure provides a means for retrieving the towing head and the towlines from a submerged position if the towing head becomes disconnected from the apparatus it has pulled downwardly into the water.

The towing head has a split flange 114 bolted to its top surface, and the flange extends radially inwardly over the cylindrical chamber 106, and there is a central opening 116 through the flange in axial alignment with the cylindrical chamber. Thus the flange forms a shoulder 118 at the upper end of the cylindrical chamber designed to engage a complementary shoulder 120 on the apparatus 122 disposed within the chamber to prevent this apparatus from being withdrawn out of the towing head in an upward direction.

The split flange 114 is made in two half-sections 124 and 126 which can be assembled around a drill string or other tool inserted into the chamber 106 as the flange is bolted to the towing head. The opening 116 in the flange is selected to fit snugly around the equipment inserted through it but with sufficient internal diameter to permit this equipment to be lowered through the towing head after the latter is pulled into engagement with the base assembly.

The lowermost portion 128 of the towing head is made with a cylindrical form which will telescope within the hollow cylindrical support element 66 of the base assembly, and the projecting ribs 130 are affixed to its outer surface to assist in centralizing the towing head in coaxial alignment with the base assembly as the parts are pulled into engagement.

The pivoted bails 132 and 134 mounted on the lower portion 128 of the towing head provide a means for attaching the towlines to it. These bails are mounted on

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a common pivot axis 136 which is diametrically disposed relative to the cylindrical portion 128. When the towing head is pulled into engagement with the base assembly, the positions of the pulleys 82 and 84 in relation to the engaged position of the towing head causes the towlines to swing their respective bails laterally away from the axis of the passageway through the base assembly, as illustrated in FIG. 4. Thus the passageway 90 is cleared for the passage of the well drilling apparatus as it is lowered through the towing head and base assembly 38 and into the well bore.

After the base assembly is secured to the submerged earth, the towlines and towing head are used to pull the drilling string 26 with a drill bit 28 attached to the end of it down to the base assembly in the manner illustrated in FIG. 1, and into axial alignment with the conductor casing 36. During this operation, as in other tow-in operations to be described hereinafter, the upper portion of the drill string is supported by the derrick on the drilling platform, and the restraining force of the drawworks is balanced against the pull of the towline to cause the drill string to move downwardly through the water while a considerable amount of tension is imposed on it. The towline tension may be in the order of several times as great as the weight of the drill string, and the derrick hook, therefore, is loaded both with the weight of the drill string and the pull of the towline. Hence there is provided a direct control of the forces which may be exerted in positioning the towing head on the base assembly and bringing the drill string into alignment with the well bore. The balancing of the opposed tensions imposed on the apparatus as it progresses through the water provides a means for applying sufficient force to the derrick lines and towline to counteract the hydraulic forces imposed by the transverse water currents and hence provides a means for maintaining the drill string in alignment with the well bore.

A bore hole is drilled into the earth to accept a string of surface casing 138, FIG. 3, which is pulled downwardly from the drilling vessel and into alignment with the well bore in the manner of the drill string as explained heretofore. The upper end of the string of surface casing is supported by the derrick 30 on the drilling vessel by a string of tubing to which it is attached by a connection, such as a safety joint, which can be released by remote operation.

As illustrated in FIG. 3, the surface casing has a mandrel 140 of a safety joint attached to its uppermost portion, and when the surface casing is fully inserted into the bore hole it may be supported in the base assembly by a casing hanger 142 with the mandrel extending above the base member 60 and within the passageway 90 of the cylindrical support element 66. The string of tubing which connects the surface casing with the drilling vessel is used as a conduit to cement the surface casing in the well bore. This string of tubing is then disconnected from the surface casing at the safety joint and returned to the drilling vessel along with the towing head which was used to pull the surface casing and connected tubing downwardly through the water. The towing head remains connected to the lower end of the tubing string through the abutting, interengaging surfaces between the parts, and through the action of the connected towlines provides a restraint to control the position of the lower end of the tubing string as it ascends through the water.

The towing head is now used to pull down to the submerged well opening wellhead control equipment which is then latched and sealed into the safety joint mandrel. As illustrated in FIGS. 3 and 4, this equipment may comprise a series of blowout preventers 144 and a drilling head 146 which are connected together in axial alignment to provide a passage through the equipment to the well bore. A short length of pipe 148 is connected to the lower portion of the control equipment, and the barrel or female portion of the safety joint, which in this instance

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corresponds to the apparatus 122 mentioned heretofore, is fixed to the lower end of this tubing.

A tow-in assembly 150 comparable to the base assembly 38 described heretofore is fixed to the top portion of the drilling head when the wellhead control equipment is assembled together at the surface of the water and prior to pulling it downwardly to the submerged well site. This assembly comprises sheave-and-pulley arrangements for mounting a pair of second towlines and a centralizing means for a second towing head. The pair of second towlines are used to pull well drilling or other apparatus downwardly through the water to the submerged wellhead control equipment through which it is lowered into the well bore.

While the wellhead control assemblage is being pulled downwardly through the water by the towlines 40 and 42, it is supported from the derrick 30 of the drilling vessel by a string of tubing 152 and by the second pair of towlines. The tubing string is lowered by the derrick, and the second pair of towlines are unreeled from their associated winch drums as the assemblage progresses downwardly. Sufficient tension is maintained on the second pair of towlines to keep the second towing head in engagement with the tow-in assembly 150.

When the towing head 58 engages the base assembly 38, the tubing string 152 is lowered by the derrick 30 to pass the barrel 122 of the safety joint through the passage 106 in the towing head and the passageway 90 in the base assembly until the barrel engages the mandrel 140 and automatically latches onto it. Thus the well control equipment is securely connected to the well opening. The first towlines 40 and 42 now remain idle while the second towlines 154 and 156 are used to pull apparatus subsequently used for drilling or working the well downwardly from the drilling vessel to the submerged wellhead.

The tow-in assembly 150 which is connected to the top of the wellhead control equipment comprises a hollow cylindrical support element 158 comparable to the support element 66 of the base assembly. A respective pulley-and-sheave arrangement for each of the second towlines is mounted on the exterior of the support element 158 in a manner comparable to the pulleys 82 and 84 and sheaves 92 and 94 of the base assembly, as illustrated by the pulley 160 and sheave 162 for the towline 156 of FIG. 4. The respective pulleys are positioned on the support element 150 in diametrically opposed relationship and with a portion of their rims extending within the axial passageway 164. Each respective towline 154 and 156 is mounted over its pulley and its companion sheave with one end of the towline being disposed operatively within the axial passageway 164 and continuing upwardly to the surface of the water. The other end of each towline is connected to a respective winch mechanism aboard the drilling vessel.

FIG. 2 is a diagrammatic illustration of the operative relationship aboard the drilling vessel of the winches for the towlines. In this figure the circumference of the circular trunk 39 through the hull of the drilling vessel is indicated by the numeral 166. To simplify the explanation of the arrangement, the various winches are shown as disposed in equiangular relationship around the circumference of the well, although it will be appreciated that these winches may be otherwise positioned on the drilling vessel and the respective towlines carried to their operative positions relative to the trunk 39 by appropriate sheave arrangements.

As illustrated, the winches 44 and 46 are disposed on diametrically opposite sides of the trunk 39. The towlines 40 and 42, respectively, are reeled on these winches and operate in a vertical plane which passes through the winches. The winches 168 and 170 are positioned at the well also in diametrically opposite relationship on a diameter at right angles to that of the winches 40 and 42. The second pair of towlines 154 and 156 are reeled on the winches 168 and 170, respectively, and these tow-

lines operate in a vertical plane which is positioned at right angles to the plane in which the first-mentioned towlines operate. This disposition of the winches and towlines prevents the latter from becoming entangled when the apparatus is in operation.

The tow-in assembly 150 has a conically flared portion 172 at its upper end to engage and center a second towing head 174 which is attached by a pair of pivoted bails 176 and 178 to the respective towlines 154 and 156 in a manner described with relation to the towing head 58. The second towing head is similar to and may be a duplicate of the towing head 58 described heretofore.

FIG. 4 illustrates the arrangement of the parts after the wellhead control equipment has been connected to the surface casing and shows a drill bit 180 on the end of the drill string 152 being pulled down into engagement with the submerged wellhead apparatus. The wellhead control equipment is actuated by remote operation from the drilling vessel through the hydraulic lines designated generally by the numeral 182. A mud return line 184 is connected to the assemblage below the drilling head, and a production or, alternatively, a "kill" line 186, which is controlled by a remotely operated valve 188, is connected to the assemblage below the blowout preventers. During a drilling operation drilling mud is forced downwardly through the string of drill tubing and returns to the drilling vessel through the mud return line 184 in a manner understood in the art.

When apparatus is to be pulled into the well bore, the blowout preventers and drilling head are actuated from aboard the drilling vessel to open a passageway from the towing head 174 into the surface casing 138. The winches 168 and 170 are placed in operation to pull the second towing head 174 downwardly through the water into contact with the submerged tow-in assembly 150 in which it is centered through the cooperation of the complementary surfaces of the flared conical portion 172 of the tow-in assembly and the lower conical portion 190 of the towing head.

As explained heretofore, the upper portion of the drill string is supported in a vertical position by the derrick of the drilling vessel. Sections of drill tubing are added to the upper portion of the string in a manner analogous to that employed in ordinary drilling practice. When the towing head 174 is pulled into engagement with the tow-in assembly 150, the drill string is lowered by the derrick 30 to pass through the submerged wellhead assembly into the well bore and in contact with the subterranean formations. Subsequently the drill string is rotated by the rotary table 32 to continue the well drilling operation.

FIG. 5 illustrates the arrangement of the submerged wellhead apparatus during a drilling operation. As will be noted, the drill string 152 has been pulled into axial alignment with the well bore through the action of the towlines 154 and 156 and the towing head 174. The towing head is held in contact with the tow-in assembly 150 through the action of these towlines while the drilling operation is proceeding. The wellhead control equipment is connected to the well opening through the safety joint as explained heretofore, and the towlines 40 and 42 remain tight though idle.

When it becomes necessary to change a drill bit, the drill string is raised by the hoist means on the drilling vessel. As the bit moves upwardly, it enters the towing head 174 to assume the position shown in FIG. 4 with the radially projecting shoulder 192 on the drilling apparatus engaging the flange member 194. An appreciable restraining tension is held on the towlines 154 and 156 to control the ascent of the equipment while the drill string continues to be raised, and the drawworks is operated to overpower this tension.

The drill string carries the towing head to the surface of the water and thence aboard the drilling vessel. Thus when the drill bit is changed, the towing head is available to be connected to it, and the drill string is again pulled

downwardly through the water by operation of the towlines 154 and 156. This operation, of course, applies also to other well working apparatus than drill strings which it is desired to insert into the well bore.

FIGS. 6 and 7 show a modification of structure made in accordance with this invention. In this modification a hollow cylindrical support element 200 is affixed to a base member 202 and extends upwardly from it in vertical alignment with the well bore. The support element has a pair of diametrically opposed bracket members 204 and 206 affixed to its outer surface, and respective pulleys 208 and 210 are rotatably mounted adjacent the radially outer end of each bracket. A respective towline 212 and 214 is mounted over each pulley with one end, 216 and 218, respectively, of each towline connected to a winch mechanism on the drilling vessel and the other end, 220 and 222, respectively connected to a towing head. The respective connections 224 and 226 for the towlines on the towing head are placed in spaced-apart diametrically opposed relationship to provide a torque which will rotate the towing head into alignment with the pulleys 208 and 210 on the base assembly as the parts are pulled into engagement.

The towing head 228 is formed with a hollow cylindrical portion 230 which has a conically flared skirt 232 attached to the bottom of it with the largest diameter of the cone disposed at its lowermost portion. A vertical chamber 234 through the cylindrical portion is made with sufficient internal diameter to telescope over the cylindrical support member 200 when the parts are pulled into engagement, and the conical skirt 232 assists in centering the towing head over the cylindrical support element. A second cylindrical section 236 having a vertical passageway 238 through it of reduced internal diameter is affixed to the top of the first section 230, in axial alignment. The lower end surface 240 of the second cylindrical section projects radially inwardly within the vertical passageway 234 of the first section to provide a diametrically disposed shoulder 242. This shoulder engages the top end 243 of the cylindrical support element 200 when the parts are in full engagement to limit the downward travel of the towing head. Centralizing ribs 244 project radially inwardly from the wall of the passageway 234 to center the towing head in coaxial alignment with the cylindrical support element.

The cylindrical section 236 has a cap element 246 mounted on its upper end. This cap element is supported on antifriction bearings 248 to enable it to rotate in a horizontal plane relative to the vertical axis of the towing head. There is a central opening 250 through the cap element in alignment with the passageway through the towing head but of smaller internal diameter than the passageway 238. Therefore, the cap element extends radially inwardly of the passageway 238 to form a shoulder 252 which will abut a complementary shoulder such as the shoulder 254 on the drilling apparatus shown in FIG. 6 when the latter is pulled upwardly relative to the towing head. The opening through the cap is selected to fit snugly around the apparatus inserted through it but with sufficient internal diameter to permit this apparatus to be lowered through the towing head when the latter is seated on the base assembly. Desirably, the cap 246 is made with two internal half-sections 256 and 258 which can be assembled within a sleeve 259 to surround a drill string or other tool inserted into the passageway 238. The half-sections are then bolted to the sleeve to form a unitary assemblage. The rotatable mounting 248 of the cap assemblage permits the towing head to be turned in a horizontal plane to align the ends 220 and 222 of the respective towlines with the pulleys 208 and 210 without interference from the frictional effects of the abutting shoulders 252 and 254. This arrangement also prevents the intertwining of the two towlines through any rotational movement of the apparatus being towed downwardly through the water.

The operation of the apparatus described immediately heretofore is similar to that previously described with relation to FIGS. 3 and 4. The towlines 212 and 214 are employed to pull the first towing head 228 downwardly through the water to the base assembly. This towing head is employed to pull down to the base assembly the apparatus required to drill the bore hole for, and to set, the string of surface casing 138, in the manner previously described.

A mandrel 264 of a safety joint is connected to the uppermost portion of the string of surface casing, as explained heretofore, and the wellhead control equipment 266 is pulled down through the water and latched onto it. A tow-in assembly 268 similar to that described for the base assembly is fixed to the top portion of the wellhead control equipment. This tow-in assembly has associated with it a pair of towlines, one 270 of which is shown, which are disposed in a vertical plane positioned transversely of the vertical plane of the towlines 212 and 214. They are attached at one end to a second towing head 272 and at the other end to a winch mechanism aboard the drilling vessel. The second towing head has a split cap element 274 affixed to its upper end and projecting radially inwardly of the vertical passageway 276 through the towing head to form an abutting shoulder 278 for the purpose described heretofore.

In this modification of the towing head the cap element is formed with a hollow cylindrical portion 280 projecting upwardly on it with a chamber 282 having an internal diameter which closely approaches the diameter of the portion of the tool 283 engaged within the passage 276, as indicated at 285. As in previous modifications, the cap is made with a central opening 284 which will permit a string of tubing, for instance, to slide downwardly through it. The cylindrical projection 280 centers the tool in coaxial alignment with the towing head and hence in alignment with the wellhead control equipment when the towing head is pulled into engagement with the tow-in assembly. The lower portion of the towing head is formed with a conically flared skirt 286 to center the towing head with the tow-in assembly 268 when the parts are pulled together.

The operation of this modification of apparatus is similar to that described heretofore with respect to previous modifications. After the wellhead control equipment is pulled down to the submerged well opening and latched onto the safety joint, the towlines 212 and 214 remain idle. Subsequently the second pair of towlines, as represented by 270, are used to pull down to the wellhead other apparatus required for drilling or working the well, and this apparatus is further lowered from the drilling vessel into the well bore.

It is apparent from the foregoing description that the apparatus of this invention achieves the objects as set forth heretofore and provides a means for forcibly pulling well working tools and apparatus downwardly from a floating platform on the surface of the water to a submerged wellhead and into alignment with the well bore through the force imposed by towlines. The apparatus is constructed to permit towline tensions in the range of thousands of pounds to be used. Thus a means has been provided to align the well working apparatus with the submerged wellhead in a positive manner and with sufficient force to overcome the effects of subsurface water currents which heretofore have proved troublesome in offshore drilling operations.

It is apparent that other modifications than those described herein may be made to the apparatus of this invention without departing from the inventive concept. Therefore, it is intended that the invention embrace all equivalents within the scope of the appended claims.

I claim:

1. Apparatus for use in working in a well in an offshore location comprising a drilling vessel at the surface of a body of water and anchored above a submerged well

site, a submerged well having an opening at said well site, a base assembly at the bottom of said water and affixed to the submerged earth at said well site, said base assembly formed with a passageway therethrough in alignment with said submerged well, a pair of pulley means mounted on said base assembly in spaced-apart diametrically opposed relationship relative to the axis of said passageway, a respective towline mounted over each of said pulley means, a respective winch means on said drilling vessel for each said towline, a single towing head formed with a vertical passageway therethrough, means operably connecting one end of each said towline to a said respective winch means and the other end of each said towline to said single towing head in substantially coaxial alignment with said passageway through said towing head, complementary means on said base assembly and said towing head to center said towing head on said base assembly with said passageway in said towing head in coaxial alignment with said passageway in said base assembly when said towing head is in engagement with said base assembly, means displacing said other end of each said towline from said coaxial alignment with said passageway in said towing head and said passageway in said base assembly when said towing head and said base assembly are in engagement, a string of tubing supported in a vertical position by said drilling vessel, means on said drilling vessel and connected to said string of tubing for lowering and raising said string of tubing vertically through said water, means connecting the lower end of said string of tubing to said towing head and in axial alignment with said passageway through said towing head, means to operate said winch means to forcibly pull said towing head downwardly through the water and into engagement with said base assembly, said means for lowering said string of tubing vertically through said water being operable to lower said string of tubing through said towing head and said base assembly and into said submerged well.

2. Apparatus in accordance with claim 1 comprising a respective bail for each said towline with each said bail pivotally mounted on said towing head on a common diametrical axis, means connecting the said other end of each said towline to its said respective bail, and wherein said pulley means are spaced apart a distance sufficient to cause said bails to swing laterally away from the axis of said passageway through said base assembly when said towing head is pulled into engagement with said base assembly.

3. Apparatus for pulling equipment downwardly from a surface platform to a well opening submerged under a body of water comprising a base member submerged at the bottom of a body of water and secured to a submerged well opening, a hollow cylindrical element secured to and projecting upwardly from said base member and terminating at its upper end in a conically flared portion, said base member and said cylindrical element formed with a passage therethrough in vertical alignment with said well opening, the circumferential wall of said cylindrical element formed with a pair of openings therethrough in diametrically opposed relationship, a respective pulley means mounted on said cylindrical element at the location of each opening of said pair of openings and disposed with at least a portion of the rim of each of said pulley means within said hollow cylindrical element, a respective towline mounted over each of said pulley means with each said towline having one end portion thereof disposed operatively vertically through said hollow cylindrical element, a power means for pulling on said towlines, the other end portion of said towlines connected to said power means, a single towing head formed with an axially disposed passage therethrough, said single towing head formed to detachably engage said cylindrical element in concentric relationship, means connecting said single towing head to the said one end portion of each said towline, means to op-

erate said power means to pull said towing head into engagement with said cylindrical element, and means on said towing head to detachably engage equipment extended through said axially disposed passage through said towing head to pull said equipment from said surface platform into concentric relationship with said cylindrical element when said towing head is pulled into engagement with said cylindrical element.

4. Apparatus for pulling equipment downwardly through a body of water from a vessel anchored at the surface thereof to a well opening at the bottom thereof comprising a vessel at the surface of a body of water, a support structure separate from said vessel and submerged at the bottom of said body of water and affixed to a submerged well, said support structure formed with a passage therethrough in vertical alignment with said wall, a pair of arms projecting radially from said support structure in diametrically opposed relationship, a respective pulley means rotatably mounted adjacent the end of each of said arms, winch means on said vessel, a respective towline mounted over each of said pulley means and connected at one end to said winch means, a single towing head separate from said vessel and formed with spaced-apart diametrically opposed respective connecting means for each said respective towline, means connecting each said respective towline to said respective connecting means, said towing head formed with a passageway therethrough to receive equipment to be pulled downwardly through the water, bearing means on said towing head, a cap element formed with an opening therethrough in alignment with the said passageway through said towing head and supported on said bearing means for rotation about a vertical axis, said cap element formed with a portion thereof projecting radially inwardly of said passageway through said towing head to provide a shoulder adjacent the upper end thereof to engage a complementary shoulder on equipment disposed through said cap element and said passageway through said towing head, a conically flared lower portion on said towing head, and complementary engaging means on said towing head and said support structure to align the said passageway through said towing head and the said passage through said support structure in coaxial relationship when said towing head is pulled by said towlines into engagement with said support structure.

5. Apparatus in accordance with claim 4 wherein said support structure comprises a vertically disposed cylindrical member having a vertical passage therethrough, and wherein said towing head has a complementary cylindrical portion which engages said cylindrical member of said support structure in telescopic relationship when said towlines pull said towing head into engagement with said support structure.

6. Apparatus for drilling a well in an offshore location comprising a drilling vessel at the surface of a body of water and anchored above a submerged well site, a base assembly at the bottom of said water and affixed to the submerged earth at said well site and having a vertical

passageway formed therethrough, a plurality of pulley means mounted on said base assembly, a plurality of towlines with a respective towline mounted over each of said pulley means, winch means on said drilling vessel, one end of each of said plurality of towlines operatively connected to said winch means, a single towing head having a vertical passageway therethrough, the other end of each of said plurality of towlines connected to said towing head in substantially concentric relationship with said vertical passageway through said towing head, said plurality of towlines comprising a flexible connection between the submerged fixed said base assembly and said drilling vessel which permits said drilling vessel to move on the surface of said water relative to said base assembly while remaining connected to said base assembly, a string of tubing having a drill bit affixed to the lower end thereof, a derrick means on said drilling vessel, means connecting the upper end portion of said string of tubing to said derrick means, means for operating said derrick means for lowering and raising said string of tubing vertically through said water, means detachably connecting said towing head to the lower end portion of said string of tubing with said string of tubing in alignment with said vertical passageway through said towing head, means for operating said winch means to forcibly pull said towing head and said string of tubing downwardly through said water by the said plurality of towlines connected to said towing head and against the restraining force of said derrick means to place said towing head into engagement with said base assembly, co-operating means on said towing head and said base assembly to seat said towing head on said base assembly with the said lower end portion of said string of tubing in vertical axial alignment with said vertical passageway through said base assembly when said towing head is placed in engagement with said base assembly, means maintaining said other end of each of said towlines clear of the said passageway through said towing head and the said passageway through said base assembly when said towing head is seated on said base assembly, said derrick means being operable to further lower said string of tubing through said towing head and said base assembly to place said drill bit in contact with said submerged earth, and means on said drilling vessel to rotate said string of tubing.

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**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,021,909

February 20, 1962

William R. Postlewaite

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 14, for "drilling" read -- drill --;
column 11, line 17, for "wall" read -- well --.

Signed and sealed this 16th day of July 1963.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents