A method and at least one remote control apparatus for performing the method is disclosed for flow control and preventing blow-outs in offshore wells. The apparatus comprises a plurality of pins extendible into a flow chamber interconnecting two tubing ends for catching sealer material introduced into the well below the flow chamber for forming an impermeable plug for sealing the well tubing fluid tight until the pins are retracted to restore free fluid flow.

10 Claims, 4 Drawing Figures
METHODS AND APPARATUS FOR CONTROLLING AND PREVENTING BLOW-OUTS IN WELLS

This is a division, of application Ser. No. 383,867, filed July 30, 1973 now abandoned.

BACKGROUND OF THE INVENTION

An ever constant problem, particularly with offshore oil and gas wells is stopping wells which have blown out of control. An early method comprised flattening the oil well tube by sending a diver to the sea bottom, cutting a window in the casing and applying a clamp to the tube to flatten it and then introduce sealer balls below through another hole in the tubing, through which the balls float up and plug the tube at the flattened position as disclosed in Ocean Industry Magazine, April, 1971, pages 69-72. Another "subsea blowout preventer packing unit" is disclosed in U.S. Pat. No. 3,662,823 which has an elaborate lever system that is designed to be replaced more easily "at the subsea wellhead location and at greatly reduced expense."

The blow-out preventer disclosed in U.S. Pat. No. 2,760,750 would have a short life due to the excessive amount of deformation required of the solid packer to close the well and thus would be costly and inefficient.

The disclosed methods and blow-out preventers for carrying out the methods are manually remote controlled at the surface on the platform to immediately stop the flow of oil or gas from a blow-out and thus greatly reduce the risk of costly offshore platform fires.

OBJECTS OF THE INVENTION

Accordingly, a primary object of this invention is to provide a few methods for controlling flow through an oil or gas well for preventing a blow-out therein.

Another primary object is to provide at least one different apparatus for carrying out or performing each of the different methods disclosed.

Another object of this invention is to provide a method for sealing a deformable annulus over a frustum for sealing hydrocarbon well fluid tight.

A further object of this invention is to provide a method for bending an annulus for sealing an oil or gas well fluid tight.

A still further object of this invention is to provide a method of extending pins into the passage through which the oil or gas is caused to flow and introducing a sealer material into the passage from below for catching on the extended pins for forming an impermeable plug for sealing the well tubing fluid tight.

Yet another object of this invention is to provide at least one mechanism for performing each of the disclosed methods.

A further object of this invention is to provide a mechanism for controlling fluid flow and preventing blowouts in offshore wells that is easy to operate, is of simple configuration, is economical to build and assemble, and is of greater efficiency for controlling the blow-out.

Other objects and various advantages of the disclosed methods and apparatuses for preventing blow-outs in offshore wells will be apparent from the following detailed description, together with the accompanying drawings, submitted for purposes of illustration only and not intended to define the scope of the invention, reference being had for that purpose to the subjoined claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings diagrammatically illustrate by way of example, not by way of limitation, a few forms or mechanisms for carrying out the methods of the invention wherein like reference numerals have been employed to indicate similar parts in the several views in which:

FIG. 1 is a schematic sectional view of one embodiment of the invention, the left half illustrating the retracted position and the right half illustrating the extended position of the invention;

FIG. 2 is a sectional view taken at 2—2 on FIG. 1;

FIG. 3 is a modification of FIG. 1; and

FIG. 4 is another modification of FIG. 1.

DESCRIPTION OF THE INVENTION

The invention disclosed herein, the scope of which being defined in the appended claims, is not limited in its application to the details of construction and arrangement of parts shown and described for carrying out the disclosed methods, since the invention is capable of other embodiments for carrying out other methods and of being practiced or carried out in various other ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Further, many modifications and variations of the invention as hereinbefore set forth will occur to those skilled in the art. Therefore, all such modifications and variations which are within the spirit and scope of the invention herein included and only such limitations should be imposed as are indicated in the appended claims.

DESCRIPTION OF THE METHODS

This invention comprises a few methods for controlling fluid flow and for preventing blow-outs in offshore wells and a few mechanisms for practicing the methods.

PREFERRED METHOD

A method for controlling fluid flow and preventing blow-outs in offshore wells including a well tubing extending from the bottom up to the surface of a body of water comprises the method steps of,

1. forming a chamber with a frustum surface in a subsurface housing for interconnecting two ends of the well tubing,
2. forming a deformable annulus with a plurality of tapered projections on one end thereof slideable in the chamber,
3. forming a fluid power remote control valve system for sliding the deformable annulus in the chamber,
4. deforming the deformable annulus by sliding it over the frustum surface to seal the well tubing fluid tight, and
5. deforming the deformable annulus by sliding it off the frustum surface to open the well tubing to full fluid flow.

At least one mechanism for performing or carrying out the above method is disclosed in FIGS. 1 and 2 and described hereinafter.

A SECOND METHOD

A method for controlling fluid flow and preventing blow-outs in offshore wells including a well tubing extending from the bottom up to the surface of a body of water comprises the method steps of,
3,926,256

1. forming a chamber in a housing for interconnecting two ends of the well tubing,
2. forming a flexible wall annulus with both ends thereof fixed in the ends of the chamber,
3. bending the flexible wall annulus inwardly at the center to seal the well tubing fluid tight, and
4. straightening the flexible wall annulus to open the well tubing to free full fluid flow.

At least one mechanism for performing or carrying out the above method is disclosed in FIG. 3 and described hereinafter.

A THIRD METHOD

A method for controlling fluid flow and preventing blow-outs in offshore wells including a well tubing extending from the bottom up to the surface of a body of water comprises the method steps of,
1. forming a chamber in a housing for interconnecting two ends of the well tubing,
2. forming actuable pins in the housing for being extendible into the chamber and for being retractable from the chamber,
3. inserting sealer material below the pins for catching and lodging on the extended pins for forming an impermeable plug for sealing the well tubing fluid tight, and
4. retracting the pins from the chamber for opening the well tubing to free full fluid flow.

At least one mechanism for performing or carrying out the above method is disclosed in FIG. 4 and described hereinafter.

MODIFICATION OF FIGS. 1 AND 2

A remote control fluid flow controller 10, FIG. 1, is disclosed for performing the first method set forth above for controlling fluid flow and preventing blow-outs in offshore gas and oil wells.

The controller 10 comprises a conventional manually controlled hydraulic system 11 mounted on an offshore platform (not shown) connected with two hydraulic lines 12 and 13 to a fluid flow controller housing 14 connected and mounted between well tubing ends 15 and 16 adjacent to bottom of the body of water above. While a rubber or rubber-like sleeve or annulus 17 having tapered projections 18 is illustrated in retracted and full fluid flow position on the left side of the centerline 19, the annulus 17a with tapered projections 18a is illustrated in fully and fluid tight sealed position on the right side of the centerline. The elements identified with the subscript a merely illustrate the extended closed position of the corresponding element from its retracted open position.

Annulus 17, FIG. 1, with its upper tapered projections 18 is slidable in chamber 20, which cavity interconnects the tube ends 15 and 16 in housing 14. This latter cavity comprises a cylindrical surface 21 and a beveled or frustum surface 22. With the annulus 17 having a piston 23 formed intermediate the ends thereof, the annulus is actuable forwardly by controlled high pressure hydraulic fluid in lines 12 and 13 causing the tapered projections 18 to ride up on and bear inwardly from the retracted position shown on the left side in FIG. 1 to the fully extended position shown on the right side. The annulus is returned to retracted position by reversal of flow through hydraulic lines 12 and 13.

FIG. 2, a sectional view at 2—2 on FIG. 1, illustrates the tapered projections 18 in flush retracted position on the left side providing free full fluid flow through the well tubing and in extended position, 18a, on the right side for forming an impermeable plug for sealing the well tubing fluid tight. Also, one, two, or more hydraulic or pneumatic lines like 12 and 13, FIG. 1, may be utilized as required.

MODIFICATION OF FIG. 3

Another remote control fluid flow controller 10b, FIG. 3, is disclosed in FIG. 3 for carrying out or performing the second method set forth above of controlling fluid flow and preventing blow-outs in offshore gas and oil wells tubing 15b and 16b interconnected by annular chamber 20b.

The manually controlled hydraulic system (not shown) of controller 10b is similar to that of the FIG. 1 embodiment, controls reversible hydraulic fluid flow through lines 12b and 13b to the housing chamber 20b.

A rubber or rubber-like annulus 17b is secured at its ends in each end of the chamber by any suitable adhesive or other fastening means.

In operation of the embodiment of FIG. 3, manipulation of the manually operated controls (not shown) on the platform injects and maintains high pressure fluid in hydraulic line 13b to collapse the annulus 17b at the center to effectively seal off the flow of fluid. While only line 13b is illustrated in sealing position, obviously, line 12b would be pressurized similarly if this second line is desired for backup purposes. For opening the well tubes for free full fluid flow, both lines 12b and 13b would be operated to draw the hydraulic fluid out from around the annulus 17b as illustrated by line 12b and the left side of housing 14b. Likewise one, two, or more hydraulic lines like 12b and 13b may be utilized to collapse the annulus 17b and maintain it in sealing position as long as required.

MODIFICATION OF FIG. 4

Another remote control fluid flow controller 10c is disclosed in FIG. 4 for performing or carrying out the third method set forth above for controlling fluid flow and preventing blow-outs in offshore gas and oil wells.

Controller 10c, FIG. 4, comprises a manually controlled hydraulic system similar to that of FIG. 1 on the platform (not shown) for controlling the reversible hydraulic fluid flow through lines 12c and 13c to the housing annular chamber 23 in the housing 14c for either pressurizing the chamber as illustrated on the right half of FIG. 4 or for depressurizing the chamber as illustrated in the left half of FIG. 4.

Pins 24, FIG. 4, are slideably mounted in holes 25 in housing 14c for protruding into cylindrical chamber 21c interconnecting well tubes 15c, 16c, when the annular chamber 23 is pressurized, and for retracting the pins 24 from the cylindrical chamber when the annular chamber is depressurized.

Another fluid control system controlled by the same manual control which controls fluid pressure to lines 12d, 13d injects a sealer material 26 insoluble in petroleum and hydrocarbon gases through line 27 or 28. These lines extend down from the controller through the casing to the tubing. Exemplary sealer materials are balls of rubber or fiber, natural or synthetic, Fiberglas, aluminum, shredded Teflon, etc., followed by a mastic, which act as the fluid stopping or sealing material.

In operation of the embodiment of FIG. 4 for carrying out the third method described above, manipulation of the controls (not shown) on the platform injecting
and maintains high pressure fluid in both hydraulic lines 12c, 13c to extend the pins 24 into the cylindrical chamber 20c, and simultaneously sealer material 26 is injected into the well through lines 27, 28 to catch on and form a barrier up against the pins resulting in an impermeable plug for sealing the well tubing fluid tight.

For opening the blow-out preventer of FIG. 4, pressure in hydraulic lines is reduced for retracting the pins, if desired, and simultaneously, the flow of sealing material is cut off, if it hasn't already been stopped previously after the barrier was formed. Thus free full fluid flow through the well tubes results.

**ALL MODIFICATIONS**

In each of the above three embodiments, fluid pressure lines 12, 12a, 12b, 12c, 13, 13a, 13b, and 13c, pneumatic or hydraulic, are preferably extended from the controller at the surface down between the casing and tubing to the housing of each respective embodiment.

The embodiments of FIGS. 1 and 3 likewise may have added thereto valve means for injecting a sealing material into the flow stream ahead of the annuluses when it is desired to only partially close the annular chambers 20 of FIG. 1 and 20b of FIG. 3 similar to that of FIG. 4 for forming the tube sealing barrier when the well tubing so requires this design.

Obviously other methods may be utilized for controlling fluid flow and preventing blow-outs in offshore wells with the embodiments of either FIGS. 2, 3, or 4, than those listed above, depending on the particular fluid flow desired to be controlled.

Accordingly, it will be seen that while blow-outs may occur in wells at various depths below the surface of the water, the disclosed methods and apparatuses for performing the methods will operate in a manner which meets each of the objects set forth hereinafore.

While only three methods of the invention and three mechanisms for carrying out the methods have been disclosed, it will be evident that various other methods and modifications are possible in the arrangement and construction of the disclosed methods without departing from the scope of the invention and it is accordingly desired to comprehend within the purview of this invention such modifications as may be considered to fall within the scope of the appended claims.

1. A method for controlling fluid flow and preventing blow-outs in offshore well including a well tubing extending from the bottom up to the surface of a body of water comprising the method steps of,
   a. forming a chamber in a housing for interconnecting two ends of the well tubing,
   b. forming actutable pins in the housing for being extendible into the chamber and for being retractable from the chamber,
   c. inserting sealer material below the pins for catching and lodging on the extended pins for forming an impermeable plug for sealing the well tubing fluid tight,
   d. retracting the pins from the chamber for opening the well tubing to free full fluid flow.

2. A remote control offshore well flow controller and blow-out preventer for a well tubing extending from the bottom up to the surface of a body of water comprising,
   a. subsurface housing means having a flow chamber means for interconnecting two ends of the well tubing,
   b. remote control pin extendible and retractable means for extending pins into said flow chamber means and for retracting the pins from said flow chamber means,
   c. remote control supply means for inserting sealer material into said well tubing below said pins when said pins are extended into said flow chamber,
   d. said subsurface housing means being responsive to said remote control pin extendible and retractable means and remote control supply means for catching said sealer material on extended pins for forming an impermeable plug for sealing the well tubing fluid tight, and
   e. said subsurface housing means being responsive to said remote control pin extendible and retractable means and remote control supply means for opening said flow chamber means for free full fluid flow.

3. A remote control offshore well flow controller and blow-out preventer for a well tubing extending from the bottom up to the surface of a body of water comprising,
   a. subsurface housing having a chamber means interconnecting two ends of the well tubing and pins extendible into said chamber and retractable from said chamber,
   b. remote control valve means above the surface operatively connected to said housing for extending and retracting said pins,
   c. remote control valve means for supplying sealer material to the well tubing below said pins when said pins are extended into said chamber means,
   d. said chamber means being responsive to said pin extendible and retractable remote control valve means and said sealer material supply remote control valve means for catching said sealer material on extended pins for forming an impermeable plug for sealing the well tubing fluid tight, and
   e. said chamber means being responsive to said pin extendible and retractable remote control valve means and said sealer material supply remote control valve means for opening said chamber means for free full fluid flow.

4. A method for controlling fluid flow and preventing blow-outs in a well tubing having upward fluid flow comprising the steps of,
   a. forming a chamber in the well tubing,
   b. forming retractable snare means in the chamber for being both extendible into the chamber and retractable from the chamber,
   c. sealing the well tubing by inserting sealer material upstream of the extended snare means for catching and lodging on the extended snare means for forming an impermeable plug for stopping the well tubing fluid flow, and
   d. unplugging the well by freeing the sealer material from the snare means by retracting the snare means from the chamber for opening the well tubing to free full fluid flow.

5. A method as recited in claim 4 wherein the second method step comprises,
   a. forming remote control extendible and retractable pin means for being extendible into the chamber and retractable from the chamber by actuation of controllable reversible fluid flow lines.

6. A method as recited in claim 4 wherein the third method step comprises,
   a. forming balls for insertion into the well tubing upstream of the extended snare means for catching and lodging on the extended snare means, and
3,926,256

7. A remote control well flow controller and blowout preventer for a well tubing extending down into a well having upward fluid flow comprising,
   a. chamber means for mounting in the well tubing,
   b. remote control retractable snare means for said chamber means for being both extendible into said chamber means and retractable from said chamber means,
   c. remote control supply means for inserting a sealer material upstream of the extended snare means, and
   d. said remote control supply means being responsive to said remote control retractable snare means for inserting a sealer material in the well tubing upstream of said chamber means for catching and lodging on the extended snare means for forming an impermeable plug for sealing the well tubing fluid tight.

8. A remote control well flow controller as recited in claim 7 wherein,

   a. said chamber means is responsive to said remote control retractable snare means for being freed of said sealer material for opening the well tubing to free full fluid flow.

9. A remote control well flow controller as recited in claim 7 wherein,

   a. said remote control retractable snare means comprises a plurality of controllable extendible and retractable pins,
   b. said pins being extendible for catching said sealer material when injected upstream in the well tubing for forming an impermeable plug for stopping the well tubing fluid flow, and
   c. said pins being retractable for releasing said sealer material for unplugging the well for providing free full fluid flow.

10. A remote control well flow controller as recited in claim 7 wherein said sealer material comprises,

    a. balls of at least two different sizes for lodging and piling up on said extended snare means, and
    b. mastic means for following said balls for forming an efficient impermeable fluid tight seal in the well tubing.

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