

[54] **UNDERWATER CONNECTOR FOR WELLHEADS**

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[58] Field of Search **166/.5, .6; 137/236;**
285/26, 29, 131

[56] **References Cited**
UNITED STATES PATENTS

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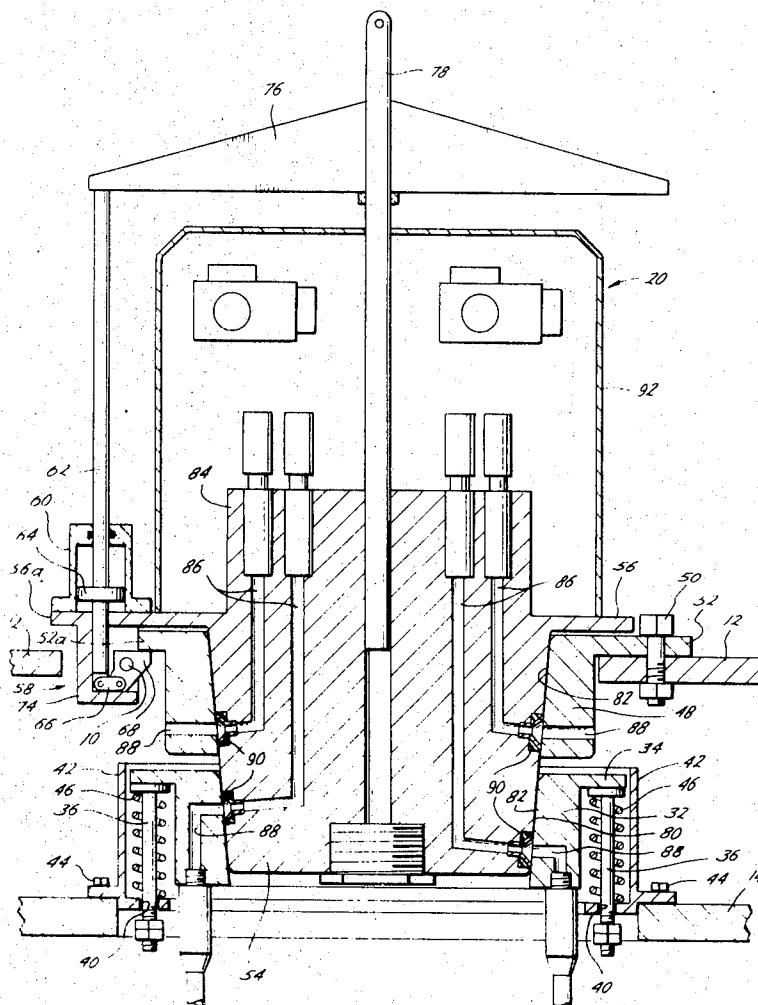
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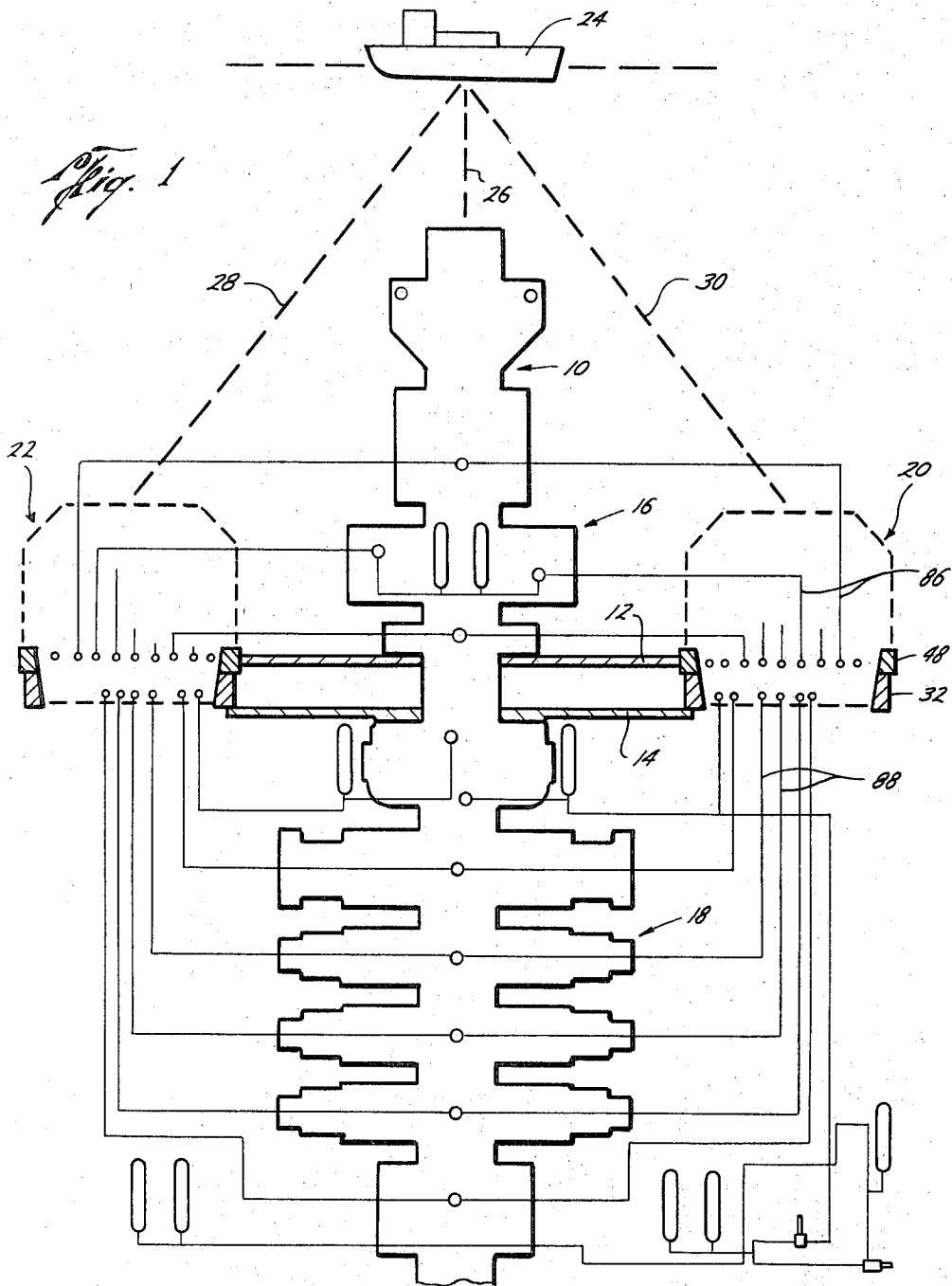
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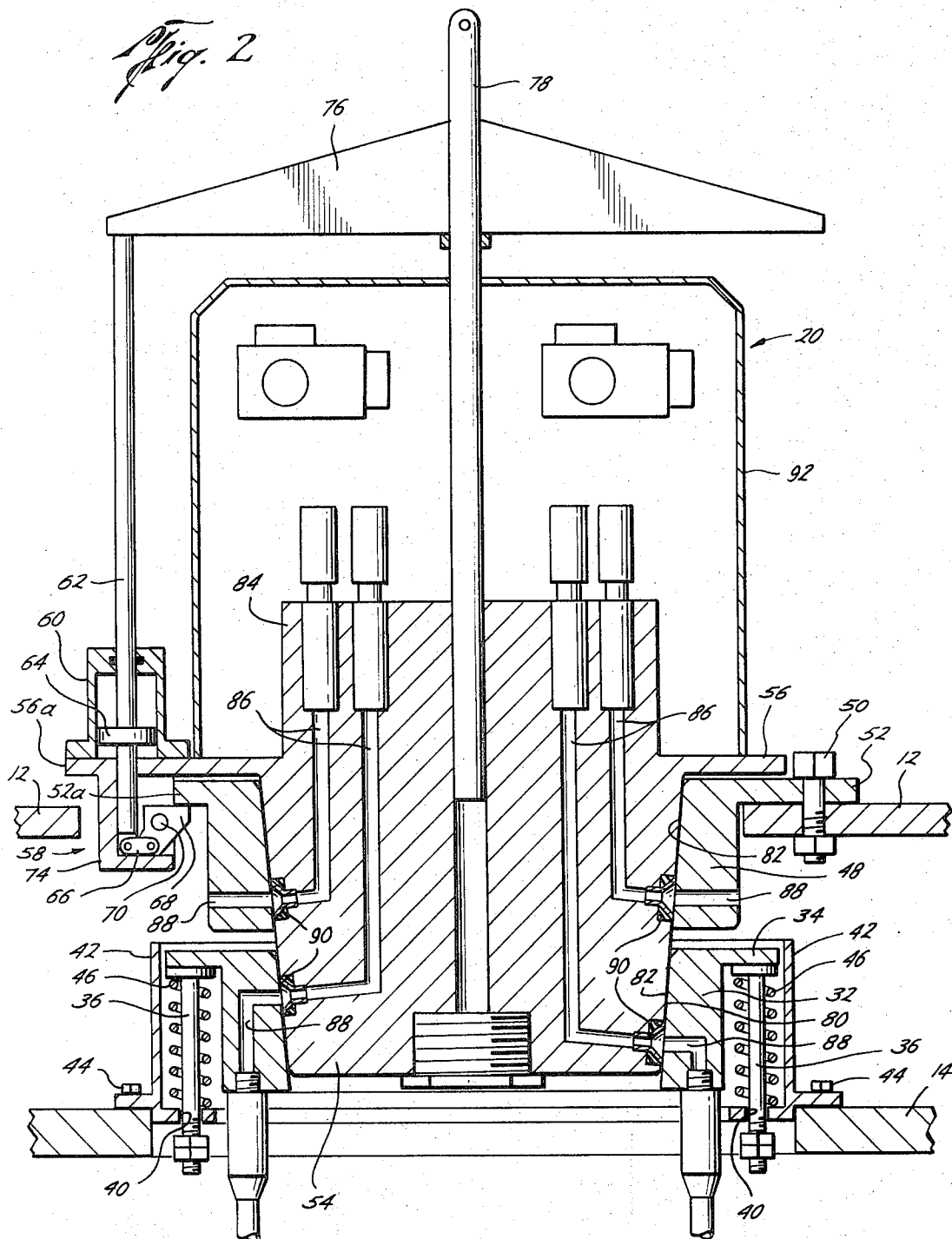
[57] **ABSTRACT**

An underwater connecting apparatus for subsea control systems for wells drilled on the ocean floor and like areas. The connecting apparatus includes at least two female receptacles, a male stinger engageable in both receptacles and a spring mounting secured to one of the receptacles for flexing attachment to a well-head.

7 Claims, 2 Drawing Figures







UNDERWATER CONNECTOR FOR WELLHEADS

CROSS-REFERENCES TO RELATED APPLICATIONS

None.

BACKGROUND OF THE INVENTION

When an oil or gas well is drilled under bodies of water such as lakes and oceans, the wells generally are completed by addition of wellhead equipment having valves, blow-out preventers and the like to control various functions of the wellhead. This equipment is frequently positioned underwater thereby necessitating remote control from the water's surface. The control lines are usually of the hydraulic fluid type which must be capable of expeditious connection and disconnection such as during emergencies or when moving a water surface control vessel from one location to another. Connector devices to carry out control functions are shown, for example, in U.S. Pat. No. 3,486,556 issued Dec. 30, 1969 to Harry L. Burgess and in references cited in that patent. A further embodiment of a connector device is also shown in U.S. application Ser. No. 79,504 filed Oct. 9, 1970 and entitled "Connector." Generally speaking, these devices provide detachable control means for connecting to and controlling underwater wells such as those drilled for oil and natural gas. The connectors may be raised and lowered as desired and, when secured to the equipment at the underwater wellhead site, provide conduit means for transmitting control fluids through underwater equipment such as a blow-out preventer.

In connector devices such as that of U.S. Pat. No. 3,486,556, the connector apparatus includes a receptacle having an opening therein into which a tapered stinger is adapted to be removably telescoped, and in which the receptacle and stinger have coacting fluid passageways when the stinger is seated therein. Typical of the conventional connector apparatus shown in such patent is the provision of a protective shield together with means for aligning the stinger for insertion into the receptacle to insure a proper fluid-tight engagement between the stinger and receptacle.

While conventional connector devices have, in most cases, functioned for the purpose intended, nevertheless the apparatus has been rather expensive to machine and manufacture due to close tolerances required for proper sealing relationships. In addition, conventional connector apparatuses have required the use of locking devices to maintain proper sealing engagement of the connector apparatus with the wellhead which adds to the expense of the equipment as well as its operation. Advantageously, the apparatus of the present invention results in significantly reduced manufacturing costs and facilitates locking of the connector apparatus to the wellhead.

SUMMARY OF THE INVENTION

The present invention is of the type utilizing a tapered stinger and receptacles wherein passageways extending through the stinger terminate preferably in common planes so that a lengthy stinger body is not necessary. Spring mounting means are secured to the lower of two female receptacles for flexing attachment to a stationary portion of the wellhead. The flexing ability of the lower receptacle practically eliminates the possibility of damage to the stinger and passageway

seals during engagement and greatly reduces the cost of manufacture.

An annular second or upper female receptacle is provided releasably engaging the stinger above the lower female receptacle, the second female receptacle being adapted so as to be fixedly secured to an upper detachable portion of the wellhead. This arrangement adds versatility to the connector apparatus in that the stinger portion may be disconnected along with the second female receptacle member when the upper portion of a wellhead is detached or disconnected from the stationary part of the wellhead, or the stinger may be disconnected and removed at will without any necessity of removing the upper detachable portion of the wellhead. Locking means are employed to interlock the stinger in the annular second female receptacle to insure a fluid-tight fit.

It is, therefore, an object of the present invention to provide an underwater connecting means for expeditious connection and disconnection of control lines leading to underwater equipment such as a wellhead.

A further object of the present invention is the provision of a connector apparatus for connection to an underwater wellhead wherein the apparatus includes a lower, first female receptacle, spring mounting means secured to the female receptacle and adapted for flexing attachment to the wellhead, an upper, second female receptacle, and a male stinger engageable in both female receptacles so as to provide hydraulic communication therewith.

Still a further object of the present invention is the provision of a connector apparatus for connection to an underwater wellhead having an upper detachable portion and a lower stationary portion wherein the apparatus includes a first female receptacle, spring mounting means secured to the female receptacle and adapted for flexing attachment to the lower stationary portion of the wellhead, an annular second female receptacle secured to the upper detachable portion of the wellhead, and a male stinger engageable in the female receptacles.

A still further object of the present invention is the provision of such a connector apparatus wherein locking means are provided to releasably secure the male stinger to the second female receptacle.

Other and further objects, features and advantages will be apparent from the following description of a presently preferred embodiment of the invention, given for the purpose of disclosure and taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

Like character references designate like parts throughout the several views of the drawings, which are as follows:

FIG. 1 is a schematic elevation view of a wellhead having a connecting apparatus for remote control of wellhead functions from a water surface vessel, the connector apparatus being shown in duplicate in dotted outline, and

FIG. 2 is a partial elevation view partly in cross section showing apparatus according to the present invention.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and particularly to

FIG. 1, the reference numeral 10 generally designates an underwater wellhead apparatus having an upper detachable portion and a lower stationary portion. The upper detachable portion is generally the equipment shown in schematic attached to and positioned above a riser plate 12 while the lower stationary portion is that portion of the wellhead below and to which is attached a stack plate 14. The upper detachable portion of the wellhead will simply be referred to as the "riser" and indicated generally by the reference numeral 16 while the lower stationary portion of the wellhead will be referred to as the "stack" and will be indicated generally by the reference numeral 18.

Shown secured to the wellhead 10 is a connector apparatus according to the present invention and designated generally by the reference character 20. An identical duplicate connector apparatus 22 is also shown connected to the wellhead and which may serve in a stand-by capacity if desired should the first connector apparatus 20 become inoperative for any reason.

Continuing with respect to FIG. 1, the functions of the wellhead 10 are controlled remotely by a water surface vessel 24 via an umbilical 26 connecting with the riser 16 of the wellhead. The umbilical 26 provides fluid communication between the vessel 24 and the wellhead 10 to in turn impart fluid to the connectors 20 and 22 as will be described hereinafter. Alternatively, umbilicals 28 and 30 may be provided for direct fluid communication between the vessel 20 and connectors 22 and 20 respectively as will be explained.

Referring now to FIG. 2, a connector apparatus 20 according to the present invention is shown having a lower, first female receptacle 32 secured by spring mounting means to the stack plate 14. The spring mounting means includes an annular flange 34 fixed to and surrounding the female receptacle 32. Mounted to and depending from the flange 34 are a plurality of bolts 36 (only two bolts 36 being visible in FIG. 2). The bolts 36 each engage holes 40 within the lower flange of a mounting ring 42 which in turn is secured such as by bolts 44 or other suitable means to the stack plate 14. It should be noted that the holes 40 are larger than the diameter of the bolts 36 in order that the bolts pass freely through the holes. Mounted between the flange 34 and the mounting ring 42 are springs 46, each spring being retained by a bolt 36. Thus, the spring mounting means as just described attaches the lower, first female receptacle 32 to the stack plate 14 so that the female receptacle 32 has limited flexibility relative to the stack plate 14.

An upper, second female receptacle 48 is secured such as by a plurality of bolts 50 to the riser plate 12 of the upper detachable portion 16 (FIG. 1) of the wellhead 10. The female receptacle 48 is provided with a flange 52 to which the bolts 50 are attached.

Continuing with respect to FIG. 2, a male stinger member 54 is engageable in both the first female receptacle 32 and the second female receptacle 48 when inserted into the receptacles. The male stinger member 54 is provided with an outwardly projecting flange 56 which has a plurality of extensions 56a (only one being shown in FIG. 2) each of which accommodates a locking means 58.

Each locking means 58 comprises a cylinder 60 suitably secured such as by welding or bolting to the flange extension 56a. Passing through an axial aperture in the cylinder is a piston rod 62 having a piston 64 secured

thereto and disposed within the cylinder 60. As will be appreciated by those skilled in the art, the piston 64 may be actuated either hydraulically or pneumatically by any suitable means.

Pivotaly secured to the lower end of the piston rod 62 is a link 66 which in turn is pivotaly secured to a lever or dog 68. The lever 68 is journaled such as by means of a pin 70 to a downward extension 74 of the flange extension 56a. Thus the extension member 74 provides a housing and support for the lever 68 and protects the rod 62 and link 66. As will be explained hereafter, the lever 68 is adapted to engage the lower side of the flange 52 which is recessed as at 52a to accommodate each of the locking means 58.

The piston rod 62 of each locking means 58 is secured to a stabilizer plate 76, an aperture of which slideably engages a rod 78 secured to the male stinger member 54. Thus, each piston rod 62 may move synchronously with the other piston rods 62 during actuation.

In order to insure a sealing connection upon engagement of the male stinger member 54 with the female receptacles 32 and 48, the engaging surface 80 of the male stinger 54 and the engaging surfaces 82 of the female receptacles 32 and 48 taper downwardly and inwardly as shown in the FIG. 2.

Secured by any suitable means such as bolts and the like to the male stinger 54 or formed integrally thereof is a valve block 84 which receives appropriate fluid supply lines from the umbilical 30 (FIG. 1). The fluid supply lines connect with the valve block 84 and are in fluid communication with a plurality of passageways 86 illustrated in FIG. 2. The fluid passageways 86 (which are illustrative of preferably a plurality of such passageways) are in fluid communication with corresponding passageways 88 formed in the female receptacles 32 and 48. Thus, it may be seen that one end of each passageway 86 in the male stinger mates for fluid communication with a passageway 88 when the male stinger 54 is engaged with the female receptacles 32 and 48.

Annular seal means are provided around each passageway at the mating surfaces 80 and 82 of the male stinger 54 and female receptacle members 32 and 48, respectively. Thus, as shown in FIG. 2, an appropriate resilient seal 90 is seated within a flared portion of each passageway 86 in the male stinger 54. It is to be understood that other such passageways preferably are provided with similar seals. It will also be understood that such seals may be positioned within the female receptacle passageways if so desired. Consequently, the seals such as those illustrated with the reference character 90 provide a liquid-tight seal between the mating end of the passageways in communication between the male stinger 54 and the female receptacles 32 and 48 to avoid loss of fluid and to maintain appropriate pressure in the fluid communication lines or passageways.

An appropriate cover 92 is provided to surround the valve block 84 and various supply lines and the like therewithin. Also, the rod 78 is connected to the male stinger 54 in order to remove the male stinger, attached or integral valve block 84 and associated parts from the female receptacle 48 for maintenance purposes and the like.

With regard to operation of the invention, the male stinger 54 with attached or integral valve block 84, sup-

ply lines, cover 92 and the like is locked by the lock means 58 in position within the second female receptacle 48 as shown in FIG. 2. The male stinger 54 is also engaged within the first female receptacle 32. As has been described, the first female receptacle 32 is adapted for flexing attachment to the lower stationary portion 18 of the wellhead 10 by spring mounting means which secure the female receptacle 32 to the stack plate 14. Once the lower stationary portion 18 of the wellhead 10 is positioned underwater at the well site, the upper detachable portion 16 of the wellhead 10 may be connected to and disconnected from the stack portion 18 as becomes necessary. Since the connector apparatus 20 (and also its duplicate counterpart 22 if provided as shown in FIG. 1) is fixedly secured to the riser by means of the riser plate 12, removal of the riser or upper detachable portion 16 of the wellhead removes the second female receptacle 48 thereby disengaging the male stinger 54 from the first female receptacle 32. Conversely, connection of the riser portion 16 to the stack portion 18 of the wellhead 10 causes the male stinger 54 to engage with the first female receptacle 32, provided, of course, that the male stinger 54 within the second female receptacle 48 is positioned approximately over the first female receptacle 32. During such engaging action, the spring mounting feature of the first female receptacle 32 permits the female receptacle to flex or move slightly so as to properly align its mating surface 82 with the corresponding mating surface 80 of the male stinger 54. No locking means is necessary to maintain the male stinger 54 in engagement with the first female receptacle 32 since an appropriate locking means secures the riser portion 16 to the stack portion 18 of the wellhead.

Upon engagement of the stinger 54 with the first female receptacle 32, the various passageways such as those designated by the reference character 86 of the stingers 54 and 88 of the female receptacles are in alignment for fluid communication. Such fluid communication is maintained once the riser portion 16 is locked to the stack portion 18 of the wellhead. In this engaged state, the fluid supply lines communicating with the passageways in the male stinger are pressurized with fluid which in turn passes through the fluid supply lines 88 (the only ones shown but which are representative of a plurality of such lines). The fluid supply lines 88 emanating from the first female receptacle 32 are connected to the stack portion 18 of the wellhead for proper control of the stack and its function. The supply lines 88 of the second receptacle 48 lead from the valve block 84 through the second receptacle 48 to the riser portion 16 of the wellhead 10 to control functions of the riser. It should also be mentioned in relation to FIG. 1 that the umbilical 30 may be omitted and the fluid supply lines therethrough pass instead through the umbilical 26 to the riser portion 16 of the wellhead and thence to the valve block 58. Thus, it may be seen that the male stinger 54, the valve block 84 and the various fluid transfer and supply lines are connected to the riser portion 16 of the wellhead and may move up and down with the riser. When circumstances dictate that the control lines 26, 28 and 30 shown in FIG. 1 be raised to the surface of the water, the riser portion 16 of the wellhead is simply disconnected from the stack portion 18 and drawn to the surface taking with it the male stinger 54 and associated parts described above.

However, if it is necessary or desirable to lift only the control pod 20 to the surface (i.e., leaving the riser plate 12 in place), then each locking means 58 is actuated. To do so, fluid pressure is exerted against the piston 64 in an upward direction so that the rod 62 moves upward. In doing so, the link 66 follows causing the lever 68 to pivot (in a clockwise manner as shown in FIG. 2) about the pin 70 so that the lever disengages from the flange portion 52a of the second female receptacle 48. Thus the male stinger 54 may be lifted and disengaged from both the first and second female receptacles 32 and 48 simultaneously. The stinger 54 may be lifted such as by attaching a cable (not shown) to the upper end of the rod 78.

For purposes of making re-connections of the apparatus of the present invention and, assuming that the upper detachable portion 16 of the wellhead 10 is removed, the riser portion 16 is lowered such as by means of a cable or umbilical 26 back to the wellhead site. While the riser 16 is guided into engagement with the stack portion 18 of the wellhead 10, at the same time the male stinger projecting through the second receptacle 48 is guided into engagement with the first female receptacle 32. By virtue of the spring mounting means providing flexing attachment of the first female receptacle 32 to the stack plate 14, the male stinger 54 is automatically seated in engagement with the first female receptacle 32. Fluid communication is then established through the passageways and wellhead functions may be carried out.

On the other hand, if the upper detachable portion 16 of the wellhead 10 has remained in place at the well site and only the control pod 20 portion of the apparatus of FIG. 2 removed, the male stinger 54 is lowered such as by a cable attached to the upper end of the rod 78 until the male stinger engages the annular second female receptacle 48. Then the male stinger 54 is guided into a sealed, seated position by rotating it to align fluid passageways within the male stinger with corresponding passageways in the annular second female receptacle 48. Alignment may be facilitated such as by providing a suitable tongue and groove arrangement as will be appreciated by those skilled in the art. Once this position is attained, fluid communication may be established via the passageways and functions of the wellhead 10 begun after relocking the locking means 58 by reversing the procedure previously explained in regard to activating the locking means.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as others inherent therein. While a presently preferred embodiment of the invention is given for the purpose of disclosure, numerous changes in the details of construction and arrangement of parts may be made which will readily suggest themselves to those skilled in the art and which are encompassed within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A connector apparatus for connection to an underwater wellhead, the wellhead having an upper detachable portion and a lower stationary portion, including,

- a. a first female receptacle secured to the lower stationary portion of the wellhead,
- b. a second female receptacle secured to the upper detachable portion of the wellhead,

- c. a male stinger engagable with both the first and second female receptacles (a) and (b) respectively when inserted into said receptacles, and
- d. said engaging surfaces of the female receptacles (a) and (b) and the male stinger (c) tapering downwardly and inwardly.
- 2. A connector apparatus for connection to an underwater wellhead, the wellhead having an upper detachable portion and a lower stationary portion, including,
 - a. a first female receptacle secured to the lower stationary portion of the wellhead,
 - b. a second female receptacle secured to the upper detachable portion of the wellhead,
 - c. a male stinger engagable with both the first and second female receptacles (a) and (b) respectively when inserted into said receptacles,
 - d. at least one passageway in each of the female receptacles (a) and (b), and
 - e. passageways in the male stinger (c), one end of each of the passageways (d) mating for fluid communication with the passageways (e) when the male stinger (c) is engaged with the female receptacles (a) and (b), and
 - f. annular seal means around one of said passageways at its mating end for forming a liquid-tight seal between the ends of said passageways (d) and (e).
- 3. A connector apparatus for connection to an underwater wellhead, the wellhead having an upper detachable portion and a lower stationary portion, including,
 - a. a first female receptacle secured to the lower stationary portion of the wellhead,
 - b. a second female receptacle secured to the upper detachable portion of the wellhead,
 - c. a male stinger engagable with both the first and second female receptacles (a) and (b) respectively when inserted into said receptacles, and
 - d. locking means for releasably securing the male stinger (c) in engagement with the second female receptacle (b) wherein the locking means includes,
 - i. a flange projecting from the second female receptacle (b),
 - ii. at least one lever pivotal about an axis member for engagement with the flange (i) of the second female receptacle (b),
 - iii. a link pivotally attached to and for moving the lever (ii), and
 - iv. piston means coacting with the link (iii) for moving said link.
- 4. In an underwater wellhead apparatus having an upper detachable portion and a lower stationary portion, the improvement comprising,
 - a. a first female receptacle secured to the lower stationary portion of the wellhead,
 - b. a second female receptacle secured to the upper detachable portion of the wellhead,
 - c. a male stinger engagable with both the first and second female receptacles (a) and (b) respectively when inserted into said receptacles, wherein the engaging surfaces of the female receptacles (a) and (b) and the male stinger (c) taper downwardly and inwardly,
 - d. locking means for releasably securing the male stinger (c) in engagement with the second female

- receptacle (b), and
- e. spring mounting means for flexingly securing the first female receptacle (a) to the lower stationary portion of the wellhead.
- 5. The invention of claim 4 where the spring mounting means includes,
 - i. an outwardly extending flange secured to the first female receptacle (a),
 - ii. a mounting ring secured to the lower stationary portion of the wellhead, and
 - iii. bolt-guided spring means for flexingly connecting the flange (i) to the mounting ring (ii).
- 6. In an underwater wellhead apparatus having an upper detachable portion and a lower stationary portion, the improvement comprising,
 - a. a first female receptacle secured to the lower stationary portion of the wellhead,
 - b. a second female receptacle secured to the upper detachable portion of the wellhead,
 - c. a male stinger engagable with both the first and second female receptacles (a) and (b) respectively when inserted into said receptacles,
 - d. locking means for releasably securing the male stinger (c) in engagement with the second female receptacle (b),
 - e. spring mounting means for flexingly securing the first female receptacle (a) to the lower stationary portion of the wellhead,
 - f. at least one passageway in each of the female receptacles (a) and (b), and
 - g. passageways in the male stinger (c), one end of each of the passageways (f) mating for fluid communication with the passageways (g) when the male stinger (c) is engaged with the female receptacles (a) and (b), and
 - h. annular seal means around one of said passageways at its mating end for forming a liquid-tight seal between the ends of said passageways (f) and (g).
- 7. In an underwater wellhead apparatus having an upper detachable portion and a lower stationary portion, the improvement comprising,
 - a. a first female receptacle secured to the lower stationary portion of the wellhead,
 - b. a second female receptacle secured to the upper detachable portion of the wellhead,
 - c. a male stinger engagable with both the first and second female receptacles (a) and (b) respectively when inserted into said receptacles,
 - d. locking means for releasably securing the male stinger (c) in engagement with the second female receptacle (b), wherein the locking means includes,
 - i. a flange projecting from the second female receptacle (b),
 - ii. at least one lever pivotal about an axis member for engagement with the flange (i) of the second female receptacle (b),
 - iii. a link pivotally attached to and for moving the lever (ii), and
 - iv. piston means coacting with the link (iii) for moving said link, and
 - e. spring mounting means for flexingly securing the first female receptacle (a) to the lower stationary portion of the wellhead.

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