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APPARATUS TO PREVENT FOULING OF WIRE LINES WHEN USING PUMPDOWN TOOLS

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FIG. 1.

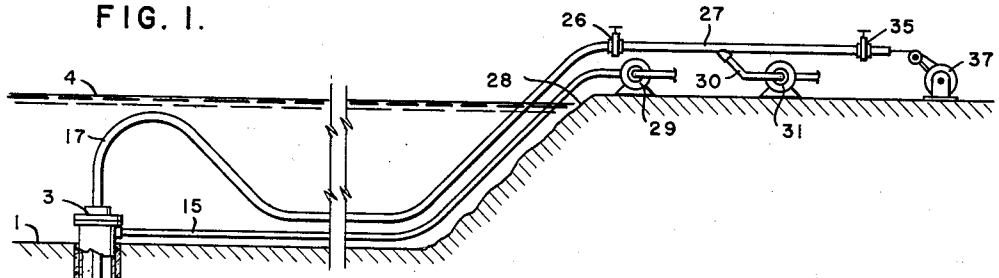


FIG. 2.

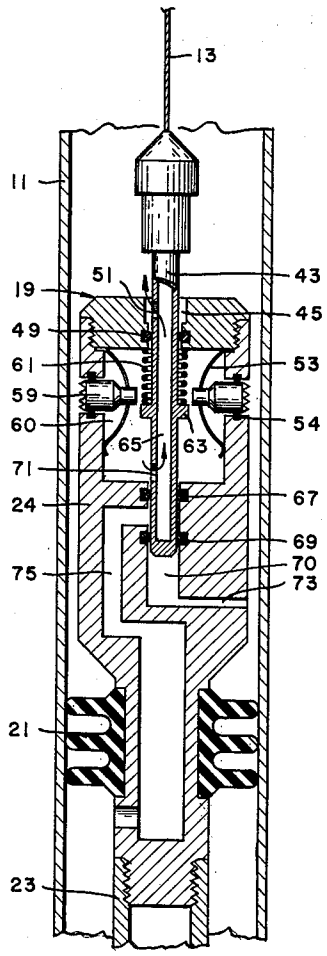
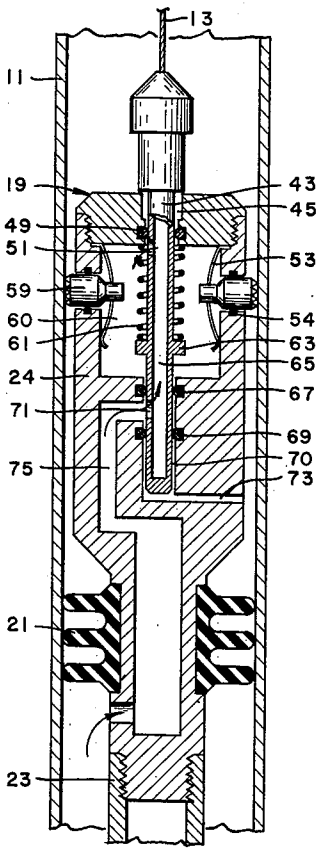
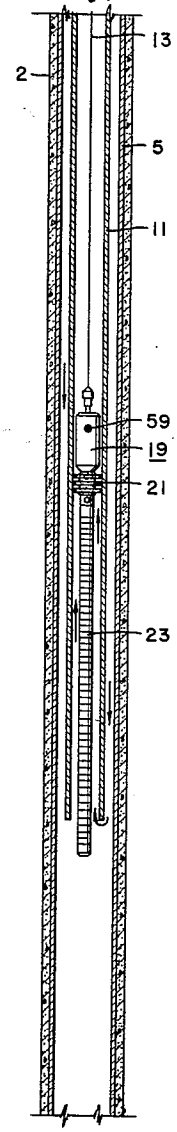


FIG. 3.





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APPARATUS TO PREVENT FOULING OF WIRE LINES WHEN USING PUMPDOWN TOOLS

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This invention relates to the pumping of well tools through a flow line for fluids, with the tools connected to a cable or wire line, and more particularly to the manipulation of wire line tools in wells having horizontal flow lines connected both to the vertical casing and to the vertical flow tubing of a cased and tubed well at a remote location.

In connection with the production of oil and gas wells at offshore locations, special techniques have been required to minimize costs and to increase operational safety. One technique that has been developed utilizes substantially horizontal flow lines connected both to the tubing and to the casing of a tubed and cased well having an underwater wellhead. When it is necessary to send well tools down the well, the tools are pumped on the end of a wire line from an onshore location into the horizontal flow lines and down the vertically disposed tubing string. The tool may be retracted from the well by reversing the pressure differential across the tool. Inasmuch as there is considerable friction between the wire line and the sides of the flow line and tubing string, it is very difficult for an operator to have any "feel" with regard to the stress in the wire line at the tool. For this reason it is rather easy for the tool to overrun the wire line when the tool is being retracted from the well. The present invention is particularly directed to apparatus for the purpose of preventing a well tool from overrunning a wire line.

In accordance with one aspect of the present invention, the well tool is connected to the wire line through a connecting means including a housing and a plurality of slips extending outwardly from the housing. The slips are adapted to engage the inner walls of the flow line or tubing through which the well tool is to pass. Included within the housing is means for detecting the tension in the wire line at the housing and for forcing the slips into engagement with the inner wall of the flow tubing when the tension in the wire line falls to predetermined limits. In a preferred embodiment of the invention, the slips extend outwardly from a chamber in the housing, and sealing means are connected to the exterior of the housing so as to be in sealing engagement between the housing and the inner wall of the flow tubing. The detecting means preferably connects the upper portion of the flow tubing to the chamber when the tension is greater than a predetermined tension, and hydraulically interconnects the down-the-well portion of the flow tubing to the chamber when the tension in the wire line is less than the given tension. Thus, hydraulic pressure is transmitted into the chamber to force the slips outwardly from the chamber and into engagement with the inner wall of the flow tubing.

Objects and features of the invention which are not apparent from the above discussion will become evident upon consideration of the following description thereof when taken in connection with the accompanying drawing, wherein:

FIG. 1 is a schematic showing of a well drilled at an underwater location illustrating the use of a preferred embodiment of the invention; and

FIGS. 2 and 3 are cross-sectional representations of

a preferred embodiment of the invention in the two operative positions thereof.

With reference now to FIG. 1, numeral 2 designates a well drilled from the water bottom 1 of a body of water 4 located at a substantial distance from the shoreline 28. Arranged in the well bore 2 is a casing string 5 which is cemented in place in the well bore. The casing string 5 may extend substantially to the bottom of the well bore. Arranged in the casing 5 and coextending therewith from the earth's surface is a tubing string 11 having its lower open end disposed at a level above a hydrocarbon productive zone.

The tubing string 11 and the casing string 5 are suspended from a wellhead 3 at the water bottom 1. A horizontal flow line or pipe string 17 is connected to the wellhead 3 so as to be in fluid communication with the vertically disposed flow line or tubing string 11. Similarly, a second flow line 15 is connected to the wellhead so as to be in fluid communication with the annulus between the casing string 5 and the tubing string 11. Flow line 17 has a small-radius bend at the wellhead end thereof which may be of any desired degree. Both flow line 15 and flow line 17 extend substantially horizontally to a remote location which may be on dry land at the shore 28. The flow line 17 is provided with a lubricator 27 and a blowout preventer 35. Lubricator 27 is provided with a valve 26. Connected to the lubricator 27 by a laterally extending conduit 30 is a pump 31 which connects to a fluid source, not shown. Flow line 15 also is provided with a pump 29 which also is connected to the fluid source. The fluid source may be mud, oil, fresh or salt water, or may be a suitable well treating agent known to the art.

Shown in FIG. 1 is a well tool 23 which is illustrated as being a tubular extension member but which may be a logging sonde, a perforating gun, or other tool. The tool 23 is connected to the remote operating location by an elongated wire line 13 and a connecting device 19 which will be described in detail with respect to FIGS. 2 and 3. The line 13 may be a logging cable or a stranded or piano wire line, as desired, and may have one or more electrical conductors associated therewith in accordance with the type of tool to be run into the well. The wire line is wound or spooled on a reel or drum 37 having associated therewith apparatus for measuring the length of line payed into and retracted from the lubricator. Suitable apparatus for this purpose is described in the "Composite Catalog of Oil Field Equipment and Services," 1958–59 edition, pages 2272 and 2273.

With reference now to FIGS. 2 and 3, the connecting apparatus 19 mentioned above is shown in position in the tubing string 11. The connecting apparatus comprises a housing 24 having a packing or sealing means 21 affixed thereto near the lower end thereof. The packing or sealing means 21 may be of rubber or rubber-like material and is adapted to be in sealing engagement with the inner wall of the pipe string 11 through which the tool 23 is to pass. The tool 23 is preferably screw-threadedly affixed to the housing 24 at the lower end thereof.

A chamber 60 is provided in the housing 24, preferably near the upper end thereof. A plurality of slips 59 extend through the walls of the housing 24 out of the chamber 60. A plurality of spring means 53 individually affixed to the slips 59 bias the slips into the chamber 60, as shown in FIG. 2, and hold the slips in place therein. Associated with each of the slips 59 is an O-ring 54 for providing a fluid seal between the slips 59 and the housing 24.

An elongated rod 43 is connected to wire line 13 and extends into the housing 24. In effect, rod 43 and housing 24 comprise first and second members in telescoping

relationship adapted for limited telescoping movement between first and second telescoping positions thereof. A coil spring 61 is positioned between an annular shoulder 63 on the rod 43 and the upper end of the housing 24. The spring is adapted to bias the rod into its most telescoping position relative to housing 24. The rod 43 extends through a port 45 in the upper end of housing 24, through chamber 60, and into a passageway 70 in the housing. A passageway 73 provides fluid relief between passageway 70 and the exterior of the housing above packer element 21. O-rings 49, 67, and 69 provide sealing engagement between the housing 24 and the rod 43 to hydraulically isolate chamber 60. The rod 43 is drilled and ported as shown so as to have a passageway 65 extending between ports 51 and 71. Port 71 is located so as to be aligned with passageway 75 when rod 43 is in its most telescoped position. Port 51 is positioned so as to be below O-ring 49 and in fluid communication with chamber 60 and when the rod 43 is in its most telescoped position illustrated in FIG. 3, and so as to be above O-ring 49 and in fluid communication with the exterior of the housing when rod 43 is in a less telescoped position, as is illustrated in FIG. 2.

Let it be assumed that the tool has been run into the well and that it is desired to retract it from the well. Fluid pressure is applied to the annulus between the casing 5 and the tubing 11. As long as the tension in the wire line 13 is greater than a predetermined tension, the components of the apparatus will be as shown in FIG. 2. The interior of the chamber 60 will be at the same pressure as the exterior of the housing above the packer element 21, and the slips 59 will be fully retracted into the position shown in FIG. 2. However, when the tension in wire line 13 falls to a predetermined tension so that there is danger of the tool overrunning the wire line 13, spring 61 will push rod 43 into the position shown in FIG. 3. The chamber 60 will now be in fluid communication with the down-the-hole portion of the tubing below packer 21 in view of the fact that port 71 and port 51 transmit fluid pressure from passageway 75 through passageway 65 into the chamber 60. Slips 59 will be biased outwardly into engagement with the inner wall of tubing 11, and the frictional opposition provided thereby will substantially slow the movement of the housing 24. When the tension in the line 13 increases to a safe value, the components of the apparatus will resume the position shown in FIG. 2 and the slips will be pulled out of engagement with the inner wall of the tubing 11.

The invention is not to be restricted to the specific structural details or arrangement of parts herein set forth, as various modifications thereof may be effected without departing from the spirit and scope of the invention.

What is claimed is:

1. For use in a well installation wherein a well tool is pumped through a flow tubing at the end of a wire line for running into and retrieval from an operating location in a well, the combination comprising:

a housing adapted to be connected to the well tool, said housing having a chamber therein;

annular sealing means connected to said housing for sealing between the housing and the inner wall of the flow tubing;

an elongated rod telescopingly extending into said housing through said chamber and adapted to be connected to the wire line;

means in said housing for limiting the telescopic movement of said rod into said housing;

means including spring means in said chamber for biasing said rod into said housing against the force exerted thereon by the wire line;

means including fluid passageways in said rod and in said housing, adapted to hydraulically interconnect the downhole portion of the flow tubing to said chamber when said rod is at a most extended position in said housing, and to hydraulically interconnect the uphole portion of the flow tubing and said chamber when said rod extends out of said chamber by a predetermined distance;

slips means extending out of said chamber through the walls of said housing so as to engage the inner walls of the flow tubing to oppose movement of said housing through the flow tubing; and

spring means connected to said slips means biasing said slips means into said chamber so that a predetermined hydraulic pressure is required in said chamber relative to the pressure uphole of said sealing means to force said slips means into engagement with the walls of the flow tubing.

2. For use in a well installation wherein a well tool is pumped through a flow tubing at the end of a wire line for running into and retrieval from an operating location in a well, the combination comprising:

a housing adapted to be connected to the well tool, said housing having a chamber therewithin;

annular sealing means connected to said housing for sealing between the housing and the inner wall of the flow tubing;

an elongated rod telescopingly extending into said housing through said chamber and adapted to be connected to the wire line;

means in said housing for limiting the telescopic movement of said rod into said housing;

means including spring means in said chamber for biasing said rod into said chamber against the force exerted thereon by the wire line;

means including fluid passageways in said rod and in said housing, adapted to hydraulically interconnect the downhole portion of the flow tubing to said chamber when said rod is at a most extended position in said housing, and to hydraulically interconnect the uphole portion of the flow tubing and said chamber when said rod extends out of said chamber by a predetermined distance; and

means, including slips means extending out of said chamber through the walls of the housing, adapted to engage the inner wall of the flow tubing responsive to a predetermined hydraulic pressure in said chamber so as to oppose movement of said housing through the flow tubing.

3. For use in a well installation wherein a well tool is pumped through a flow tubing at the end of a wire line for running into and retrieval from an operating location in a well, the combination comprising:

first outer and second inner interconnected telescoping members respectively adapted to be connected to the tool and to the wire line, said telescoping members being constructed and arranged for relative movement between a most telescoped position and a least telescoped position, said first telescoping member including a chamber through which said second member extends;

passageway means in said telescoping members adapted to hydraulically interconnect said chamber and the downhole portion of the flow tubing when said telescoping members are in the most telescoped position thereof, and to interconnect said chamber and the upper portion of the flow tubing when said telescoping members are in a lesser telescoped position thereof;

annular sealing means on said first telescoping member adapted to sealingly engage the inner wall of the flow tubing; and

means extending from said chamber through said first telescoping member adapted to engage the walls of the flow tubing to oppose movement of said telescoping members therethrough when the pressure differential between the chamber and the exterior of said first telescoping member on the uphole side of said sealing means exceeds a predetermined pressure.

4. For use in a well installation wherein a well tool is

pumped through a flow tubing at the end of a wire line for running into and retrieval from an operating location in a well, the combination comprising:

a housing adapted to be connected to the well tool, said housing having a chamber therewithin;

annular sealing means connected to said housing for sealing between the housing and the inner wall of the flow tubing;

an elongated rod telescopingly extending into said housing through said chamber and adapted to be connected to the wire line;

means in said housing for limiting the telescopic movement of said rod into said housing;

spring means in said chamber connected to said rod for biasing said rod into said housing against the force exerted thereon by the wire line;

means including fluid passageways in said rod and in said housing, adapted to hydraulically interconnect the downhole portion of the flow tubing to said chamber when said rod is at a most extended position in said housing, and to hydraulically interconnect the uphole portion of the flow tubing and said chamber when said rod extends out of said chamber by a predetermined distance;

slips means extending out of said chamber through the walls of said housing so as to engage the inner walls of the flow tubing to oppose movement of said housing through the flow tubing; and

spring means connected to said slips means biasing said slips means into said chamber so that a predetermined hydraulic pressure is required in said chamber relative to the pressure uphole of said sealing means to force said slips means into engagement with the walls of the flow tubing.

5. For use in a well installation wherein a well tool is pumped through a flow tubing at the end of a wire line for running into and retrieval from an operation location in a well, the combination comprising:

a housing adapted to be connected to the well tool, said housing having a chamber therewithin;

annular sealing means connected to said housing for sealing between the housing and the inner wall of the flow tubing;

an elongated rod telescopingly extending into said housing through said chamber and adapted to be connected to the wire line;

means in said housing for limting the telescopic movement of said rod into said housing;

spring means in said chamber connected to said rod for biasing said rod into said housing against the force exerted thereon by the wire line;

means including fluid passageways in said rod and in said housing, adapted to hydraulically interconnect the downhole portion of the flow tubing to said chamber when said rod is at a most extended position in said housing, and to hydraulically interconnect the uphole portion of the flow tubing and said chamber when said rod extends out of said chamber by a predetermined distance;

slips means extending out of said chamber through the walls of said housing so as to engage the inner walls of the flow tubing to oppose movement of said housing through the flow tubing;

annular sealing means between said slips means and the walls of said housing; and

spring means connected to said slips means biasing said slips means into said chamber so that a predetermined hydraulic pressure is required in said chamber relative to the pressure uphole of said sealing means to force said slips means into engagement with the walls of the flow tubing.

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