Description

This invention relates to a method and apparatus for conducting operations within a subsea wellhead.

The operation of equipment in remote and inaccessible locations is difficult and, at times, impossible since there is no information available as to the condition or the occurrence of an event in such remote location. A typical example of a remote and inaccessible location is a subsea marine wellhead. The operations in a subsea marine wellhead are numerous and difficult to determine by the operations on the drilling vessel whether or not the exact desired operation has been successful. Examples of the kinds of operations contemplated herein are the landing of a casing hanger on the housing seat, the proper setting of the annulus seal, the positioning of a tool or component at a particular level or orientation within the wellhead, the strain on a component within the wellhead as an indication of the completion of a downhole cold forging operation or merely the application of a preselected amount of torque or other load to a component within the wellhead.

Prior to the present invention, the operations contemplated herein were done from a drilling vessel at the surface of the water and either no indications or very limited indications have been available as to whether or not such operations have been successfully completed. The penalty for failure of completion of such operations successfully has been at least having to recover the string and other equipment to the surface and to redo the operation completely, usually with new equipment. Failure to complete some operations can result in damage to the wellhead and possible other damage to the well.

While well logging has for years been accomplished in well bores both on land and in marine applications, the information was normally transmitted back to the surface electrically by direct wiring or recorded by the tool in the well bore and the tool recovered to the surface. The information which such devices have acquired is not helpful in providing the desired completion of operations information which is desired.

Some information has been provided from a well bore for directional drilling purposes but this information is generally an indication of the direction and inclination taken by the drilling tool during directional drilling operations. Such information did not provide any signal which would be sufficiently complete for any operations other than the controlling of the direction of the drilling.

There has been a considerable amount of work on systems and apparatus for use to make measurements while drilling. These measurements include transmitting information, such as logging data and transmitting to the surface on longitudinal and torque pulses in the drill string (U. S. Patent Nos. 3,813,656 and 3,830,389; utilizing an acoustic signal transmitted through the drill string U. S. Patent Nos. (3,900,827 and 4,066,995); generating mud pulses and transmitting through the drilling fluid (U. S. Patent Nos, 3,958,217, 4,001,775, 4,134,100, 3,821,696, 3,949,354 and 3,982,224); sonic signals detect change in mud flow rate from drill string to annulus (U. S. Patent No. 4,527,425); information electrically transmitted to the surface over wires (U. S. Patent Nos. 3,825,078, 4,121,193 and 4,126,848); well logging information transmitted in the range from 1-30 Hertz and includes repeater stations (U. S. Patent No. 4,087,781); and pressure pulses generated in the string and detected at the surface as stress changes in the material of the drill string wall (U. S. Patent No. 4,066,995).

As can be seen from a review of such prior art references, none of them address the problem of providing information to the surface to indicate the position of equipment being used within a subsea wellhead in a marine well.

US-A-4206870 describes a method of providing a surface indication of the arrival of a top releasing plug used in the cementing of a well. A magnet is placed in the plug and a magnetic switch in the well bore senses the magnet in the plug when it arrives in the well bore at the sea floor. A signal is transmitted to the surface to indicate arrival of the plug.

According to one aspect of the present invention there is provided a method of conducting operations within a subsea marine well from the water surface comprising lowering a well component into the subsea wellhead on a running string and detecting the occurrence of a condition with respect to said well component or said string and said subsea wellhead and, in response to said detection, transmitting a signal to the water surface, wherein detecting equipment and transmitting equipment are lowered into the wellhead with said component on the running string, characterised in that said detecting equipment is used to carry out said detecting step by detecting the occurrence of a condition as between the well component or said string and said wellhead and said transmission equipment is used to carry out said transmitting step.

According to another aspect of the present invention there is provided an apparatus for manipulating equipment including a well component in a subsea wellhead of a subsea marine well comprising a running string for lowering the well component into the subsea marine well, detecting means for detecting the occurrence of a condition with respect to said well component in the subsea

wellhead, transmitting means for transmitting a signal to the water surface, means for supporting the detecting means and the transmitting means on the running string with the well component so that the detecting means, transmitting means and well component can be lowered together into the wellhead on the running string, said detecting means upon the detection of the occurrence of a condition with respect to said well component in the subsea wellhead causing said transmitting means to transmit a signal to the water surface that the condition has occurred, characterised by said wellhead and said detecting means being adapted to enable the detection of a condition as between said well component or said running string and said wellhead.

The present invention is applicable to any application in which equipment is operated at a remote inaccessible loation by manipulation at an accessible location and providing a signal to indicate that the desired position of the equipment has been achieved or that the event desired has occurred. It is contemplated that the method and apparatus of the present invention is applicable to operations of underwater Xmas trees, marine production manifolds, underwater pipeline repairs, underwater laying of pipelines, remote leak detection, remote choke and valve positioning, the remote flow rate detection, remote annular and ram type blowout preventer positioning and other details in the positioning and operation of remote equipment. The apparatus includes the equipment to perform the method as hereinafter described.

The present invention can he used to provide an indication at the surface of the positive completion of the opration or setting of equipment within the wellhead.

The invention will be described now by way of example only, with partgicular reference to the accompanying drawings. In the drawings:

FIGURE 1 is a schematic elevation view of a subsea marine completion of proper setting or location of equipment within the subsea wellhead.

FIGURE 2 is a schematic transverse sectional view of a proximity location detection sub with the section being taken through each individual proximity detector to illustrate its location with respect to the circumference of the others around the sub.

FIGURE 3 is a longitudinal sectional view of the detection sub shown in FIGURE 2 taken along line 3 - 3.

FIGURES 4A and 4B are schematic electric diagrams of the circuit used with the detection sub and its proximity detectors to provide an indication of the exact location and a partial sectional view of the interior grooves on the interior of the housing used to provide such indication is shown to the left of the schematic diagrams to illustrate the relative detector and groove locations.

FIGURE 5 is a partial sectional view of the detection sub shown in FIGURES 2 and 3 and further showing the means of transmitting the information out of the sub.

FIGURE 6 is an elevation view of a subsea marine wellhead including the riser connection to the surface. This view schematically illustrates a plurality of operations which can be detected as hereinafter described and transmitted directly to the surface through wiring associated with the tube bundles extending from the surface to the wellhead.

FIGURE 7 is another partial sectional view of the subsea marine wellhead illustrating the landing of the hanger on the housing shoulder and the sub having the landing detector therein.

FIGURE 8 is a partial sectional view of a tool used to cold forge a tubular member within an annular member and having means providing a noise or other type of acoustic wave responsive to the landing of the tool in its proper position. In the drawing of this FIGURE the tool carries a shear pin which has landed on the upper edge of the tubular member in the well but has not sheared.

FIGURE 9 is another partial sectional view illustrating the landing of the tool shown in FIGURE 8 and the shearing of the shear pin which creates the acoustic wave which can be detected to indicate the landing.

FIGURE 10 is a longitudinal sectional view through the cold forging tool shown in FIGURES 8 and 9 after it has forged the tubular member into the annular member and showing the means for detecting the completion of the cold forging step.

FIGURE 11 is a partial longitudinal sectional view of the wellhead illustrating the landing of the seal assembly and the ratcheting of the latch mechanism and the detecting means for sensing that the latch has reached the end of its ratcheting.

FIGURE 12 is a detail sectional view of the latch mechanism in its initial stages of its ratcheting movement.

FIGURE 13 is another detail sectional view of the latch mechanism on the completion of its ratcheting movement.

FIGURE 14 is a sectional view of the detecting sub and the string on which it is run within the riser and indicating the means by which the sensed condition is transmitted to the surface through the fluids in the annulus between the string and the riser.

FIGURE 15 is another sectional view similar to FIGURE 14 but illustrates the sensed condition being transmitted to the surface through the fluids in the string.

FIGURE 16 is another sectional view similar to FIGURES 14 and 15 and illustrates the sensed condition being transmitted through the riser to the surface.

FIGURE 17 is another sectional view similar to FIGURES 14, 15 and 16 and illustrates the sensed condition being transmitted through the string to the surface.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Wellhead 10 shown in FIGURE 1 is a subsea marine wellhead and has housing 12 to which stack 14 is connected by remotely actuated collet connector 16. Riser 18 connects from the upper end of stack 14 to floating structure 20 at water surface 22. Mechanical guide cables 24 also extend from stack 14 to floating structure 20 and wiring bundles 26 are secured to guide cables 24 to connect between structure 20 and stack 14 to provide control of stack 14. Choke and kill lines 28 extend upward along the exterior of riser 18. Stack 14 includes a plurality of ram type blowout preventers 30 and upper annular blowout preventer 32. Sensing means 34 are provided in one of the tailstocks of each of preventers 30 for sensing the position of the rams in the preventers and lines 36 extend from such sensing means 34 to transmitter 38 which is mounted at the upper end of stack 14 and offset to the side thereof as shown. Also, sensing means 40 is mounted in the choke and kill connection of the lower preventer 30 and line 42 extends from sensing means 40 to transmitter 38. Transmitter 38 is shown to be a sonar transmitter which receives data through lines 36 and 42 and transmits such data through the sea water to receiver 39 suspended in the water below structure 20 and preferably at a position substantially aligned and above transmitter 38.

One of the sensing means 44 contemplated herein is illustrated in FIGURES 2 and 3. Means 44 is used to sense when sub 46 is positioned exactly in a desired preselected position within housing 48. Sensing means 44 includes a plurality of proximity detector 50 which sense the closeness of the wall of housing 48. Sensing means 44 functions by the relative positions of each of detectors 50 with respect to grooves 52 and 54 on the interior of housing 48. As shown schematically in FIGURE 2, there are six of detectors 50 positioned around the exterior of sub 46 and with each of detectors 50 is positioned at a different elevation in sub 46. While six of detectors 50 are shown, there could be fewer or more depending upon the complexity of the groove coding needed to positively identify the location. The levels are identified for each of the detectors 50 in FIGURE 3 by the letters A, B, C, D, E, and F. The orientation of each of detectors 50 is identified in FIGURE 2 by the same letters. The detectors 50 are identified by the same letters in FIGURES 4A and 4B. FIGURE 4B illustrates the normal position of each of detectors 50. This normal position is A normally open, B normally open, C normally closed, D normally open, E normally open, F normally closed. In FIGURE 4A the position of detectors 50 when sub 46 is in the desired preselected position within housing 48. When in this preselected position, detector A, being close to the inner wall of housing 48, is closed; detector B, being close to the inner wall of housing 48, is closed; detector C, being opposite groove 52, is closed; detector D, being close to the inner wall of housing 48, is closed; detector E, being close to the inner wall of housing 48, is closed; and detector F, being opposite groove 54, is closed. Thus in this position, all of detector 50 are closed and circuit 56, which includes all of detector 50 wired in series, suitable source of power 58 and acoustic generator 60, generates an acoustic signal as hereinafter explained.

As shown in FIGURE 5, sub 46 includes inner tubular mandrel 62 having lower threads 64 for engaging within string 66 and external threads 68 on which lower ring 70 is threaded, collar 72 which is secured by cap screws 74 to the recess 76 in the upper exterior of collar 72 and ring 78 which is positioned between the upper end of collar 72 and the exterior of mandrel 62. Circuit 56 includes wiring 80 from each of detectors 50, circuit control box 82, wiring 84 and acoustic generator 60. Acoustic generator 60 is secured to the exterior of tubular mandrel 62 so that the acoustic signal generated thereby is available to detected at sensor 86 positioned on collet collector 16, as shown in FIGURE 1.

FIGURE 6 discloses subsea wellhead 90 which is similar to wellhead 10 and includes housing 92 to which stack 94 is connected by collet connector 96. Riser 98 connects from the upper end of stack 94 to floating structure 100 at water surface 102. Guide cables 104 also extend from stack 94 to floating structure 100 and wiring bundles 106 are secured to guide cables 104 to connect between structure 100 and stack 94 to provide control of stack 94 other components of wellhead 90. Choke and kill lines 108 extend upward along the exterior of riser 98. Stack 94 includes a plurality of ram type blowout preventers 110 and upper annular blowout preventer 112. Sensing means 114 are provided in one of the tailstocks of each of the preventers 110 for sensing the position of the rams

in the preventers and lines 116 extend from such sensing means 114 to female stab-in connector 118. Additionally, sensing means 120 is mounted in the choke and kill connection on one side of the lower preventer 110 and line 122 extends from sensing means 120 to connector 118. Sensing means 123 is positioned on the exterior of connecter 96. Wiring 121 connects sensing means 123 to connecter 118. The lower portion of riser which is lowered into position on the top of stack 94 includes male stab-in connector 124 which is adapted to seat within female connector 118 carried at the side of stack 94. Wiring 126 extends from male stab-in connector 124 upward with guide cable 104 with wiring bundles 106 to data processor 128 and indicating means 130 on floating structure 100. In this manner the data such as the position of the rams in each of the blowout preventers 110 and any other sensed position as previously described or hereinafter described and detected by sensing means 120 is transmitted to the surface on a direct wire connection and displayed on indicating means 130.

Wellhead 90 is illustrated in greater detail in FIGURE 7 and includes string 132 with sub 134 mounted therein. Sub 134 is similar to sub 46 described above and includes acoustic detecting means 136 therein which is connected to acoustic generator 138 which is mounted to transmit acoustic signals through opening 140 in upper ring 142 into the fluid in annulus 144 surrounding string 132. Hanger 146 is supported on string 132 below subs 134. Hanger 146 is lowered on string 132 and is to be landed on landing seat 148 within housing 150. Acoustic detecting means 136 is adapted to detect the acoustics of the landing of hanger 146 on the landing seat 148 to provide a positive indication at the surface of the successful landing. The acoustic signal which is transmitted by acoustic generator 138 can be detected by sensing means 120 which is mounted on the choke and kill opening on the lower blowout preventer 110 or by sensing means 123 on connecter 96.

Wall casing 152, shown in FIGURES 8 and 9, has string 154 positioned therein with the upper end of string indicated at 156 and housing 158 has been lowered into the space between casing 152 and string 154 and ring 160, which is secured to the interior of housing 158 by shear pins 162, is engagement with the upper end 156 of string 154. Cold forging tool T is positioned within string 154 and both tool T and housing 158 are supported on running string 164. The interior of housing 158 includes interior recess 166 having a forging profile to provide a tight gripping and sealing engagement between string 154 and the interior of housing 158 after the forging step. With ring 160 positioned on upper end 156 of string 154 as shown in FIGURE 8, additional weight is put on housing 158 sufficient to shear pins 162. After pins 162 have been sheared housing 158 is lowered until ring, which is seated on end 156 is in supporting engagement with downwardly facing internal shoulder 168. This position is shown in FIGURE 9 and the cold forging step may then be initiated. It should be noted that the acoustic waves generated by the shearing of pins 162 are detected by sensing means 170 positioned on the upper end of tool T and such data is transmitted through wiring 172 to be delivered either directly or otherwise to the floating structure on the water surface. Also, a suitable sensor could be used to detect such shearing of the pins 162 either in the location of sensing means 122 or 123 as illustrated in FIGURE 6.

As shown in FIGURE 10, the completion of the cold forging step in forging the upper end of a string 174 positioned in a casing string 176 into housing 178 by the cold forging tool 180 can be detected by sensing means 182 positioned on tool 180. Sensing means 182 is connected by suitable wiring 186 up through string 184 which supports tool 180 to a suitable location for transmission to the surface. Sensing means 182 may be an acoustic receiver which listens for the acoustic waves which are given off by the deformation of the housing 178 as the cold forging step is completed or it could be the specific noise given off by a ring of brittle plastic which is mounted in a groove around the exterior of housing 178.

Another system of determining the landing of a string and the setting of the ratcheting latch mechanism is illustrated in FIGURES 11, 12 and 13. Wellhead housing 186 is shown with hanger 188 supported from string 190 and landed on wellhead landing shoulder 192. Also, ratcheting latch mechanism 194 is positioned between the upper interior of hanger 188 and the exterior of sleeve 196 which moves to set latch mechanism 194. Latch mechanism 194 is shown in FIGURE 12 with its latch element 198 in initial engagement with the ratchet teeth 200 on the interior of hanger 188. Subsequent movement of sleeve 196 moves latch element 198 downward to the position indicated in FIGURE 13. Sub 202 is a detecting sub such as sub 46 illustrated in FIGURE 5. Sub 202 functions to provide a surface indication of the landing of hanger 188 and the setting of the latch mechanism 194. Sub 202 is shown having a plurality of proximity detectors 204 which are positioned around sub body 206 at different levels to provide an indication of the position of subs 202 with respect to grooves 208 on the interior of housing 186.

FIGURES 14, 15, 16, and 17 illustrate the different means of transmitting data detected by a position detecting sub. In FIGURE 14 sub 210 is a position location sub using proximity detectors and

the data is transmitted from sub through opening 212 in the upper ring of sub 210 by directing the output of acoustic generator 214 through such opening 21 and into the fluid within the annulus 216 between sub string 218 and housing 220. Detector 221 positioned in the upper end of annulus 216 receives the transmitted signal. In FIGURE 15 sub 222 has acoustic generator 224 which is positioned at opening 226 in sub mandrel 228 to transmit the acoustic signal through the fluids in the bore of mandrel 228 and string 230 above mandrel 228. Detector 229 positioned within the interior of the upper portion of string 230 detects the signal. Sub 232, shown in FIGURE 16, transmits the signal generated by acoustic generator 234 which is positioned against the collar 236 and up through housing 238. Detector 239 is secured to the exterior of the upper end of housing 238 detects the signal sent therein. Sub 240 of FIGURE 18 is similar in that its acoustic generator 242 is secured against the exterior of sub mandrel 244 so that the signal is transmitted upward through the central portion of string 246 and is received by detector 248 secured to the exterior of string 246.

Claims

1. A method of conducting operations within a subsea marine well from the water surface comprising lowering a well component (188) into the subsea wellhead on a running string and detecting the occurrence of a condition with respect to said well component (188) or said string (190) and said subsea wellhead, and in response to said detection, transmitting a signal to the water surface, wherein detecting equipment (44) and transmitting equipment (60) are lowered into the wellhead with said well component (188) on said running string (190), characterised in that said detecting equipment (44) is used to carry out said detecting step by detecting the occurrence of a condition as between the well component or said string and said wellhead and said transmission equipment (60) is used to carry out said transmitting step.

2. A method of conducting operations within a subsea wellhead of a subsea marine well from the water surface comprising lowering a well component (158), detecting equipment (44) and transmitting equipment (170) on a running string (164), detecting the occurrence of a condition with respect to the well component (158) and, in response to said detection, transmitting a signal to the water surface, characterised in that the detecting equipment (170) detects noise generated directly by the occurrence of the condition.

3. A method according to claim 1 or claim 2, including the step of displaying at the water surface an indication of the occurrence of the condition of the well component (158, 188) responsive to the receipt of the transmitted signal.

4. A method according to claim 1 or claim 2 including the step of generating an acoustic wave responsive to the detected condition of the well component within the subsea wellhead.

5. A method according to claim 2 wherein said detecting step includes detecting the noise generated by the occurrence of a predetermined strain in the well component (158).

6. A method according to claim 1 including the steps of

manipulating a string (190) at the water surface to lower a detecting means (44), a transmitter (60) and a well component (188) into a desired position within the subsea wellhead,

detecting the achievement of the desired position by the well component (188) within the subsea wellhead,

transmitting to the water surface a signal responsive to the detection of the achievement of the desired position by the well component (188), and

indicating at the water surface the position of the well component within the subsea wellhead.

7. A method according to claim 2 including the steps of

manipulating a string (164) at the water surface to lower a detecting means (44), a transmitter (170) and a well component (158) into a desired position within the subsea wellhead,

detecting the achievement of the desired position by the well component (158) within the subsea wellhead,

transmitting to the water surface a signal responsive to the detection of the achievement of the desired position by the well component, and

indicating at the water surface the position of the well component within the subsea wellhead.

8. A method according to claim 7, wherein said well component is a hanger (146) and said

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the data is transmitted from sub through opening 212 in the upper ring of sub 210 by directing the output of acoustic generator 214 through such opening 21 and into the fluid within the annulus 216 between sub string 218 and housing 220. Detector 221 positioned in the upper end of annulus 216 receives the transmitted signal. In FIGURE 15 sub 222 has acoustic generator 224 which is positioned at opening 226 in sub mandrel 228 to transmit the acoustic signal through the fluids in the bore of mandrel 228 and string 230 above mandrel 228. Detector 229 positioned within the interior of the upper portion of string 230 detects the signal. Sub 232, shown in FIGURE 16, transmits the signal generated by acoustic generator 234 which is positioned against the collar 236 and up through housing 238. Detector 239 is secured to the exterior of the upper end of housing 238 detects the signal sent therein. Sub 240 of FIGURE 18 is similar in that its acoustic generator 242 is secured against the exterior of sub mandrel 244 so that the signal is transmitted upward through the central portion of string 246 and is received by detector 248 secured to the exterior of string 246.

Claims

1. A method of conducting operations within a subsea marine well from the water surface comprising lowering a well component (188) into the subsea wellhead on a running string and detecting the occurrence of a condition with respect to said well component (188) or said string (190) and said subsea wellhead, and in response to said detection, transmitting a signal to the water surface, wherein detecting equipment (44) and transmitting equipment (60) are lowered into the wellhead with said well component (188) on said running string (190), characterised in that said detecting equipment (44) is used to carry out said detecting step by detecting the occurrence of a condition as between the well component or said string and said wellhead and said transmission equipment (60) is used to carry out said transmitting step.

2. A method of conducting operations within a subsea wellhead of a subsea marine well from the water surface comprising lowering a well component (158), detecting equipment (44) and transmitting equipment (170) on a running string (164), detecting the occurrence of a condition with respect to the well component (158) and, in response to said detection, transmitting a signal to the water surface, characterised in that the detecting equipment (170) detects noise generated directly by the occurrence of the condition.

3. A method according to claim 1 or claim 2, including the step of displaying at the water surface an indication of the occurrence of the condition of the well component (158, 188) responsive to the receipt of the transmitted signal.

4. A method according to claim 1 or claim 2 including the step of generating an acoustic wave responsive to the detected condition of the well component within the subsea wellhead.

5. A method according to claim 2 wherein said detecting step includes detecting the noise generated by the occurrence of a predetermined strain in the well component (158).

6. A method according to claim 1 including the steps of

manipulating a string (190) at the water surface to lower a detecting means (44), a transmitter (60) and a well component (188) into a desired position within the subsea wellhead,

detecting the achievement of the desired position by the well component (188) within the subsea wellhead,

transmitting to the water surface a signal responsive to the detection of the achievement of the desired position by the well component (188), and

indicating at the water surface the position of the well component within the subsea wellhead.

7. A method according to claim 2 including the steps of

manipulating a string (164) at the water surface to lower a detecting means (44), a transmitter (170) and a well component (158) into a desired position within the subsea wellhead,

detecting the achievement of the desired position by the well component (158) within the subsea wellhead,

transmitting to the water surface a signal responsive to the detection of the achievement of the desired position by the well component, and

indicating at the water surface the position of the well component within the subsea wellhead.

8. A method according to claim 7, wherein said well component is a hanger (146) and said

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desired position is the landing of the hanger on a landing shoulder (148) within the subsea wellhead.

9. A method according to claim 6 or claim 7, wherein said well component is a hanger having an annulus seal and said desired position is the setting of the annulus seal.

10. A method according to claim 6, wherein said well component includes a ratcheting latch mechanism (194) and said desired position is the ratcheting and setting of the ratcheting latch mechanism (194) within the subsea wellhead.

11. A method according to claim 7, wherein said well component is a tubular member (158) and said desired position is the completion of the cold forging of the tubular member (158) into tight gripping and sealing engagement within another member within said subsea wellhead.

12. A method according to claim 8, wherein said detecting step includes

detecting the noise of the landing of the hanger (146) on the landing shoulder (148).

13. A method according to claim 6, wherein said detecting step includes

detecting the position with a ferrous metal proximity switch detector (44).

14. A method according to claim 13 wherein said ferrous metal proximity switch detector (44) creates a preselected acoustic output pattern when the landing is complete and which method includes

detecting the preselected acoustic output pattern of said proximity switch.

15. A method according to claim 6 or 7, wherein said transmitting step includes

transmitting through the water by sonar.

16. A method according to claim 6 or 7, wherein said transmitting step includes

transmitting the signal through the subsea wellhead equipment.

17. A method according to claim 6 or 7, wherein said transmitting step includes

transmitting the signal through the string (246) extending from the water surface to the interior of the wellhead equipment.

18. A method according to claim 6 or 7, wherein said transmitting step includes

transmitting the signal through a wire (72).

19. An apparatus for manipulating equipment including a well component (188) in a subsea wellhead of a subsea marine well comprising a running string (190) for lowering the well component (188) into the subsea marine well, detecting means (44) for detecting the occurrence of a condition with respect to said well component (188) in the subsea wellhead, transmitting means (60) for transmitting a signal to the water surface, means for supporting the detecting means (44) and the transmitting means (60) on the running string with the well component (188) so that the detecting means (44), transmitting means (60) and well component (188), can be lowered together into the wellhead on the running string (190), said detecting means (44) upon the detection of the occurrence of a condition with respect to said well component (188) in the subsea wellhead causing said transmitting means (60) to transmit a signal to the water surface that the condition has occurred,

and characterised by said wellhead and said detecting means (44) being adapted to enable the detection of a condition as between said well component (188) or said running string (190) and said wellhead.

20. An apparatus for manipulating equipment including a well component (146) in a subsea wellhead of a subsea marine well comprising a running string (132) for lowering the well component (146) into the subsea marine well, detecting means (136) for detecting the occurrence of a condition with respect to said well component (146) in the subsea wellhead, transmitting means (138) for transmitting a signal to the water surface, means for supporting the detecting means (136) and the transmitting means (138) on the running string (132) with the well component (146) so that the detecting means (136), transmitting means (138) and well component (146), can be lowered into the wellhead on the running string (132), said detecting means (136) upon the detection of the occurrence of a condition with respect to said well component (146) in the subsea wellhead causing said transmitting means (138) to transmit a signal to the water surface that the condition has occurred,

and characterised by said wellhead and said detecting means (136) being adapted to detect a noise generated directly by the occurrence of the condition with respect to the well component (146).

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21. An apparatus according to claim 19 or 20, including means (39) at the water surface for receiving the transmitted signal, and
means (130) at the water surface for displaying the occurrence of the condition with respect to the well component.

22. An apparatus according to claim 20, wherein said detecting means (136) is an acoustic sensor (136).

23. An apparatus according to claim 19 or 20, including means (60, 138) for generating an acoustic signal responsive to the detection of the occurrence of the condition.

24. An apparatus according to claim 20, wherein the detection means (182) detects the exceeding of a predetermined level of strain in the well component (158) within the subsea wellhead to determine the occurrence of the condition with respect ot the well components.

25. An apparatus according to claim 19, wherein
said running string (190) includes
a sub (202),
the wellhead includes
a housing (186) having internal lands and grooves (52, 54),
said condition is the well component reaching a desired position within said subsea wellhead, and
said detecting means includes
a plurality of proximity detectors (50) mounted at different levels in said sub (202) on the running string (190) with the detectors coacting with lands and grooves (52, 54) on the interior of the wellhead housing (186) to determine the reaching of such desired position by said well component (188).

26. An apparatus according to claim 19 or 20, wherein
said transmitting means includes a sonar transmitter (38) facing upwardly toward the water surface and positioned within the water to one side of the subsea wellhead.

27. An apparatus according to claim 19 or 20, wherein
said transmitting means (38) is an acoustic generator.

28. An apparatus according to claim 19 or 20, including
wiring (106) connecting said transmitting means (138) to the water surface.

29. An apparatus according to claim 21 wherein said display means includes
a data processor (128) for processing the data received from the subsea wellhead, and
an indicator (130) to display the results of the processed data.

Patentansprüche

1. Verfahren zur Durchführung von Operationen in einem Unterwasser-Bohrloch von der Wasseroberfläche aus, umfassend: Absenkung eines Bohrlochbauteils (188) in den Unterwasser-Bohrlochkopf an einem Betriebsstrang und Ermittlung des Vorhandenseins eines Zustandes in bezug auf das Bohrlochbauteil (188) oder den Strang (190) und den Unterwasser-Bohrlochkopf, und in Abhängigkeit der Ermittlung, Übertragung eines Signals zur Wasseroberfläche, wobei die Ermittlungseinrichtung (44) und die Übertragungseinrichtung (60) mit dem Bohrlochbauteil (188) am Betriebsstrang (190) in den Bohrlochkopf abgesenkt werden, **dadurch gekennzeichnet**, daß die Ermittlungseinrichtung (44) benutzt wird, um den Ermittlungsschritt durch Feststellung des Vorhandenseins eines Zustandes zwischen dem Bohrlochbauteil oder dem Strang sowie dem Bohrlochkopf durchzuführen, und die Übertragungseinrichtung (60) verwendet wird, um den Übertragungsschritt auszuführen.

2. Verfahren zur Durchführung von Operationen in einem Unterwasser-Bohrlochkopf eines Unterwasser-Bohrloches von der Wasseroberfläche aus, umfassend das Absenken eines Bohrlochbauteils (158), einer Ermittlungseinrichtung (44) und einer Übertragungseinrichtung (170) an einem Betriebsstrang (164), das Feststellen des Vorhandenseins eines Zustandes in bezug auf das Bohrlochbauteil (158) und, in Abhängigkeit der Ermittlung, Übertragung eines Signals zur Wasseroberfläche, **dadurch gekennzeichnet**, daß die Ermittlungseinrichtung (170) ein Geräusch ermittelt, das durch das Vorhandensein des Zustandes unmittelbar erzeugt wird.

3. Verfahren nach den Ansprüchen 1 oder 2, **dadurch gekennzeichnet**, daß es den Schritt des Sichtbarmachens einer Anzeige an der Wasseroberfläche über das Vorhandensein eines Zustandes des Bohrlochbauteiles (158, 188) in Abhängigkeit vom Empfang des übertragenen Signals einschließt.

4. Verfahren nach den Ansprüchen 1 oder 2, **dadurch gekennzeichnet**, daß es den Schritt

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der Erzeugung einer akustischen Welle in Abhängigkeit des ermittelten Zustandes des Bohrlochbauteils in dem Unterwasser-Bohrlochkopf einschließt.

5. Verfahren nach nach Anspruch 2, **dadurch gekennzeichnet**, daß der Ermittlungsschritt das Ermitteln des durch Vorhandensein einer vorherbestimmten Spannung in dem Bohrlochbauteil (158) erzeugten Geräusches einschließt.

6. Verfahren nach Anspruch 1, **dadurch gekennzeichnet**, daß es die Schritte
Betätigen eines Stranges (190) an der Wasseroberfläche, um eine Ermittlungseinrichtung (44), einen Übertrager (60) und ein Bohrlochbauteil (188) in eine erforderliche Position im Bohrlochkopf abzusenken,
Ermitteln des Erreichens der erforderlichen Position durch das Bohrlochbauteil (188) im Bohrlochkopf,
Übertragen eines Signals in Abhängigkeit der Ermittlung des Erreichens der erforderlichen Position durch das Bohrlochbauteil (188) zur Wasseroberfläche, und
Anzeige der Position des Bohrlochbauteils im Bohrlochkopf an der Wasseroberfläche einschließt.

7. Verfahren nach Anspruch 2, **dadurch gekennzeichnet**, daß es die Schritte
Betätigen eines Stranges (164) an der Wasseroberfläche, um eine Ermittlungseinrichtung (44), einen Übertrager (170) und ein Bohrlochbauteil (158) in eine erforderliche Position im Bohrlochkopf abzusenken,
Ermitteln des Erreichens der erforderlichen Position durch das Bohrlochbauteil (158) im Unterwasser-Bohrlochkopf,
Übertragen eines Signals in Abhängigkeit der Ermittlung des Erreichens der erforderlichen Position durch das Bohrlochbauteil zur Wasseroberfläche, und
Anzeige der Position des Bohrlochbauteiles im Bohrlochkopf an der Wasseroberfläche einschließt.

8. Verfahren nach Anspruch 7, **dadurch gekennzeichnet**, daß das Bohrlochbauteil ein Hänger (146) ist und die erforderliche Position das Landen des Hängers auf einer Setzschulter (148) im Unterwasser-Bohrlochkopf darstellt.

9. Verfahren nach den Ansprüchen 6 oder 7, **dadurch gekennzeichnet**, daß das Bohrlochbauteil ein Hänger mit einer Ringdichtung ist und die erforderliche Position im Setzen der Ringdichtung besteht.

10. Verfahren nach Anspruch 6, **dadurch gekennzeichnet**, daß das Bohrlochbauteil einen Sperrklinkenmechanismus (194) enthält und die erforderliche Position im Einrasten und Setzen des Sperrklinkenmechanismus (194) im Unterwasser-Bohrlochkopf besteht.

11. Verfahren nach Anspruch 7, **dadurch gekennzeichnet**, daß das Bohrlochbauteil ein rohrförmiger Körper (158) ist und die erforderliche Position im Abschluß der Kaltverformung des rohrförmigen Körpers (158) in enger Klemm- und Dichtungsverbindung mit einem anderen Körper innerhalb des Unterwasser-Bohrlochkopfes besteht.

12. Verfahren nach Anspruch 8, **dadurch gekennzeichnet**, daß der Ermittlungsschritt einschließt:
das Ermitteln des Geräusches der Landung des Hängers (146) auf der Setzschulter (148).

13. Verfahren nach Anspruch 6, **dadurch gekennzeichnet**, daß der Ermittlungsschritt einschließt:
Ermittlung der Position mit einem eisenmetallischen berührungslosen Schalttaster (44).

14. Verfahren nach Anspruch 13, **dadurch gekennzeichnet**, daß der eisenmetallische berührungslose Schalttaster (44) ein vorbestimmtes akustisches Ausgangsmotiv erzeugt, wenn die Landung abgeschlossen ist und das Verfahren einschließt:
Ermittlung des vorbestimmten akustischen Ausgangsmotives des berührungslosen Schalters.

15. Verfahren nach den Ansprüchen 6 oder 7, **dadurch gekennzeichnet**, daß der Übertragungsschritt einschließt:
Übertragung über das Wasser mittels Sonar.

16. Verfahren nach den Ansprüchen 6 oder 7, **dadurch gekennzeichnet**, daß der Übertragungsschritt einschließt:
Übertragung des Signales über die UnterwasserBohrlochkopf-Ausrüstung.

17. Verfahren nach den Ansprüchen 6 oder 7, **dadurch gekennzeichnet**, daß der Übertragungsschritt einschließt:
Übertragung des Signals über den sich von der Wasseroberfläche bis in das Innere der Bohrlochkopf-Ausrüstung erstreckenden Strang (246).

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18. Verfahren nach den Ansprüchen 6 oder 7, **dadurch gekennzeichnet**, daß der Übertragungsschritt einschließt:
Übertragung des Signals über einen Draht (72).

19. Vorrichtung zum Betätigen der Ausrüstung einschließlich eines Bohrlochbauteiles (188) in einem UnterwasserBohrlochkopf einer Unterwasserbohrung, umfassend einen Betriebsstrang (190) zum Absenken des Bohrlochbauteiles (188) in die Unterwasser-Bohrung, eine Ermittlungseinrichtung (44) zur Ermittlung des Vorhandenseins eines Zustandes in bezug auf das Bohrlochbauteil (188) in dem Unterwasser-Bohrlochkopf, eine Übertragungseinrichtung (60) zum Übertragen eines Signals zur Wasseroberfläche, eine Einrichtung zur Abstützung der Ermittlungseinrichtung (44) und der Übertragungseinrichtung (60) am Betriebsstrang mit dem Bohrlochbauteil (188), so daß die Ermittlungseinrichtung (44), die Übertragungseinrichtung (60) und das Bohrlochbauteil (188) am Betriebsstrang (190) zusammen in dem Bohrlochkopf abgesenkt werden können, daß die Ermittlungseinrichtung (44) bei Ermittlung des Vorhandenseins eines Zustandes in bezug auf das Bohrlochbauteil (188) im Unterwasser-Bohrlochkopf die Übertragungseinrichtung (60) veranlaßt, ein Signal zur Wasseroberfläche zu übertragen, daß der Zustand eingetreten ist,
dadurch gekennzeichnet, daß der Bohrlochkopf und die Ermittlungseinrichtung (44) angepaßt sind, um die Ermittlung eines Zustandes zwischen dem Bohrlochbauteil (188) oder dem Betriebsstrang (190) einesteils und dem Bohrlochkopf zu ermöglichen.

20. Vorrichtung zum Betätigen der Ausrüstung einschließlich eines Bohrlochbauteiles (146) in einem Unterwasser-Bohrlochkopf einer Unterwasserbohrung, umfassend einen Betriebsstrang (132) zum Absenken des Bohrlochbauteiles (146) in die Unterwasser-Bohrung, eine Ermittlungseinrichtung (136) zur Ermittlung des Vorhandenseins eines Zustandes in bezug auf das Bohrlochbauteil (146) in dem Unterwasser-Bohrlochkopf, eine Übertragungseinrichtung (138) zum Übertragen eines Signals zur Wasseroberfläche, eine Einrichtung zur Abstützung der Ermittlungseinrichtung (136) und der Übertragungseinrichtung (138) am Betriebsstrang (132) mit dem Bohrlochbauteil (146), so daß die Ermittlungseinrichtung (136), die Übertragungseinrichtung (138) und das Bohrlochbauteil (146) am Betriebsstrang (132) in den Bohrlochkopf abgesenkt werden können, daß die Ermittlungseinrichtung (136) bei Ermittlung des Vorhandenseins eines Zustandes in bezug auf das Bohrlochbauteil (146) im Unterwasser-Bohrlochkopf die Übertragungseinrichtung (138) veranlaßt, ein Signal zur Wasseroberfläche zu übertragen, daß der Zustand eingetreten ist,
dadurch gekennzeichnet, daß der Bohrlochkopf und die Ermittlungseinrichtung (136) angepaßt sind, um ein Geräusch zu ermitteln, das unmittelbar durch das Vorhandensein des Zustandes in bezug auf das Bohrlochbauteil (146) erzeugt wird.

21. Vorrichtung nach den Ansprüchen 19 oder 20, **dadurch gekennzeichnet**, daß sie eine Einrichtung (39) an der Wasseroberfläche zum Empfang des übertragenen Signales und eine Einrichtung (130) an der Wasseroberfläche zur Anzeige des Vorhandenseins des Zustandes in bezug auf das Bohrlochbauteil enthält.

22. Vorrichtung nach Anspruch 20, **dadurch gekennzeichnet**, daß die Ermittlungseinrichtung (136) ein akustischer Sensor (136) ist.

23. Vorrichtung nach den Ansprüchen 19 oder 20, **dadurch gekennzeichnet**, daß sie eine Einrichtung (60, 138) zur Erzeugung eines akustischen Signals in Abhängigkeit von der Ermittlung des Vorhandenseins des Zustandes enthält.

24. Vorrichtung nach Anspruch 20, **dadurch gekennzeichnet**, daß die Ermittlungseinrichtung (182) das Überschreiten eines vorbestimmten Spannungspegels im Bohrlochbauteil (158) im Bohrlochkopf ermittelt, um das Vorhandensein des Zustandes in bezug auf die Bohrlochbauteile zu ermitteln.

25. Vorrichtung nach Anspruch 19, **dadurch gekennzeichnet**, daß der Betriebsstrang (190) einen Schallempfänger (sub) (202) enthält,
daß der Bohrlochkopf
ein Gehäuse (186) mit inneren Anschlußflächen und Nuten (52, 54) enthält,
daß der Zustand darin besteht, daß das Bohrlochbauteil eine erforderliche Position innerhalb des Unterwasser-Bohrlochkopfes erreicht, und daß
die Ermittlungseinrichtung umfaßt:
eine Vielzahl von berührungslosen Tastern (50), die in verschiedenen Höhen im Schallempfänger (sub) (202) am Betriebsstrang (190) angeordnet sind, wobei die Taster mit den Anschlußflächen und Nuten (52, 54) an der Innenseite des Bohrlochkopfgehäuses (186) zusammenwirken, um das Erreichen dieser er-

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forderlichen Position durch das Bohrlochbauteil (188) zu ermitteln.

26. Vorrichtung nach den Ansprüchen 19 oder 20, **dadurch gekennzeichnet**, daß die Übertragungseinrichtung einen Sonarübertrager (38) enthält, der nach oben zur Wasseroberfläche gerichtet ist und im Wasser auf einer Seite des Unterwasser-Bohrlochkopfes befestigt ist.

27. Vorrichtung nach den Ansprüchen 19 oder 20, **dadurch gekennzeichnet**, daß die Übertragungseinrichtung (38) ein akustischer Generator ist.

28. Vorrichtung nach den Ansprüchen 19 oder 20, **dadurch gekennzeichnet**, daß eine Verdrahtung (106) die Übertragungseinrichtung (138) mit der Wasseroberfläche verbindet.

29. Vorrichtung nach Anspruch 21, **dadurch gekennzeichnet**, daß die Anzeigeeinrichtung umfaßt:
einen Datenprozessor (128) zur Verarbeitung der vom Unterwasser-Bohrlochkopf empfangenen Daten und
eine Anzeige (130) zur Sichtbarmachung der Ergebnisse der verarbeiteten Daten.

Revendications

1. Procédé de réalisation d'opérations dans un puits sous-marin à partir de la surface de l'eau, consistant à descendre un composant du puits (188) dans la tête de puits sous-marin sur un train mobile et à détecter la réalisation d'une situation par rapport audit composant de puits (188) ou audit train (190) et à ladite tête de puits sous-marin et, en réponse à ladite détection, à transmettre un signal à la surface de l'eau, procédé dans lequel un équipement de détection (44) et un équipement de transmission (60) sont descendus dans la tête de puits avec ledit composant (188) sur ledit train mobile (190), caractérisé en ce que ledit équipement de détection (44) est utilisé pour effectuer ladite opération de détection en détectant la réalisation d'une situation entre le composant du puits ou ledit train et ladite tête de puits, et le ledit équipement de transmission (60) est utilisé pour effectuer ledit stade de transmission.

2. Procédé de réalisation d'opérations à l'intérieur d'une tête d'un puits sous-marin à partir de la surface de l'eau, consistant à descendre un composant du puits (158), un équipement de détection (44) et un équipement de transmission (170) sur un train mobile (164), à détecter la réalisation d'une situation par rapport au composant de puits (158) et, en réponse à ladite détection, à transmettre un signal à la surface de l'eau, caractérisé en ce que l'équipement de détection (170) détecte un bruit généré directement par la réalisation de la situation précitée.

3. Procédé selon la revendication 1 ou 2, comportant l'étape consistant à afficher à la surface de l'eau une indication de la réalisation de la situation du composant de puits (158, 188) sensible à la réception du signal transmis.

4. Procédé selon le revendication 1 ou 2, comportant l'étape consistant à générer une onde acoustique sensible à la situation détectée du composant de puits à l'intérieur de la tête de puits sous-marin.

5. Procédé selon la revendication 2, dans lequel ladite étape de détection consiste à détecter le bruit généré par la présence d'une contrainte prédéterminée d'un composant de puits (158).

6. Procédé selon la revendication 1, comprenant les étapes suivantes :
on manipule un train (190) à la surface de l'eau pour descendre un moyen de détection (44), un émetteur (60) et un composant de puits (188) dans une position souhaitée à l'intérieur de la tête de puits sous-marin,
on détecte l'achèvement de la position souhaitée du composant (188) dans la tête de puits sous-marin,
on transmet à la surface de l'eau un signal sensible à la détection de l'achèvement de position souhaitée du composant de puits (188), et
on indique à la surface de l'eau la position du composant de puits à l'intérieur de la tête de puits sous-marin.

7. Procédé selon la revendication 2, comprenant les étapes suivantes :
on manipule un train (164) à la surface de l'eau pour descendre un moyen de détection (44), un émetteur (170) et un composant de puits (158) dans une position souhaitée à l'intérieur de la tête de puits sous-marin,
on détecte l'achèvement de la position souhaitée du composant de puits (158) à l'intérieur de la tête de puits sous-marin,
on transmet à la surface de l'eau un signal sensible à la détection de l'achèvement de la position souhaitée du composant de puits, et
on indique à la surface de l'eau la position

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du composant de puits à l'intérieur de la tête de puits sous-marin.

8. Procédé selon la revendication 7, dans lequel ledit composant de puits est un support (146) et ladite position souhaitée est l'amarrage du support à un épaulement d'amarrage (148) à l'intérieur de la tête de puits sous-marin.

9. Procédé selon la revendication 6 ou 7, dans lequel ledit composant de puits est une suspension ayant un joint étanche annulaire et ladite position souhaitée est le réglage du joint étanche annulaire.

10. Procédé selon la revendication 6, dans lequel ledit composant de puits comprend un mécanisme de verrouillage à encliquetage (194) et ladite position souhaitée est l'encliquetage et le réglage du mécanisme de verrouillage à encliquetage (194) à l'intérieur de la tête de puits sous-marin.

11. Procédé selon la revendication 7, dans lequel ledit composant de puits est un élément tubulaire (158) et ladite position souhaitée est la réalisation du forgage à froid de l'élément tubulaire (158) en contact étroit de préhension et d'étanchéité avec un autre élément à l'intérieur de ladite tête de puits sous-marin.

12. Procédé selon la revendication 8, dans lequel ladite étape de détection comprend la détection du bruit de l'amarrage du support (146) sur l'épaulement d'amarrage (148).

13. Procédé selon la revendication 6, dans lequel ladite étape de détection comprend la détection de position avec un détecteur de proximité de métal ferreux (44).

14. Procédé selon la revendication 13, dans lequel ledit détecteur de proximité de métal ferreux (44) crée un motif de sortie acoustique présélectionné lorsque l'amarrage est complété, ledit procédé comprenant par ailleurs l'étape consistant à détecter le motif de sortie acoustique présélectionné dudit commutateur de proximité.

15. Procédé selon la revendication 6 ou 7, dans lequel ladite étape de transmission consiste à transmettre à travers l'eau par un système de sonar.

16. Procédé selon la revendication 6 ou 7, dans lequel ladite étape de transmission consiste à transmettre le signal à travers l'équipement de la tête de puits sous-marin.

17. Procédé selon la revendication 6 ou 7, dans lequel ladite étape de transmission comprend la transmission du signal à travers le train (246) s'étendant de la surface de l'eau à l'intérieur de l'équipement de la tête de puits.

18. Procédé selon la revendication 6 ou 7, dans lequel ladite étape de transmission comprend la transmission du signal à travers un fil métallique (72).

19. Appareil de manipulation d'un équipement, comprenant un composant de puits dans une tête de puits sous-marin, comprenant un train mobile pour descendre le composant de puits dans le puits sous-marin, des moyens de détection pour détecter la réalisation d'une situation par rapport audit composant de puits dans la tête de puits sous-marin, des moyens de transmission pour transmettre un signal à la surface de l'eau, des moyens pour supporter les moyens de détection et les moyens de transmission sur le train mobile avec le composant de puits de telle sorte que les moyens de détection, les moyens de transmission et le composant de puits puissent être descendus conjointement dans la tête de puits sur le train mobile, lesdits moyens de détection, lors de la détection de la réalisation d'une situation par rapport audit composant de puits dans la tête de puits sous-marin, amenant lesdits moyens de transmission à transmettre un signal à la surface de l'eau indiquant que la situation a été réalisée, caractérisé en ce que ladite tête de puits et lesdits moyens de détection sont à même de permettre la détection d'une situation entre ledit composant de puits ou ledit train mobile et ladite tête de puits.

20. Appareil de manipulation de l'équipement comprenant un composant de puits (146) dans une tête de puits sous-marin, comprenant un train mobile (132) pour descendre le composant du puits (146) dans le puits sous-marin, des moyens de détection (136) pour détecter la présence d'une situation par rapport audit composant du puits (146) dans la tête de puits sous-marine, des moyens de transmission (138) pour transmettre un signal à la surface de l'eau, des moyens pour supporter des moyens de détection (136) et des moyens de transmission (138) sur le train mobile (132) avec le composant de puits (146) de telle sorte que les moyens de détection (136), les moyens de transmission (138) et le composant de puits (146) soient descendus dans la tête

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de puits sur le train mobile (132), lesdits moyens de détection (138), lors de la détection de la réalisation d'une situation par rapport audit composant de puits (146) dans la tête de puits sous-marine, amenant lesdits moyens de transmission (138) à émettre un signal à la surface de l'eau pour indiquer que la situation s'est produite,

caractérisé en ce que ladite tête de puits et lesdits moyens de détection (136) sont adaptés pour détecter un bruit engendré directement par la réalisation de la situation par rapport au composant de puits (146).

21. Appareil selon la revendication 19 ou 20, comprenant des moyens (39) à la surface de l'eau pour recevoir le signal transmis, et

des moyens (130) à la surface de l'eau pour afficher la présence de la situation par rapport au composant du puits.

22. Appareil selon la revendication 20, dans lequel lesdits moyens de détection (136) sont constitués par un capteur acoustique (136).

23. Appareil selon la revendication 19 ou 20, comprenant des moyens (60, 138) pour engendrer un signal acoustique sensible à la détection de la réalisation de la situation précitée.

24. Appareil selon la revendication 20, dans lequel les moyens de détection (182) détectent le dépassement d'un niveau prédéterminé de contrainte dans le composant de puits (158) à l'intérieur de la tête de puits sous-marin pour déterminer la réalisation de la situation précitée par rapport au composant de puits.

25. Appareil selon la revendication 19, dans lequel ledit train mobile (190) comprend :

un système sous-marin (202),

la tête de puits comprend :

un boîtier (186) ayant des méplats et des rainures internes (52, 54),

ladite situation étant obtenue lorsque le composant de puits atteint une position souhaitée à l'intérieur de la tête de puits sous-marin, et

lesdits moyens de détection comprennent :

une série de détecteurs de proximité (50) montés à différents niveaux dans ledit système sous-marin (202) sur le train mobile (190), les détecteurs coagissant avec les méplats et les rainures (52, 54) à l'intérieur du boîtier (186) de la tête de puits pour déterminer que ledit composant de puits (188) a atteint ladite position souhaitée.

26. Appareil selon la revendication 19 ou 20, dans lequel lesdits moyens de transmission comprennent un émetteur sonar (38) dirigé vers le haut en direction de la surface de l'eau et disposé dans l'eau sur un côté de la tête de puits sous-marin.

27. Appareil selon la revendication 19 ou 20, dans lequel lesdits moyens de transmission (38) sont formés d'un générateur acoustique.

28. Appareil selon la revendication 19 ou 20, comprenant un câblage (106) connectant lesdits moyens de transmission (138) à la surface de l'eau.

29. Appareil selon la revendication 21, dans lequel lesdits moyens d'affichage comprennent :

un processeur de données (128) pour traiter les données reçues de la tête de puits sous-marin,

un indicateur (130) pour afficher les résultats des données traitées.