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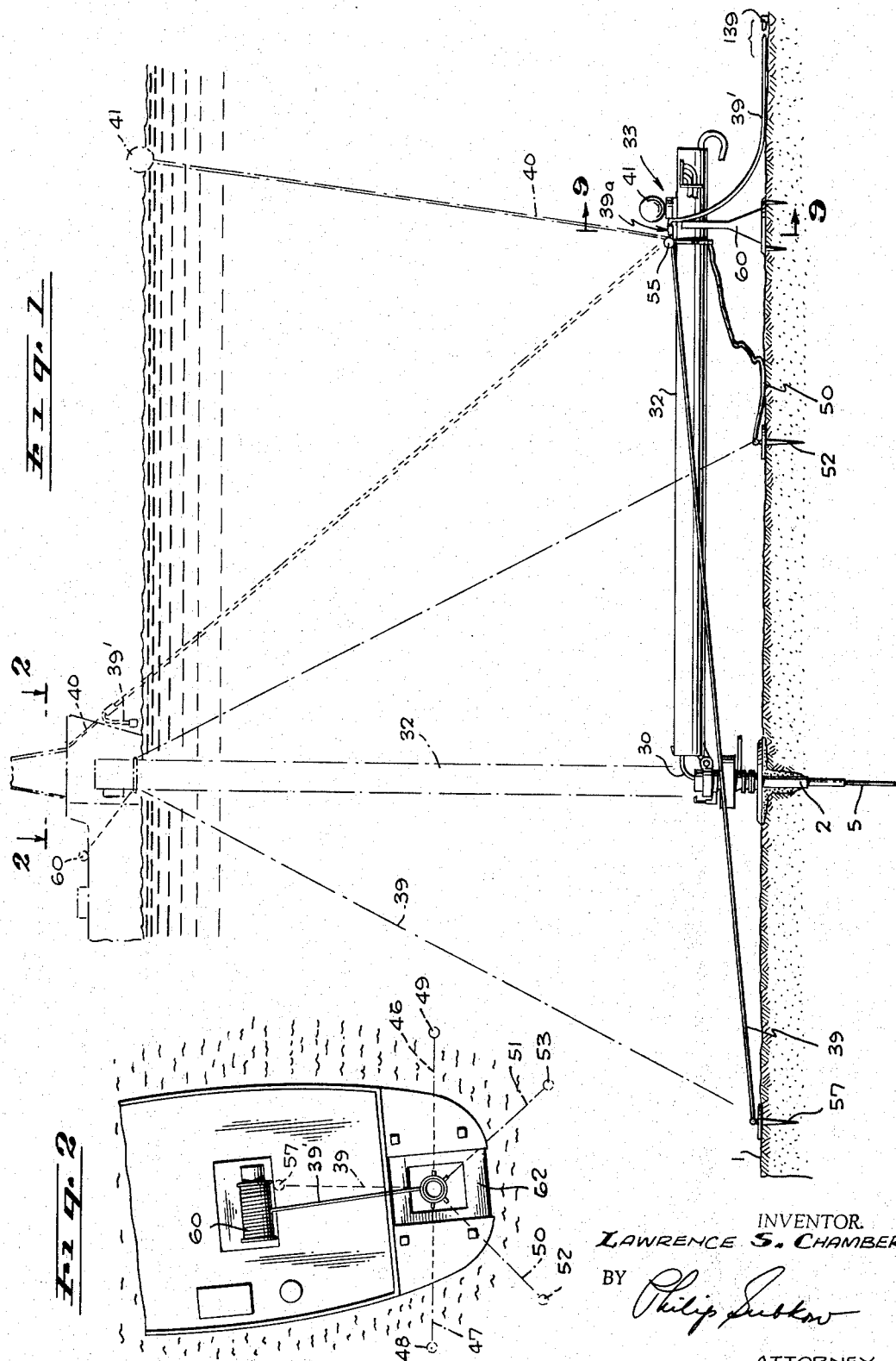
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EQUIPMENT AND METHOD FOR SERVICING SUBMARINE OIL WELLS

Filed March 1, 1965

4 Sheets-Sheet 1



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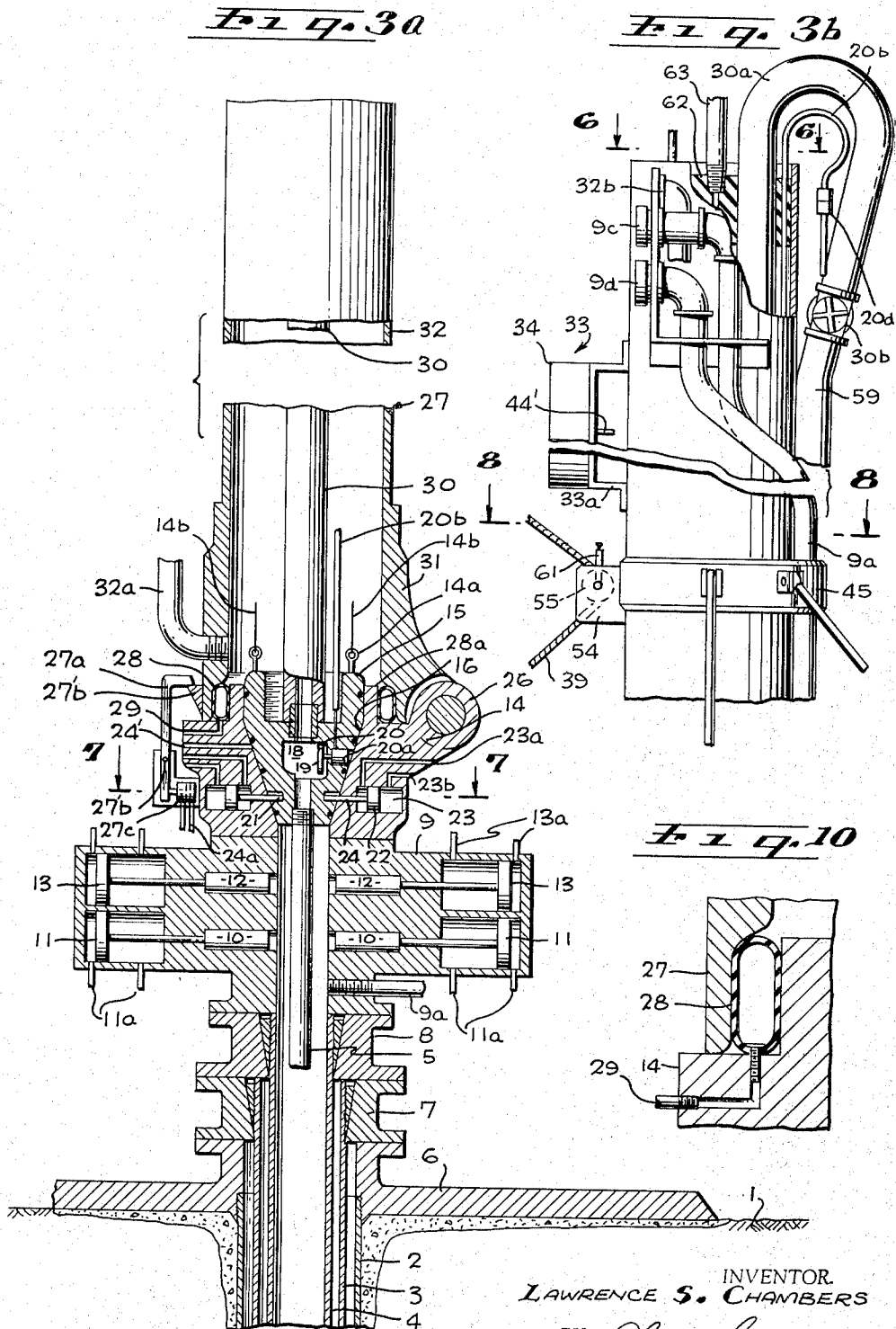
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EQUIPMENT AND METHOD FOR SERVICING SUBMARINE OIL WELLS

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4 Sheets-Sheet 2



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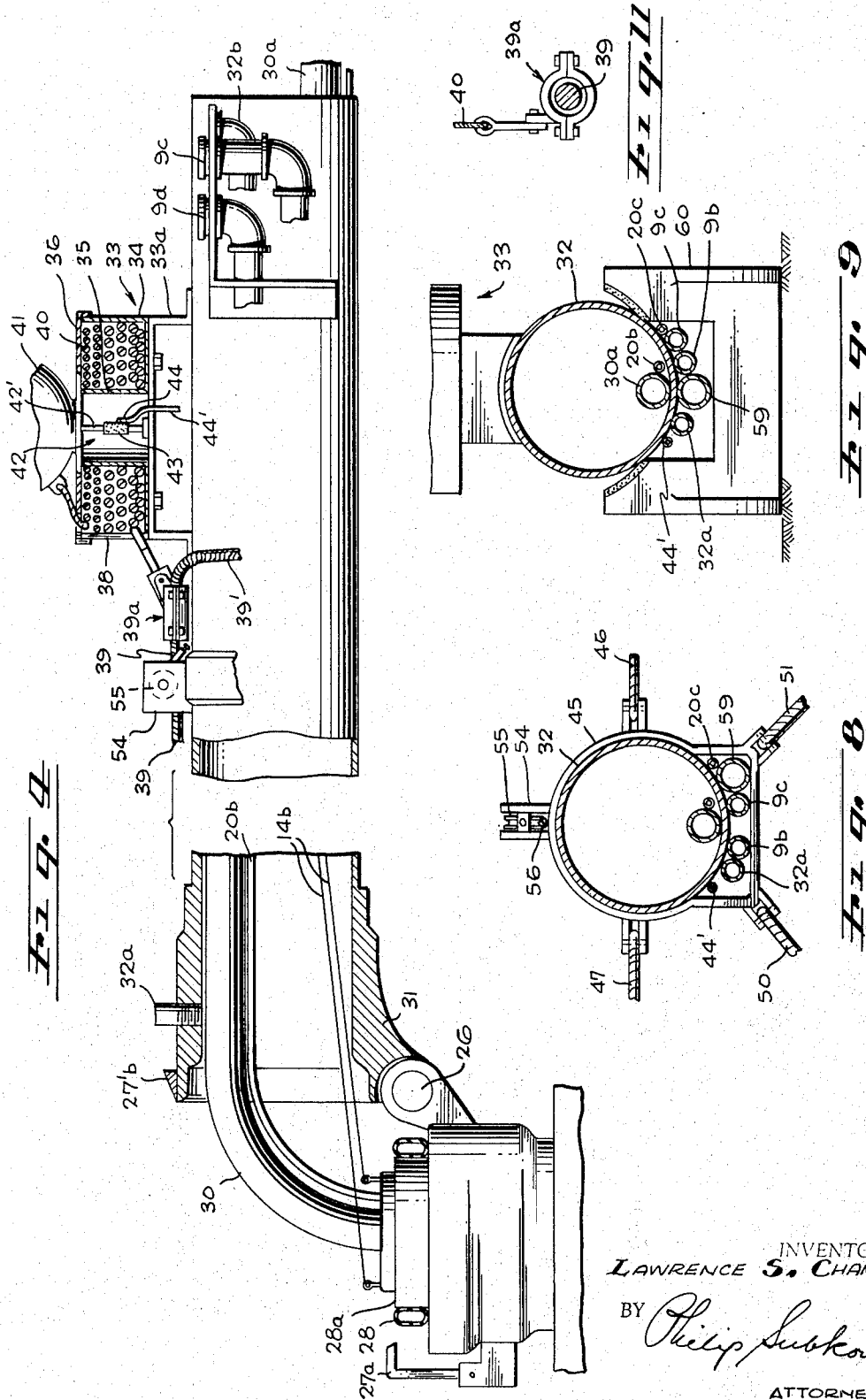
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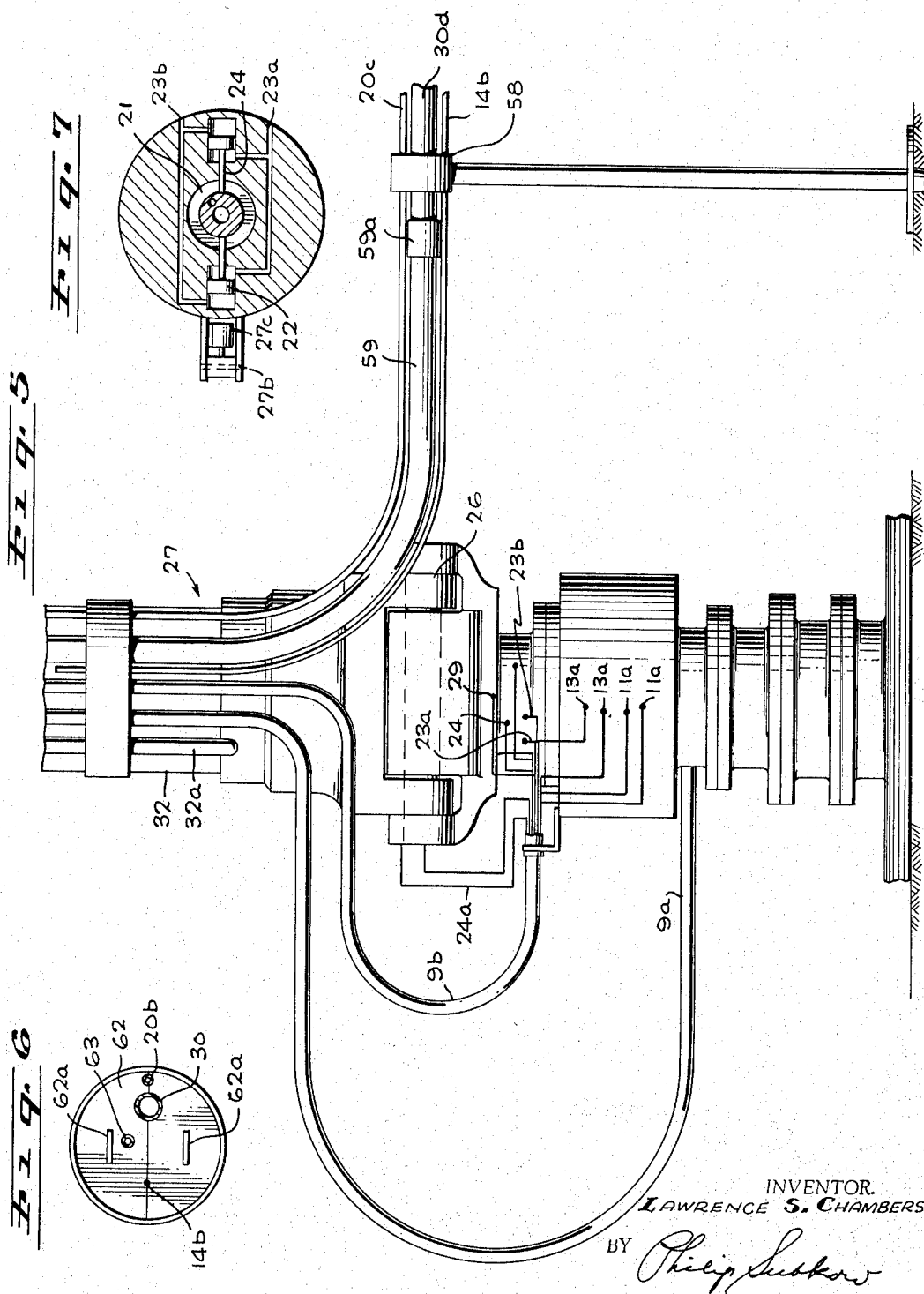
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EQUIPMENT AND METHOD FOR SERVICING SUBMARINE OIL WELLS

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4 Sheets-Sheet 4



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3,361,200

EQUIPMENT AND METHOD FOR SERVICING SUBMARINE OIL WELLS

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ABSTRACT OF THE DISCLOSURE

The present application relates to devices and systems suitable for underwater oil well completions. A tube extension with one end hingedly connected to the casing head is provided. The casing head includes a tubing hanger and control equipment. Flexible flow tubing extends through the tube extension and is connected to the tubing hanger.

This hinge supports the hinged end of the tube extension during erection and guides it on to its seat on the casing head. A separate flexible seal is used to pack off the riser on the casing head. The erection of the riser is accomplished by the application of tensional force to the erecting guy line.

The hinge pin is located off center of the bore of the riser and the casing head. In its vertical position the riser is aligned with the casing head.

The tubular extension is erected by exerting force on the erecting guy line. When in a vertical position with the erecting guy line secured, the remaining guy lines, being of fixed length, support the riser in a vertical position.

The tubular riser is of sufficient diameter so that the tubing landing spool may be removed through the riser, allowing the tubing to be pulled from the hole (or re-run) and giving access to the full diameter of the casing for possible repairs or alterations.

The drilling of oil and gas wells distant from shore and in varying depths of water, has become common practice. Two general types of completions are in use. One using permanent structures extending above the water level in which case both producing and servicing operations are conducted from such platforms. Second, wells completed with the well head a short distance above the sea floor with no extension of the well head or controls above the water level.

This invention relates to the second, or ocean floor type of completion and furnishes improved equipment and method for locating, producing, and servicing such wells.

To date the re-entering of an ocean floor completion for the purpose of repairs or clean out work usually necessary at intervals during the life of a producing well, has been an involved and costly operation. It is first necessary to relocate the well, a rather serious problem even with the most modern survey equipment, which in practice, usually has an accuracy of ± 100 to 200 feet. Divers or robots are necessary to pinpoint the location. A rather stable, well anchored work boat or a work platform with extension legs, must then be installed. Using divers and supplemental equipment, a portion of the well head is removed, flow lines disconnected (if necessary) and a tubular extension installed that extends from the well head upward to the work platform. The tubular extension is usually equipped with blow out preventing equipment, including high pressure mud lines, similar to that used on a drilling well. Hydraulic lines may also be installed to remotely control valves located on the well head. Through this tubular extension remedial work may then be performed.

Upon the completion of the repair operation the entire riser assembly is removed from the location and sections

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of the well head replaced leaving the well head in substantially its original condition.

The cost and difficulty of servicing ocean floor completions has prevented the economic use of pumping equipment and has led to the use of gas lift as an oil lifting means. In many cases, gas lift is impractical and the economic life of the wells is limited to the period of natural flow, whereas such wells would produce considerable additional oil if electric or hydraulic pumping systems now used on land could be mechanically and economically adapted to ocean floor completions.

I have solved the problem of such wells by making routine production servicing relatively simple and comparable to similar operations performed on land. No divers are used and rough surveying is adequate to locate the well. Pumping operations are made practical although gas lift can also be used if desired after the natural flow of the well has been exhausted.

This has been done by carrying the casing and necessary well head and production controls to a desirable distance above the surface of the water so that the well can be serviced in a conventional manner through such casing by a floating work boat. Practical problems and requirements of the governmental agencies make the permanent location of such casing impractical, and therefore, I have provided means for removably positioning the casing so that it may be placed in an erect position when the well is to be serviced and may be removed from an erect position at other times.

It is another feature of my invention that servicing of the well is possible without the removal of any of the exterior structure of the well head.

The preferred method for so removably mounting the casing in my invention, is to hinge the casing on the casing head so that it may be lowered to a horizontal position when it is not to be used for servicing of the well. Means are provided to pack off the casing when it is in a vertical position so as to prevent the ingress of sea water into the well or the ingress of oil into the ocean.

In order to facilitate the location of the well and the erection of the hinged casing assembly, in my preferred embodiment, I mount upon the upper end of the hinged casing a releasable buoy which, upon a signal, is released and rises to the surface and permits the location of the casing extension; and means are provided, attached to said buoy and connected to said casing extension, permitting the erection of the casing extension on the casing head and suitably support the extension in its erect position.

A work boat or platform, preferably having means to handle cables, is used to erect and lay down the extension. However, once erected, the riser is preferably self supporting and will stand without support from the work boat. Upon completion of the well the buoy is re-positioned, flow line and accessory lines reconnected, pack off means released, and the riser returned to its horizontal position.

I, therefore, provide a continuous string of pipe which is an extension of the tubular strings of the well, and thus separate the ocean from the well from the bottom clear through, and above the water surface, to a distance sufficient in height to prevent the ingress of sea water during the work over operations.

The well structure below the hinge may be as is conventional for land completions. I prefer, in my preferred embodiment, to carry the service piping and hydraulic controls and electrical lines on or in my tubular extension, so that the erection of the tube will bring to the platform of the boat, all the necessary lines, both hydraulic, fluid and/or electrical. This arrangement permits the control of all necessary operations connected with service procedure from above the surface of the water.

For the purpose of this invention, I have devised a novel form of casing head which is adaptable for the services previously described. This comprises a casing head in which a tubing hanger may be positioned. The casing head carries, on the exterior surface thereof, a hinge or means to mount a hinge or pivot so that the axis of the hinge or pivot is perpendicular to the axis of the casing head, with means provided to mount a tubular extension on said pivot or hinge.

The pivot or hinge is mounted at a distance from the axis of the casing head so that the tubular extension can be pivoted from an erect position, where it is coaxial with the casing head, to a horizontal position. Means are provided for establishing a seal between the casing head and the interior of said tubular extension.

A preferred embodiment of my invention is shown in the accompanying drawings, although variations thereof will appear to those skilled in the art.

FIG. 1 is a view partly in elevation and partly in section of the structure of my invention in one position;

FIG. 2 is a view taken on line 2—2 of FIG. 1;

FIG. 3a is a fragmentary view partly in section of the well head completion assembly in one position;

FIG. 3b is a continuation of the assembly shown in FIG. 3a;

FIG. 4 is a view partly in elevation and partly in section of the well head completion assembly in another position;

FIG. 5 is a fragmentary elevation of the well head completion in the position of FIG. 3a;

FIG. 6 is a view on line 6—6 of FIG. 3b;

FIG. 7 is a sectional view on line 7—7 of FIG. 3a;

FIG. 8 is a sectional view on line 8—8 of FIG. 3b;

FIG. 9 is a sectional view on line 9—9 of FIG. 1;

FIG. 10 is a fragmentary section detail of FIG. 3a; and

FIG. 11 is a fragmentary detail of FIG. 1.

FIGS. 1 and 3a show a conventional well assembly, modified as described below. The conventional features are somewhat schematically illustrated. The oil well casing assembly, as shown in FIG. 3a, includes the submarine bottom; the conductor casing 2; the surface casing 3; 4 is the production string; 5 is the flow tubing through which the oil is produced; 6 is the landing plate cemented in position at the bottom on which is carried the landing heads 7 and 8, on which is mounted the blow out preventer 9, of conventional design.

The blow out preventer 9 carries the rams 10 and 12 which open and close under the influence of the hydraulically actuated pistons 11 and 13, suitably operated by hydraulic lines 11a and 13a. The blow out preventer also has a tube 9a which connects with the interior of the tubing 4 as is conventional in casing head assemblies.

Rams 10 close around the tubing. Rams 12 act to close off the well when the tubing 5 is withdrawn, as will be described below.

Mounted upon the blow out preventer is a casing head assembly containing the landing spool 14, in which is mounted a tubing hanger 15. The tubing hanger is conical in shape and mates closely with the conical seat 16 of the landing spool. The tubing hanger is relieved to form a chamber 18, in which is mounted a flapper valve 19, hingedly mounted on hinge 20. Valve 19 is controlled electrically from the shore production station and is closed or opened by a solenoid or other electrical arrangement located in 20a powered by electrical wires contained in conduit 20b. This valve is used to shut off the flow from the well in case of failure of the flow lines or related equipment. The tubing hanger is provided with means to lock the tubing hanger in position in the landing spool. It is provided with a latch recess in the form of an annular groove 21. The latch means fits into the latch recess. In the specific form shown, the piston rods fit into the groove into which fit piston rods 24, operated by remote control by pistons 22 in the cylinders 23, to which are suitably connected hydraulic power lines 23a

and 23b. Connected to the top of the tubing hanger by means of eyes 14a, are the wire lines 14b which extend as described below. The tubular bore 24' is positioned to terminate at the conical seat of the hanger.

The landing spool 14 carries a hinge assembly 26 and a tubular extension 27. A hollow flexible ring 28, formed of flexible material which is impervious to sea water, such as rubber, and suitably reinforced. An hydraulic line 29 (see FIGS. 3a and 10) is connected to the ring 28a formed integrally with the landing spool 14.

The flow tube 5 is connected to the tubing head and to the top of the tubing head is suitably connected to flexible tubing 30, such as a reinforced rubber or plastic line. The tubular casing head extension 27 is hingedly connected to the hinge 26.

The axis of the hinge 26 extends perpendicular to the axis of the tubing hanger. The hinge axis is positioned at a radial distance from the axis of the tubing hanger and the landing spool 14 of the casing head greater than the radius of the bore of the tubular extension 31 and the maximum radius of the conical seat of the landing spool 14, so that when the tubular extension 27 is rotated to erect position with its axis, coincident with the axis of the tubing hanger, it will mate with the flexible hollow ring packer 28 mounted on the landing spool when the packer is in deflated position. The ring 28, which may be made of rubber or other elastomer, may be inflated or deflated by fluid pressure exerted through a tube connected to the bore 29 in communication with the interior of said ring.

The casing head extension 27 includes the reinforced portion 31 and the tubular extension 32, which in height, is sufficient to reach above the surface of the water to the desired distance as described below. The parts 31 and 32 may be formed integrally, or they may be formed in two parts with means to connect 32 to 31, as by welding or by a threaded connection.

When erected, the extension 27 may be latched in position by a dog 27a, hinged at 27b and mounted on the landing spool, and engaging the latch head 27'b. The latch is closed and opened by the hydraulic ram 27c by means of hydraulic lines 24a.

A pipe 32a is connected near the bottom end of the extension 31, and extends to the top of the extension 32.

Mounted near the outer end of the extension 32 (see FIGS. 1 and 4), is a buoy assembly 33 composed of a base 33a and a tubular housing 34, sleeve 35, and a top 36. A slot 38 is provided in the wall 34. Coiled in the annulus between the wall 34 and the sleeve 35, is a line 40, one end of which extends through the slot 38 and is connected to a sleeve 39a, described below. The other end of the line 40 extends through cover 36 and is connected to a buoy 41. An explosive ejection device 42, formed of rod 42', connected to the buoy 41 fitting slidably into a sleeve 43, carrying an electrically ignited explosive charge and mounted on the base 33a.

An electrical connection for this purpose is provided at 44, and actuated by an electrical cable 44' which extends along the exterior of the tubing head assembly, as is more fully described below. All hydraulic and electrical lines previously identified, other than 30 and 20b, extend along the exterior of the extension 32 (see FIG. 3b and FIG. 5) in which the position of the lines are schematically illustrated.

The pipes 9a and conduit 9b are formed into an arc which encompass the axis of rotation of the hinge, and are of such curvature and flexibility that the rotation of the extension 32 on the hinge does not impose an undue twist on the pipe and conduit. The pipe 9a and conduit 9b extend to the end of the tubular extension and are connected to connector fittings 9c and 9d. The pipe 32a terminates in connector fitting 32b. The fittings provide means for connection to each of the lines in a bundle of lines in conduit 9b, to the line 9a, and to pipe 32a. The pipes and conduit are supported in a bracket 45,

mounted adjacent the end of the tubular extension 32. The flexible production pipe 30, the electrical conduit 20b and the cables 14b are positioned on the interior of the tubular extension, and extend through the top of the tubular extension. Due to the flexibility of the pipes 30 and 20b, when the tube extension 32 is in the position of FIG. 4, the pipes will flex sufficiently to rest on the bottom of the tube 32 near the top of the tube 32. The pipe 30 is connected to a disconnect fitting 30a, carrying valve 30b so constructed as to permit the separation of the flexible pipe 30. The electrical cable 20b is connected to a disconnect fitting 20d.

The flow line 30 and the electrical cable 20b make a reverse bend at the top of the tubular extension, as shown in FIG. 5 and, together with electrical cables 44', extend through the tubes support 58, positioned in the ocean bottom to a shore station.

The pipe 59, which is the extension of pipe 30, may be made flexible as in the case of the pipes 9a and conduit 9b so that an undue twist does not occur when the extension 32 is rotated. This is aided by aligning the axis of the pipe 59 at the bend substantially coincident with the axis of the hinge.

A universal joint 59a may be provided, if necessary, to further avoid any undue twist. The electrical cable 20a which may be connected by a disconnect 20d is of such small diameter relative to the length of the arc (see FIG. 5) that undue twist is avoided.

Connected exteriorly of, and at the upper end of the tubular extension 32, is a strap 45 to which are connected (see FIGS. 1 and 2) guy cables 46, 47, 50 and 51 forming an angle with each other and connected at their extreme ends to dead men 48, 49, 52 and 53, securely positioned with the ocean bottom. The guy cables are evenly spaced angularly about said tubular extension.

The strap 45 carries a yoke 54, positioned on the side opposite to the hinge position and carrying a cable force reaction position, for example, pulley 55, over which the cable 39 passes at one end connected to a dead man 57 in the ocean bottom and the other end terminating in a stop 139, and position loosely on the ocean floor. The cable 39 passes freely through a split sleeve 39a, suitably secured by bolts and connected to 40, as shown in FIG. 11. The pulley position is on the side of the tubular extension opposite to the hinge position.

Positioned in the ocean bottom at a suitable distance from the well head is a cradle 60, positioned to receive the tubular extension 32 when it is in position on the bottom of the ocean, for example, in a horizontal position.

Assuming the well has been completed, and requires work, the operator on shore or upon a work boat which is to be employed, closes the electrical circuit via cable 44 and ignites the explosive charge in 43. This blows the cover 36 and the attached buoy from the buoy assembly, and the buoy rises to the surface carrying with it a light line which is connected to a heavier line, and which is in turn connected to the line 39. The line is in length sufficient to reach the surface.

In positioning the extension 32 on the bottom, the azimuthal direction of the tubing extension has been recorded. The work boat has been oriented so that it is in line with the tubular extension. The boat then picks up the buoy and reels in the line 40 connected to the buoy. This lifts the free end of the cable end extension 39' until the end 139 is stopped at the sleeve 39. The sleeve 39a is then disassembled. The free end of 39' is reeled in a winch 60, creating a tension on cable 39. Tension on the cable 39 is such as to lift the tubular extension 32 off its cradle, rotate it around the hinge 26 into an erect position, where the end of the tubular extension 31 takes a position circumambient about the flexible ring 28 (see FIGS. 1 and 3a).

With the extension in erect position, the cable 39 is secured at the cable pulley 55 by any clamping means 61, or is held in any other way, in locked position. The tube

is thus guyed against sidewise movement by the guy wires 47, 46, 50, 51 and 39, and the casing extension is thus held substantially rigid.

The hydraulic lines in conduit 9b are connected to extensions at 9c, and the pipe 9a is connected to an extension 9d, and the pipe 32a is connected to an extension at 32b.

To further secure the extension 32 in an erect position, the hydraulic cylinder 27c is powered to move the latch 27a into latching position, as shown in FIG. 3a.

Pressure is applied through bore 29 to cause an inflation of the tube 28 to make a fluid-tight seal between landing spool ring 28a and the interior of the tubular extension 31.

The work boat is positioned so that the tubular extension extends through the work platform 62 and is centered beneath the mast or derrick mounted on the work boat. In this position, the tubular extension 31 is full of sea water. In order to unwater this extension, a pump on the work boat is connected to the pipe 32a at 32b and the water is pumped out. If the water depth is too great to permit pumping out, as described above, an alternative procedure may be used as shown in FIGS. 3b and 6.

A split cover 62 carrying a pipe 63, is inserted into the top of the tubular extension 32 to seal off the interior of the extension. The flexible pipe 30, and the electrical cable 20b pass through the seal in the cover, as do also the wire line 14b. Air pressure is applied from an air pressure source connected to 63, to force water out through the bottom of the tube and pipe 32a to discharge either into the ocean or to a suitable receptacle in the boat. The end of the pipe 32a is evident above the level of the water surface.

Where the well is a flowing well and is under pressure, it is necessary to kill the well, that is, to balance the well pressure by a static head before removing the pipe 30 and tubing 5 from the well. This is done by introducing water, mud or oil through a pipe connected at 9d to the pipe 9a until the head of fluid in 4 balances well pressure.

Lubricating oil under pressure may be forced through the pipe 24' to insure lubrication between the tubing hanger and the landing spool. Pressure is also exerted through the pipes 23a to withdraw the rods 24 from the groove 21 in the tubing hanger.

The air pressure used to unwater the tube 32, having been cut off, the split plug 62 carrying the pipe 63, is withdrawn by means of the handles 62a. The tubing hanger 15 carrying the pipes 30 and the pipe 20b, may then be withdrawn by means of wire lines 14b by reeling the wires over a power winch. The tubing 5 is thus lifted. The tubing 5 is broken and separated in the usual manner employed for oil well flow tubing assemblies. The blow out preventer assembly 9 may be operated to seal the well for the usual reasons during the withdrawal of the pipe 5. If necessary, when the flow tube 5 is completely removed, the rams 12 may be closed to close the well, thus acting as a master gate.

As will be understood by those skilled in the art, by applying pressure through the hydraulic lines previously identified, the well is controlled in the same manner as in the land well. With the flow tube and associated equipment having been withdrawn, the conduit 32 is an extension of the well casing, and equipment may then be lowered into the well through the tubing extension 32 and through the open landing spool into the pipe 4. The well may then be processed in the usual manner to repair or replace bottom hole equipment, clean out the well, acidize or to test the well as is conventional in oil field operation.

When the well is to be reassembled, tubing 5 is lowered into the well in a manner usually conventional for oil field operations (by procedures well known to those skilled in the art and needing no further description), as for example, by using conventional slips and elevators. The flow tubing joints are connected at the surface above the top of the extension 32 in the derrick of the work boat, and lowered into the well. The last stand of tubing is connected to the tubing hanger. The tubing hanger with a de-

pendent tube 5, the flow tube 30 and the electrical cable 20b, is lowered by means of the cables 14a until the tubing hanger is seated on the landing head 14. The blow out preventer assembly 9 may be operated during this operation for the purposes for which they are designed, as is usual in conventional land operations.

With the tubing hanger in position on the landing spool, pressure is now exerted through lines 23b and the rods 24, entered into the receiving grooves 21, thus locking the tubing hanger in position. The pipes 30 and electrical cable 20b are connected at 20d and 30a. Pressure in the flexible ring 28 is relieved and the latch is unlatched by applying pressure to the appropriate bore 24a. The pipe 9a and conduit 9b are disconnected at the disconnects 9c and 9d. Both are sealed by suitable caps or plugs.

Before lowering the tubing extension, a new buoy assembly composed of the buoy 41, the top 36, the coiled line 40, and a new explosive charge in 43 is assembled. The line 40 is connected via the cable connector 39a to the cable 39. The clamp 61 is released and the cable 39 is released at the winch drum and the extension lowered to the cradle 60, suitable tension being held on cable 39. The cable 39 runs through the sleeve 39a, and when the extension is positioned on the cradle, the remaining end 39' is released from the winch and lowered to the ocean bottom. An alternate method may be used to lower the riser from its erect position to horizontal by using a line passed around the upper end of the tubular extension 32 to form a sling with both ends of the cable secured at the work boat. After the riser is in place on the ocean bottom, one end of the cable is released and the line recovered by the work boat. This allows sufficient heavy line to be reeled on the buoy spool to reach the work boat. The heavy line is pulled up by the light line directly attached to the buoy.

It will also be understood that if it be needed, that air inflatable members to act as floats may be attached to the riser. These can be connected to an air hose carried to the surface by the buoy. Injecting air under pressure through the hose would displace the water in the float members and the resulting buoyancy would aid in erecting the riser.

For the purposes of illustration, the device is shown as it would be used on an ocean floor completion capable of producing gas, oil or other fluids by natural flow under formation pressure only.

It will be apparent to those familiar with oil well production that three of the four common oil lifting means now in use on land can readily be adapted for use with the riser assembly. These are gas lift, down hole fluid driven pumps and submersible electrical pumps.

To apply gas lift it is necessary to pipe gas from the compressor station to be connected to the casing at 9a. Necessary gas lift valves would be installed in the tubing and changed or serviced by pulling the tubing or using a wire line as in some land operations.

Fluid driven down hole pumps would require a power fluid line from the power fluid source and a separate string of power fluid tubing in the hole. A flexible high pressure line paralleling line 59 and 30 would be extended through the tubing landing spool to connect with the power fluid tubing which in turn is connected to the pump.

Submersible electric pumps would require a power cable from the power source which would parallel lines 59 and 30 and extend downward through the tubing landing spool and alongside the well tubing to the point at which the pump is located. A suitable derrick may be positioned on the boat to aid in the above operations.

These additions and variations will be understood by those skilled in this art without further description.

While I have described particular embodiments of my invention for the purpose of illustration, it should be understood that various modifications and adaptations thereof may be made within the spirit of the invention, as set forth in the appended claims.

I claim:

1. An underwater oil well casing head assembly, com-

prising a casing positioned in the underwater bottom, a landing spool positioned on said casing, a tubing hanger in said landing spool, a tube extension, a hinge connected to said tube extension, means adjacent one end of said tube extension and connected to said landing spool, the axis of said hinge extending perpendicular to the axis of the bore of said landing spool and positioned at a radial distance greater than the radius of said bore, for mounting said tube extension for rotation to and fro from a position on said bottom to an upright position, the bore of said tube extension aligned with the bore of said landing spool, and the upper end of said tube extension extending upwardly from the water and forming a passageway through said tube extension and through the said tubing hanger.

2. The oil well assembly of claim 1, a tubing hanger in said landing spool, a flexible flow tube connected to said tubing hanger and extending through said tube extension to the end thereof.

3. The oil well assembly of claim 1, a pipe connected at the lower end of said tube extension and extending into said tube extension.

4. An underwater oil well casing head assembly, comprising a casing positioned in the underwater bottom, a landing spool, a tube extension, means adjacent one end of said tube extension for mounting said tube extension for rotation to and fro from a position on said bottom to an upright position aligned with said landing spool, and the upper end of said tube extension extending upwardly from the water and forming a passageway through said tube extension and through said landing spool, a guy cable fixedly positioned at one end and a force reaction point connected to said tube extension at a point remote from said one end of said tube extension, said cable extending through said point, whereby on applying tension to said cable, said tube extension is rotated to said upright position.

5. The oil well assembly of claim 4, a plurality of additional guy cables connected adjacent to said remote point and each fixedly positioned at the other end of said additional guy cables, and each angularly spaced from each other about said tubular extension.

6. An oil well assembly comprising a landing spool and a tubing hanger in said landing spool, a tube extension, a hinge between said landing spool and said tube extension, the axis of said hinge extending perpendicular to the axis of said tubing hanger and positioned at a radial distance greater than the radius of the bore of the landing spool, said tube extension rotatable on said hinge to an upright position on said landing spool, a seal between said tube extension and said landing spool when said tube extension is in an upright position.

7. An oil well assembly comprising a landing spool and a tubing hanger, a tube extension, a hinge between said landing spool and said tube extension, the axis of said hinge extending perpendicular to the axis of said tubing hanger, said tube extension rotatable on said hinge to an upright position on said landing spool, a seal between said tube extension and said landing spool when said tube extension is in an upright position, said tubing hanger including a latch recess in said tubing hanger, a latch means in said landing spool, said latch means including means to enter said latch recess to lock said tubing hanger in position on said landing spool.

8. The oil well assembly of claim 7, said tubing hanger having an exterior conical surface and said latch recess being an annular recess in the exterior conical surface of said tubing hanger, and said latch means including a cylinder in said landing spool, a hydraulically operated piston positioned in the cylinder, and a piston rod connected to said piston and extending to enter said recess, hydraulic lines connected to said cylinder extending along the exterior of said tube extension.

9. An oil well assembly comprising a landing spool and a tubing hanger, a tube extension, a hinge between said landing spool and said tube extension, the axis of said

hinge extending perpendicular to the axis of said tubing hanger, said tube extension rotatable on said hinge to an upright position on said landing spool, a seal between said tube extension and said landing spool when said tube extension is in an upright position, casing landing heads, casing connected to said landing heads, a flow tube connected to said tubing hanger, a blow-out preventer positioned in said assembly between said landing heads and said tubing spool.

10. The oil well assembly of claim 9, said blow-out preventer including hydraulically operated means to operate said blow-out preventer and hydraulic lines connected to said means and extending along exteriorly of said tubing extension.

11. An oil well assembly comprising a landing spool and a tubing hanger, a tube extension, a hinge between said landing spool and said tube extensions, the axis of said hinge extending perpendicular to the axis of said tubing hanger, said tube extension rotatable on said hinge to an upright position on said landing spool, a seal between said tube extension and said landing spool when said tube extension is in an upright position, a flexible flow tube connected to said tubing hanger and extending into said tube extension.

12. The oil well assembly of claim 11, casing landing heads, casing connected to the landing heads, a flow tubing connected to said tubing hanger, a blow-out preventer positioned in said assembly and between said landing heads and said tubing hanger, said blow-out preventer including a hydraulically operated means to operate said blow-out preventer, and hydraulic lines connected to said means and extending along exteriorly of said tubing extension.

13. The oil well assembly of claim 11, a guy cable fixedly positioned at one end and a cable force reaction point connected to said tube extension at a point remote from said hinge and on the side of said tubular extension away from said hinge, said cable extending through said point whereby, on applying tension to said cable, said tube extension is rotated to said upright position.

14. The oil well assembly of claim 11, said tubing hanger including a latch recess in said tubing hanger, a latch means positioned in said landing spool, said latch means including means to enter said latch recess to lock said tubing hanger in position on said landing spool.

15. The oil well assembly of claim 14, said tubing hanger having an exterior conical surface, said latch recess being an annular recess in the exterior conical surface of said landing spool and said latch means including a cylinder in said landing spool, a hydraulically operated piston positioned in the cylinder, and a piston rod connected to said piston and mounted to enter said recess, hydraulic lines connected to said cylinder and extending along the exterior of said tubular extension.

16. An underwater oil well casing head assembly, comprising a casing positioned in the underwater bottom, a landing spool, a tube extension, means adjacent one end of said tube extension for mounting said tube extension for rotation to and fro from a position on said bottom to an upright position aligned with said landing spool, and the upper end of said tube extension extending upwardly from the water and forming a passageway through said tube extension and through said landing spool, a releasable buoy connected to said tube extension remote from the end of tube extension adjacent said landing spool, a guy cable connected at one end thereof to said buoy and being fixedly positioned at the other end, a cable force reaction point connected to said tube extension at a point remote from the end of the tube extension adjacent said landing spool, said guy cable extending through said point, whereby on applying tension to said guy cable the tube extension is rotated to an upright position.

17. The assembly of claim 16, a buoy assembly comprising said buoy and a housing, said buoy positioned in said housing, said housing mounted on said tube extension,

a length of cable positioned in said housing and connected at one end to said buoy, at the other end to said first-mentioned cable, said length being sufficient to extend from said buoy, when said buoy is positioned at the water surface above said bottom, to said tube extension, when said tube extension is positioned on said bottom.

18. The assembly of claim 17, a connection between said buoy and said tube extension, an explosive ejection device positioned between said buoy and said tube extension, an explosive charge in said ejection device, remote controlled electrical means to explode said explosive charge to release said buoy from said tube extension.

19. An oil well assembly comprising a landing spool and a tubing hanger, a tube extension, a hinge between said landing spool and said tube extension, the axis of said hinge extending perpendicular to the axis of said tubing hanger, said tube extension rotatable on said hinge to an upright position on said landing spool, a seal between said tube extension and said landing spool when said tube extension is in an upright position, a casing in an underwater bottom, said landing spool connected to said casing below the water surface, a releasable buoy mounted on said tube extension, a guy cable connected to said buoy at one end and fixedly positioned at the other end, a cable force reaction point connected to said tube extension at a point remote from said hinge and on the side of said tube extension away from said hinge, said cable extending through said point, whereby on applying tension to said guy cable, the tube extension is rotated to said upright position.

20. The assembly of claim 19, a housing for said buoy mounted on said tube extension, a length of cable positioned in said housing and connected at one end to said buoy, at the other end of said length of cable to said first-mentioned cable, said length being sufficient to extend from said buoy, when said buoy is positioned at the water surface above said bottom, to said tube extension, when said tube extension is positioned on said bottom.

21. The assembly of claim 19, a casing in an underwater bottom, said landing spool connected to said casing below the surface of said water, a flexible flow tube connected to said tubing hanger and extending into said tube extension.

22. The assembly of claim 21, a housing for said buoy mounted on said tube extension, a length of cable positioned in said housing and connected at one end to said buoy and at the other end to said first-mentioned guy cable, said length being sufficient to extend from said buoy, when said buoy is positioned at the water surface above said bottom, to said tube extension, when said tube extension is positioned on said bottom.

23. The assembly of claim 22, a connection between said buoy and said tube extension, an explosive ejection device between said buoy and said tube extension, an explosive charge in said ejection device, and remote controlled electrical means to explode said explosive charge.

24. The oil well assembly of claim 23, a plurality of additional guy cables connected adjacent to said remote point and each fixedly positioned at the other end and each angularly spaced from each other about said tubular extension.

25. An underwater oil well casing head assembly, comprising a casing positioned in the underwater bottom, a landing spool, a tube extension, means adjacent one end of said tube extension for mounting said tube extension for rotation to and fro from a position on said bottom to an upright position aligned with said landing spool, and the upper end of said tube extension extending upwardly from the water and forming a passageway through said tube extension and through said landing spool, a tubing hanger in said landing spool, a flexible flow tube connected to said tubing hanger and extending through said tube extension to the end thereof, said tubing hanger having a conical exterior surface, a latch recess in said conical surface, a latch means positioned in said landing

spool, said latch means including means to enter said latch recess to lock said tubing hanger in position on said landing spool.

26. An oil well assembly comprising a casing head, positioned on an underwater bottom, said casing head including a landing spool, a tubing hanger having an exterior conical surface, a tube extension, a hinge between said landing spool and said tube extension, the axis of said hinge being positioned perpendicular to the axis of said tubing hanger, a seal between said tube extension and said landing spool when said tube extension is in upright position, and extending out of the water over said bottom, and a fluid conduit connected to the interior of said hollow ring packer, and positioned in said landing spool, a flexible flow pipe positioned in said tube extension and connected to said tubing hanger and extending into said tubing hanger away from said hinge, a pipe connected to the lower end of said tubular extension and extending exteriorly of and along said tubular extension, a guy cable fixedly positioned at one end of said cable, a cable force reaction point connected to said tube extension at a point remote from said hinge and on the side of said tubular extension away from said hinge, said cable extending through said point, a plurality of additional guy cables connected adjacent to said remote point and each fixedly positioned at the other end of said cables and each angularly spaced from each other about said tubular extension, an annular recess in the exterior conical surface of said tubing hanger, a cylinder in said landing spool, a hydraulically operated piston positioned in said cylinder, a piston rod connected to said piston mounted to enter said groove, hydraulic lines connected to said cylinder and extending along the exterior of said tubular extension, landing heads, casing in said underwater bottom connected to said landing heads, a flow tubing connected to said tubing hanger and extending into said tube extension, a blow-out preventer positioned in said assembly between said landing heads and said tubing hanger, said blow-out preventer including hydraulically operated means to operate said blow-out preventer and hydraulic lines connected to said means and extending along exteriorly of said tube extension, a releasable buoy mounted on said tube extension remote from said hinge, a housing for said buoy mounted on said tube extension, a length of cable positioned in said housing and connected at one end to said buoy, at the other end to said first-mentioned cable, said length being sufficient to extend from said buoy, when said buoy is connected at the water surface above said bottom, to said tube extension, when said tube extension is positioned on said bottom, a connection between said buoy and said tube extension, an explosive ejection device between said buoy and said tube extension, an explosive charge in said ejection device, and remote controlled electrical means to explode said explosive charge.

27. In combination, a landing spool having a conical tube hanger seat, a tube extension, a hinge between said landing spool and said tube extension, the axis of said hinge extending perpendicular to the axis of said landing spool and positioned exteriorly of said landing spool and tube extension, said tube extension by rotation on said hinge extending in an upright position and seated on said landing spool, and means constituting a fluid seal between said tube extension and said landing spool when said tubing extension is in upright position.

28. The combination comprising a landing spool having a conical tubing hanger seat, a tube extension, a hinge

between said landing spool and said tube extension, the axis of said hinge extending perpendicular to the axis of said landing spool, said tube extension by rotation on said hinge extending in an upright position on said landing spool, and means constituting a fluid seal between said tube extension and said landing spool when said tubing extension is in upright position, said seal comprising a flexible hollow ring packer mounted on said landing spool and a fluid conduit extending through said landing spool to the interior of said hollow ring packer.

29. The combination comprising a landing spool having a conical tubing hanger seat, a tube extension, a hinge between said landing spool and said tube extension, the axis of said hinge extending perpendicular to the axis of said landing spool, said tube extension by rotation on said hinge extending in an upright position on said landing spool, and means constituting a fluid seal between said tube extension and said landing spool when said tubing extension is in upright position, a cylinder in said landing spool, a hydraulically operated piston positioned in the cylinder in said landing spool and a piston rod connected to said piston extending beyond the conical seat of said landing spool when in latching position, and hydraulic passageways in said landing spool connected to said cylinder.

30. The combination comprising a landing spool having a conical tubing hanger seat, a tube extension, a hinge between said landing spool and said tube extension, the axis of said hinge extending perpendicular to the axis of said landing spool, said tube extension by rotation on said hinge extending in an upright position on said landing spool, and means constituting a fluid seal between said tube extension and said landing spool when said tubing extension is in upright position, said seal comprising a flexible hollow ring packer mounted on said landing spool and a fluid conduit extending through said landing spool to the interior of said hollow ring packer.

31. A landing spool for a casing head assembly comprising an interior conical tubing hanger seat, a hinge connected to the exterior of said landing spool, a tubular extension, said hinge connected adjacent the end of said tubular extension for rotation of said tubular extension to and fro from an erect position on said landing spool, the diameter of said tubular extension being greater than the maximum diameter of said conical bore, the axis of said hinge extending perpendicular to said conical bore and positioned at a radial distance greater than the radius of the said tubular extension when said tubular extension is in an erect position, and a seal between the end of said tubular extension and the said landing spool.

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