Method and apparatus for completing multi-string tubingless underwater wells with through flowline (TFL) pumpdown tool servicing capability. A subsea borehole is drilled through the productive oil and/or gas formations. At least two parallel small diameter casing strings are run into the borehole guided by a riser assembly. These casing strings have a common hanger at their upper ends and are connected together at various levels with a plurality of gas-lift crossover mandrels and at least two (upper and lower) circulation crossover mandrels for tool circulation. Then a Xmas tree is lowered on a disconnectable running pipe to a wellhead guided by guidelines. The Xmas tree has at least two parallel small diameter casing strings extending from the lower end thereof. These upper casing strings have a common connector on their lower ends for connection to the hanger. Each upper casing string fluidly communicates with a lower casing string through the connector and hanger. A tensioner located in the Xmas tree applies tension to the upper and lower sections of casing strings and properly spaces out the upper ends of the upper sections of casing strings in the Xmas tree. The upper ends of the casing string sections in the Xmas tree are connected to a production manifold. Suitable control fluid conduits are lowered with the Xmas tree for operation of the tensioner and for operation of safety valves located in each of the upper sections of casing strings. The lower circulation port between two of the casing strings is then opened for perforating operations. A perforator gun is landed in a landing nipple adjacent a formation and is reciprocated until it rotates to the proper direction to avoid perforating the other pipe string in the borehole and then is fired. After each of the formations has been perforated, production of the formation may be maintained by natural formation energy. Various well servicing operations may be carried out using pump-down tools and techniques. A producing formation or zone may be blocked off using a pump-down patch tool and the well fluids may be artificially lifted by positioning pump-down gas-lift valves in one of the casing strings.

18 Claims, 14 Drawing Figures
MULTI-STRING TUBINGLESS COMPLETION
TECHNIQUE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method for completing and servicing a multiple-string tubingless well which has a through flowline (TFL) pump-down tool servicing capability as well as conventional vertical reentry servicing capability. This type well is referred to herein as tubingless TFL. Such well completion and servicing techniques have application, all or in part, to underwater wells, highly deviated offshore wells drilled from platforms or piers, deviated wells drilled from urban well sites, or deviated wells drilled from land to adjacent underwater reservoir targets.

When completing and servicing wells with underwater wellheads or where the wellbore is highly deviated, hydraulic (TFL) well servicing techniques are applicable. The use of TFL tool pump-down completion and servicing techniques permits relatively inexpensive well work to be conducted from remote locations. For example, if an underwater well is drilled and the well is tied by pipelines into a shore facility, a platform, or a floating vessel some distance away or immediately above the well, the well may be completed and serviced by pumping special completion and workover tools down the pipelines and into the well. By providing multiple well pipe (casing) strings in the wellbore with crossover ports between the casing strings and a pipeline flow path (TFL lines) back to the service facility for each casing string, the TFL pump-down tools may be circulated to and from the wellbore. By utilizing a manifold near the wellheads, clustered underwater wells may share common TFL lines. Hydraulic completion and servicing techniques have application in highly deviated wells drilled from land where vertical (pipe or wireline) completion and servicing techniques are deemed impossible because of severe dog-legs in the wellbore prevent running or retrieving the tools by conventional vertical entry methods.

The use of multiple (preferably dual) parallel casing strings in the borehole effects a considerable saving over the cost of purchasing and handling the larger diameter outside casing string usually run in a conventional, tubing-casing, completion. The use of such relatively small diameter pipes cemented in the borehole and elimination of the use of inside tubing is commonly referred to as a tubingless well technique.

The problem, therefore, which the present invention overcomes is that of providing a method for conducting the method, for completing wells which permits less expensive completion and servicing of underwater, platform, or land wells than is possible with conventional well operations and permits completion and servicing of highly deviated wells where conventional techniques are deemed impossible due to dog-leg severity.

SUMMARY OF THE INVENTION

Method and apparatus for completing a submersed multi-string tubingless TFL well in which an underwater platform or template having a plurality of well bays is positioned on water bottom. Each well day is provided with a pipe manifold and a guide system. After a borehole has been drilled through a well bay and cased, the lower sections of two parallel casing strings are run into the borehole on two parallel running pipes which are releasably attached to a hanger which is connected to the upper ends of said lower sections. The lower sections are suspended in the cased borehole by the hanger and cemented in the borehole. The lower sections are connected together at a plurality of levels by a crossover manifold each of which includes a crossover port fluidically communicating the lower sections and a sleeve valve shiftable to open or close off the crossover port. The parallel running pipes are removed and a Xmas tree assembly is lowered and landed on a wellhead mounted on top of the borehole. The Xmas tree assembly suspends the upper sections of the parallel casing strings and a connector positioned on the lower end of the upper sections for connecting the upper sections to the hanger. When the Xmas tree assembly has been landed and the connector is connected to the hanger, the upper sections of the casing strings communicate with the lower sections of the casing strings through the hanger and connector. The hanger contains slips which are hydraulically actuated. The connector is also hydraulically operated to connect to and disconnect it from the hanger. The upper ends of the upper sections of the casing strings connect into vertical bores formed in the Xmas tree assembly. These bores extend vertically through the Xmas tree and other curved bores branch from the vertical bores and connect with the manifold piping. A tensioner may be provided in the Xmas tree assembly to place the upper and lower sections of the parallel casing strings in tension and space out the upper ends of the upper sections to accommodate their connection to the bores in the Xmas tree. The tensioner is hydraulically operated. Safety valves are provided in the lower portions of the upper sections. The vertical bores of the Xmas tree above the branch bores are normally closed by diverter plugs. A perforating gun is pumped down one casing string and rotated and fired when landed in a landing nipple adjacent the formation to be perforated and directed away from the adjacent casing string. Servicing of the well including closing off particular formations and gas-lifting well fluids may be carried out using TFL pump-down tools and techniques. The vertical bores in the Xmas tree permit, when desired, vertical reentry to the well.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1, 2, and 9 to 14 inclusive illustrate schematically the steps involved in completing in a two pipe string tubingless TFL well; and

FIGS. 3 to 8 inclusive illustrate portions of the apparatus used in the completion and servicing method in more detail.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

There is shown in FIG. 1 an underwater platform or template 2 positioned on water bottom 3. The platform is provided with a plurality of well bays 4 with each of which is associated a guide tube 5, a guide system 6 and a manifold 7. Guide system 6 includes guide post 6A and cables 6B extending from the guide post to the water surface. The platform is installed by lowering it from barges on cables. Each manifold arrangement is also provided with an antipollution spill pan which is described in detail in U.S. Pat. application Ser. No. 174, titled "Underwater Pollution Control" by Thomas W. Childers. After the platform has been positioned a drilling vessel is moved in and positioned over a selected well bay 4. A drill pipe 8 is run with a drill bit and a hole opener or reamer through guide tube 5 guided by the guide system 6 and a conductor casing hole is drilled to a depth of about 400 to 500 feet below the mud line or water bottom 3. During such drilling, returns and cuttings accumulate under the submerged platform and not on the deck of the underwater platform 2 since the conductor guide tube 5 does not contact water bottom 3. Drill pipe 8 along with the drill bit and reamer are then pulled from the conductor hole and the water.

A conductor casing 11 having a wellhead mounted on its upper end is then lowered on drill pipe 8 into the conductor borehole and cemented in place by pumping cement down drill pipe 8 from the water surface and into the borehole. Drill pipe 8 is then disconnected and removed.

A marine riser assembly 13 having a releasable connector 14 on its lower end and having a guide frame 19 connected to it is lowered on guide frames 6B using guide frames until connector 14 engages wellhead 12. Riser assembly 13 includes a drilling spool 15, a blowout preventer (BOP) stack 16, a flexible joint 17 and a slip joint 18. The riser assembly 13 is provided with a releasable connector 19 positioned above BOP stack 16. Drilling spool 15 is of sufficient length to permit positioning of the BOP stack above manifold 7 arranged on the deck of platform 2. Drill pipe 8 with a drill bit arranged on
the lower end thereof is then run into conductor casing 11 using the riser assembly as a guide. The surface hole is drilled with returns being taken up the annulus between the conductor casing 11 and the interior wall of riser assembly 13. After the hole has been drilled to a desired depth, drill string 8 and drill bit 16 are removed.

A surface casing 20 is positioned in the borehole. The upper end of surface casing 20 is connected by a connector to a running string which is of the same size as the casing. Surface casing 20 is guided into wellhead 12 and conductor casing 11 by riser assembly 13 and the upper end is landed in wellhead 12. Surface casing 20 is cemented down the running string and connector and surface casing 20 and up the annulus surrounding surface casing 20. The running string and surface casing 20 are reciprocated during the cementing operation and returns are taken at the deck of platform 2 at the wellhead. The running string is then disconnected from surface casing 20 and removed.

As shown in FIG. 1, drill pipe 8 with a drill bit 9 attached on the lower end thereof is run into surface casing 20 guided by riser assembly 13 and the borehole is drilled to total depth. The drill pipe and drill bit are then removed. The borehole may then be logged and/or other evaluation tools may be run.

As shown in FIG. 2, the borehole penetrates two formations A and B. The lower section of two parallel small diameter casing strings are arranged in the borehole. The upper ends of these lower sections are connected together by a common hanger 33 to which is connected releasably a running tool 34. These members are shown in greater detail in FIGS. 3 to 8. Running tool 34 is connected to the lower ends of running parallel pipe strings 35 and 36. Pipe 35 is in communication with pipe 21 through running tool 34 and hanger 33 and pipe 36 is in communication with casing 22 through running tool 34 and hanger 33. Pipe 21 is provided with a sleeve valve 23, which contains a crossover to pipe 22, and landing nipples 24, 25, 26, and 27, which are placed so as to position them above and below each of the formations A and B. The lower end of casing 21 is provided with a cementing shoe 28. Casing 22 is provided with sleeve valves 29, 30, and 31 and is closed off at its lower end by a bull plug 32. Sleeve valves 29 and 30 are positioned so as to be a substantial distance above formation A and also above sleeve valve 23. Sections 21 and 22 are run into the borehole on running strings 35 and 36 guided by riser assembly 13. In the running-in position, all of the crossovers between the two casings are closed.

Hanger 33 is positioned at least 100 feet below the mud line or water bottom. While the dual casings 21 and 22 and dual pipes 35 and 36 are reciprocated, cement is pumped down running string 35 through running tool 34 and hanger 33 and through casing 21 up around casings 21 and 22 until the top of the cement is at the desired height in the wellbore. After the wiper plug (not shown) has bumped bottom in shoe 28, hanger 33 is actuated to suspend casings 21 and 22 in surface casing 20. The cement is then permitted to harden.

A sleeve shifter is lowered through running string 36, running tool 34 and hanger 33 to the lower sleeve valve 31 in casing 22 by a wire line not shown. The sleeve valve is opened to permit fluid communication through the crossover of the lower ends of casings 21 and 22. This permits circulation between casings 21 and 22 for later TFL operations. The sleeve shifter is then removed from casing 22 and running string 36. Running tool 34 is then disconnected from hanger 33 and the running tool and pipe strings 35 and 36 are removed from surface casing 17 and riser assembly 13.

Referring now to FIGS. 3 to 8 inclusive in which details of hanger 33 and running tool 34 are shown, hanger 33 is provided with full open bores 40 and 41. Into the lower ends thereof are threaded respectively casings 21 and 22. Seal nipples and threads extend above hanger 33 and are threaded into the upper end of bores 40 and 41. The outer wall of hanger 33 is slotted at 44 to form mud bypasses around the hanger. The hanger also is provided with slip assemblies 45 for engagement with surface casing 17. Positioned on and extending upwardly from the top of hanger 33 is an orienting sleeve 46 provided with a lug slot 47. A pair of latch recesses 48 are also provided in hanger 33. A cylindrical recess 49 which fluidly communicates with a slip actuator 50 is also provided in hanger 33.

Running tool 34 is provided with full open bores 60 and 61, the lower ends of which, as shown, slide over to engage sealingly about seal nipples 42 and 43. The lower ends of running pipe strings 35 and 36 are threaded into the upper ends of bores 60 and 61. The outer wall of running tool 34 has an orienting lug 62 and is engaged in slot 47 of hanger 33. Bore 61 is aligned with the bore of lower casing pipe 22 and running string 36 has a shuttle valve 63 arranged in it. The shuttle valve is operable to fluidly communicate bore 61 with a piston chamber 64 above and below a latch piston 65, as shown in FIGS. 6 and 8. A piston rod 66 is embraced by latch spring fingers 67 when latch piston 65 is in its lower position.

Running tool 34 is also provided with a prong member 68 (see FIG. 7) on its lower end. When prong member 68 is inserted into a recess 49 in hanger 33, fluid pressure from a source of hydraulic fluid on the drilling vessel is applied to the slip actuator assembly 50 through running string 36, a passageway 69 formed in running tool 34, prong member 68 and fluid passage 70 and fluid fluid passages 71 in hanger 33. The fluid pressure causes slip actuator 50 to set slips 45. In the nonactuated or nonextended position slips 45 are maintained or held in position by shear pin 70.

When shuttle valve 63 is in the up position as shown in FIG. 6 fluid pressure communication is closed off between bore 61 and chamber 64. When running tool 34 is connected to hanger 33 at the water surface, latch fingers 67 in their collapsed positions are inserted into recess 48. Fluid pressure is applied to chamber 64 to move piston rod 66 downwardly to expand latch fingers 67 and recess 48. The running tool is thus releasably latched to the top of hanger 33. In such an operation, plunges 71 and 72 are first removed and then replaced after the running tool and hanger are latched together.

In disconnecting running tool 34 from hanger 33 a string of small diameter, e.g., 1-inch pipe 74, to the lower end of which is attached a dart 73, is run down pipe string 36 into running tool 34 where it engages shuttle valve 63 moving it down and exposing the fluid ports therein. Fluid pressure is applied down the annulus between pipe 74 and running string 36 through passageway 75 into chamber 64 (see FIG. 6) below piston 65 so as to move piston rod 66 upwards and allow latch fingers 67 to contract in recess 48. Then pipe 74 and dart 73 are retrieved and the running strings along with running tool 34 are pulled. Flexible hose and prong member 68 are also removed with running tool 34.

Following cementing of casing strings 21 and 22 in the borehole and suspending them in surface casing 20 by hanger 33, riser assembly 13 is disconnected from wellhead 12 by remote operation of connector 14 and the riser assembly is then removed along with the BOP stack and drilling spoil 15.

Prior to running the Xmas tree assembly 85 shown in FIG. 9 the downhole connector 34 used to connect hanger 33 to riser assembly 13 is made up on the lower end of two parallel small diameter riser pipes 80 and 81 which are the upper extensions or sections of the lower sections of casing pipes 21 and 22, respectively. Each riser pipe has a safety valve such as 82 or 83 arranged in it. These safety valves are spring actuated-hydraulically controlled such that loss of fluid pressure, which keeps the valves open, causes the valves to close. The safety valves are staggered one casing joint apart, and the lowestmost valve such as 82 is positioned one joint above downhole connector 34. A plurality of hydraulic control lines 84 pass through the Xmas tree and extend back from the running tool 110 to the drilling vessel at the water surface. Xmas tree 85 and a tubing hanger 86 in it extend above water surface 87 and is made up on top of the dual risers 80 and 81. The Xmas tree running tool 110 which is connected to the lower end of drill pipe 8 is also provided with a remotely operated pipe bore flow line.
connector 88. Xmas tree 85 is also provided with master valves 111 to control flow of fluids therethrough. Diverter plugs 112 are installed in the vertical bores in the crown of the tree. The lower vertical bores also terminate in curved branch bores forming Y-type bores in the Xmas tree. Pipes 115 and 116 connect into the bores in the Xmas tree below the plugs. The vertical bores permit vertical reentry to the well through the Xmas tree whenever such operation is desired. The entire Xmas tree assembly is lowered on drill pipe 8 and guided by the guide frame 10 and guide lines or cables 66. Connector 34 orients the Xmas tree with respect to hanger 33 as described previously and also correctly aligns riser or upper section casing pipes 80 and 81 with the lower section casing pipes 21 and 22. Also, the Xmas tree is properly directionally oriented with respect to the manifold 7 as it is landed on the wellhead to properly position pipelines 115 and 116 with respect to the manifold piping.

Downhole connector 34 is first operated by means of one of the control lines in the bundle 84 to connect connector 34 and riser pipes 80 and 81 to hanger 33. Then the Xmas tree connector 87 is connected by hydraulic operation to wellhead 12. Casing tensioner 86 is operated to place tension on riser pipes 80 and 81 and provide suitable casing length spacing between downhole hanger 33 and Xmas tree 85. Tensioner 86 is also used to apply adequate tension in riser pipes 80 and 81 to prevent any buckling of these pipes. Such tension is applied to the riser pipes after the running tool connector is connected to hanger 33 and the Xmas tree is landed and connected to wellhead 12. The tension is applied also to casing pipes 21 and 22 down to the top of the cement. Flow line connector 88 is then operated hydraulically to connect the manifold pipes to the Xmas tree pipes 115 and 116. The manifold pipes connect to producing and servicing facilities at the water's surface or on shore. Thereafter safety valves 82 and 83 are hydraulically opened. The Xmas tree running tool is then removed along with the drill pipe and flow line connector. A closure cap is then run on the drill pipe using a running tool and connected to the top of Xmas tree 85. Then the running tool and drill pipe are removed and the removable section 89A of the antipollution spill pan assembly 89, as shown in FIG. 10, is installed.

The well is now in condition for TFL completion procedures. Circulation between casing strings 21 and 22 is provided by the open crossover in lower sleeve valve 31. Completion tools can be pumped into and out of either casing string. Perforating is now begun with the deepest formation. As illustrated in FIG. 11, the lower formation B has been perforated and the upper formation A is being perforated. A rotatable perforator gun 90 provided with locators 120, firing section and detector 91 and pump cups 92 has been landed in landing nipple 26. Casing pipe 21 has positioned in it an orienting device such as radioactive source pill 93 which is located so as to permit firing of the rotatable gun only when pointed away from the other casing pipe 22. The gun assembly may be of the ratchet type and automatically fired when in a direction away from the casing pipe 22 as illustrated in U.S. Pat. application Ser. No. 837,245 titled "Remote Perforating of Dual Completion Wells" by Thomas W. Childers et al. After the perforator gun is fired it is circulated out of casing pipe 21 by pumping fluid down casing pipe 22 through the crossover and sleeve valve 31 and up casing pipe 21 back through the Xmas tree and then through manifold 7 to the water surface. The well is then put on production with both zones A and B being produced through casing pipe 21, 81. Other types of gun assemblies might also be used, as for example one which is oriented into proper firing position by means of a cam on or adjacent to the landing gun assembly nipple. When this gun assembly is "cammed" into position, a safety firing mechanism is released. Then, fluid pressure applied to the gun assembly causes a switch to close and fire the gun.

Assuming for example an undesirable formation exists which requires closure due to high salt water or gas production. A patch tool 95 as seen in FIG. 12 is pumped down casing pipe 21 by a locomotive means such as a running tool with swab cups (not shown) and landed in landing nipple 26 above formation B. The hollow tube in pack tube 95 is equipped with running and retrieving means and the tube section is flexible enough to be pumped through the curvatures in the pipe strings. The tube blanks off formation B; however, being hollow, circulation is permitted between the two casing pipes 21 and 22 through sleeve valves 31. The running tool is then pumped out of the well.

Gas-lift valves are not installed until required. As shown in FIG. 13 casing pipes 20 and 21 and sleeve valves 29 and 30 become gas-lift mandrels. Valve 29 is provided with a landing recess 29A and sealing rings 29B and 29C which are positioned above and below the crossover, respectively. Sleeve 30 is also provided with landing recess 30A and sealing bores 30B and 30C. A gas-lift assembly consisting of two interconnected gas-lift valves 100 and 101, running tool 102, sleeve shifter 103 and locomotive cup 104 are pumped down service casing pipe 22 until sleeve shifter 103 is below the lowestmost sleeve valve or gas-lift mandrel 30. Circulation is then reversed by circulating fluid down casing pipe 21 and pumping the gas-lift valve assembly upwardly in casing pipe 22. As the shifter moves through valve 30 it causes the sleeve therein to shift upwardly to open position and gas-lift valve 101 is opened and latched in nipple 30A as shown in FIG. 14. As the gas-lift valve assembly moves upwardly, the sleeve valve 29 is opened and gas-lift valve 100 is likewise deposited and latched in nipple 29A. The sleeve shifter 103 and locomotive means 104 is then pumped out of the well. Gas-lift for the formations can then be obtained by supplying gas down casing pipe 22 and by way of valves 101 and 100 and the respective crossovers to casing pipe 21.

Having fully described our invention, including the objects and advantages thereof, and illustrated its use, we claim:

1. A method for completing a multi-string tubingless well in which a borehole has been drilled through a productive hydrocarbon formation and provided with a surface casing and wellhead comprising the steps of:
   1. running the lower sections of at least two parallel casing strings into said surface casing and said borehole on at least two parallel running pipes releasably attached to said lower sections;
   2. cementing said lower sections in said borehole, said lower sections being connected together at a plurality of levels by crossover mandrels, each of which includes a crossover port fluidly communicating said lower sections and a sleeve valve shiftable to open or close off said crossover port, said crossover ports remaining closed during said cementing step;
   3. connecting said lower sections to said surface casing a selected distance below the wellhead by means of a hanger attached to the upper ends of said lower sections;
   4. opening one of said crossover ports;
   5. detaching and removing said parallel running pipes;
   6. lowering a Xmas tree assembly having vertical bores extending therethrough and curved bores branching from said vertical bores to said wellhead;
   7. connecting at least two parallel upper sections of said casing strings which extend from the vertical bores of said Xmas tree assembly to said hanger by means of a connector positioned on the lower ends of said upper sections, the upper sections communicating with the lower sections through the hanger and connector when said Xmas tree assembly is positioned on said wellhead;
   8. connecting the curved bores of said Xmas tree assembly to production and servicing facilities;
   9. pumping a perforator down one of said casing strings to adjacent said formation with the fluid circulation path being down said one casing string, through said one crossover port and up said other casing string;
   10. orienting said perforator to fire away from said other casing strings; and
   11. firing said perforator to perforate said formation.
2. A method as recited in claim 1 in which said borehole has been drilled through at least two productive hydrocarbon formations and including perforating each of said formations sequentially beginning with the lowest level formation.

3. A method as recited in claim 1 including hydraulically actuating said hanger to connect said lower sections to said surface casing.

4. A method as recited in claim 3 including hydraulically detaching said parallel running pipes from said hanger.

5. A method as recited in claim 4 including hydraulically connecting said upper sections of said casing strings to said hanger.

6. A method as recited in claim 5 in which said borehole is subsea and including arranging hydraulically operated safety valves in the lower ends of said lower sections to close off flow of fluids through said lower sections.

7. A method as recited in claim 6 including placing said upper and lower sections of said casing strings in tension and spacing out the upper ends of said upper sections to accommodate said upper sections in the bores of said Xmas tree assembly following connection of said upper sections to said hanger.

8. A method as recited in claim 6 and including well servicing operations in which gas-lift mandrels having gas-lift mandrel sleeves therein are located adjacent crossover ports and including pumping a train of gas-lift valves and a gas-lift mandrel sleeve shifter into one of said casing strings to below said gas-lift mandrels with the fluid circulation path being down said one casing string, through said one crossover port and up said other casing string; and reverse circulating pump fluid to move said train of valves upward through said gas-lift mandrels to shift said gas-lift mandrel sleeves open as said sleeve shifter passes each gas-lift mandrel sleeve and depositing a gas-lift valve in each gas-lift landing nipple.

9. A method as recited in claim 6 in conjunction with well servicing operations including pumping a locomotive tool string comprising a patch tool, and a running tool for said patch tool down one of said casing strings with the fluid circulation path being down said one casing string through said one crossover port and up said other casing string; landing said locomotive tool in a landing nipple in said one casing string; and blanking off a perforated interval with said patch tool.

10. A method for completing and servicing submerged multi-string tubingless TFL wells in which subsea boreholes have been drilled through subterranean formations, each of said boreholes being provided with surface casing and a wellhead comprising the steps of:
   1. positioning an underwater platform having a plurality of well bays on water bottom, one well bay being associated with each of said cased boreholes and each well bay having a guide system for guiding equipment into and from said borehole, said platform being also provided with a manifold for connecting each well with production and servicing facilities; and
   2. With respect to each well conducting the following steps:
      a. running the lower sections of at least two parallel casing strings into said surface casing and said borehole on at least two parallel running pipes releasably attached to said lower sections;
      b. cementing said lower sections in said borehole, said lower sections being connected together at a plurality of levels by crossover mandrels, each of which includes a crossover port fluidly communicating said lower sections and a sleeve valve shiftable to open or close off said crossover port, said crossover ports remaining closed during said cementing step;
      c. connecting said lower sections to said surface casing a selected distance below the wellhead by means of a hanger attached to the upper ends of said lower sections; and
      d. opening one of said crossover ports;
      e. detaching and removing said parallel running pipes;
      f. lowering a Xmas tree assembly having vertical bores extending therethrough and curved bores branching from said vertical bores to said wellhead;
      g. connecting at least two parallel upper sections of said casing strings which extend from the vertical bores of said Xmas tree assembly to said hanger by means of a connector positioned on the lower ends of said upper sections, the upper sections communicating with the lower sections through the hanger and connector when said Xmas tree assembly is positioned on said wellhead; and
      h. connecting the curved bores of said Xmas tree assembly to production and servicing facilities; and
      i. pumping a perforator down one of said casing strings to adjacent said formation with the fluid circulation path being down said one casing string, through said one crossover port and up said other casing string; and
      j. orienting said perforator to fire away from said other casing strings; and
   11. A method for use in completing a multi-string tubingless well and for conducting well servicing operations using pump-down tools and techniques comprising:
      a. a surface casing cemented in said well; and
      b. at least two casing strings cemented in said well and connected to said surface casing at the upper ends thereof;
      c. said lower sections being provided with a plurality of crossover mandrels for use in gas-lift operations and fluid circulation crossover mandrels to establish fluid circulation paths for pump-down tool operations, each crossover mandrel including a port fluidly communicating said lower sections and a sleeve shiftable to open or close off said crossover port; and
      d. a plurality of landing nipples arranged in each lower section between said uppermost and lowestmost circulation crossover ports; and
      e. at least two upper sections of said casing strings detachably connected to said lower sections of said casing strings; and
   12. A apparatus as recited in claim 11 including manifold pipes arranged adjacent and connected to said Xmas tree for carrying fluids between said well and producing and servicing facilities.

13. A apparatus as recited in claim 12 in which said Xmas tree is provided with vertical bores therethrough and branched bores curving from said vertical bores, said branched bores being connected to said manifold pipes.

14. A apparatus as recited in claim 13 including hydraulically actuated means connecting said lower sections to said surface casing.

15. A apparatus as recited in claim 14 including hydraulically actuated means for attaching and detaching said upper sections to said lower sections.

16. A apparatus as recited in claim 15 including a plurality of said cased submerged wells; and an underwater platform having a plurality of well bays positioned on water bottom, one well bay having a guide system for moving equipment into and from said well bay being associated with each of said cased wells.

17. A apparatus as recited in claim 16 including means for applying tension to said upper and lower sections to position said upper sections properly in said Xmas tree.

18. A apparatus as recited in claim 17 in which said means for applying tension comprises hydraulically operated pistons located in said Xmas tree.