Dec. 25, 1962 S. E. LOY III, ET AL 3,070,167

DEVICE FOR PUMPING TOOLS INTO WELLS

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FIG. 1.

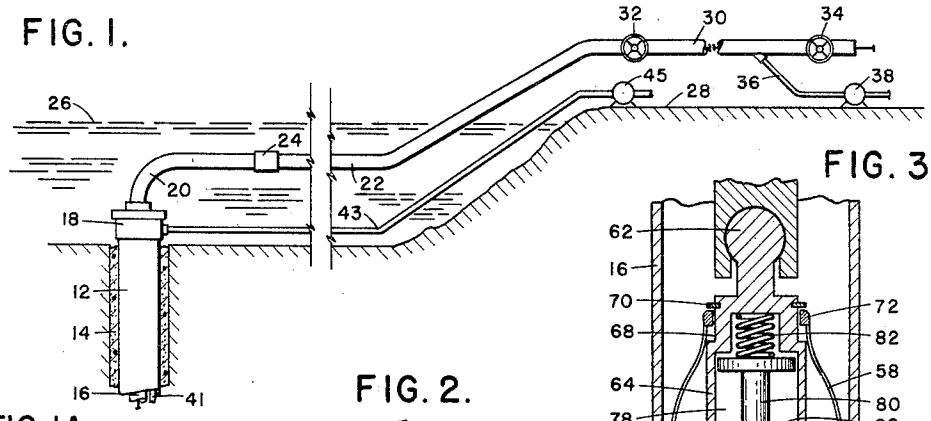

FIG. 1A.

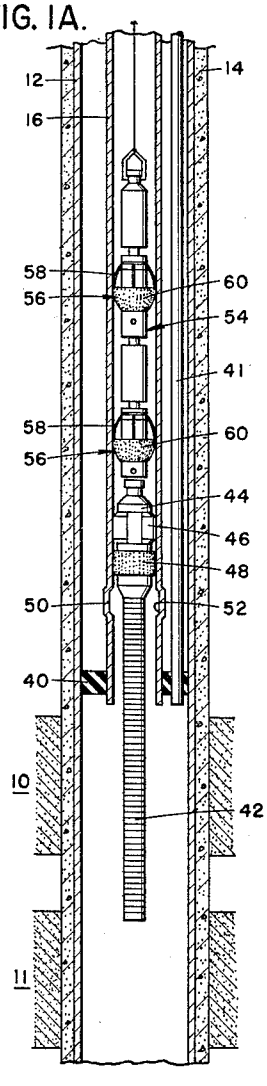

FIG. 2.

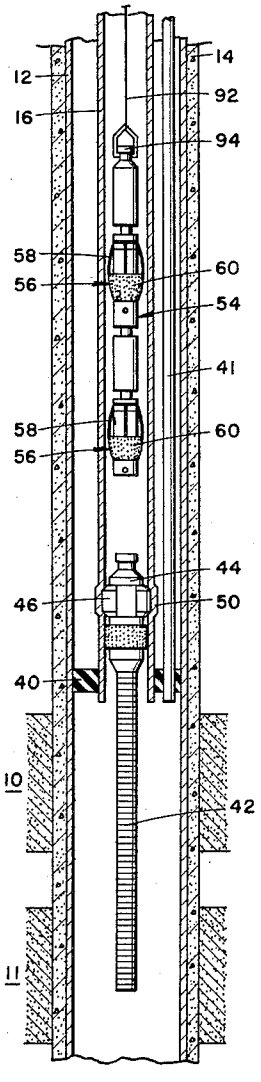

FIG. 3.

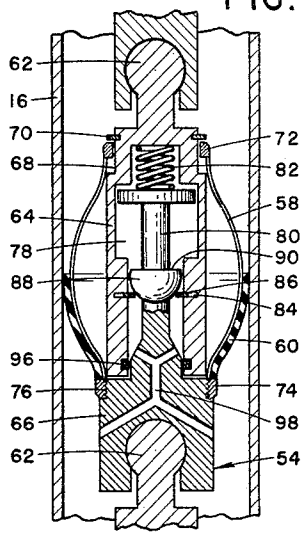

FIG. 4.

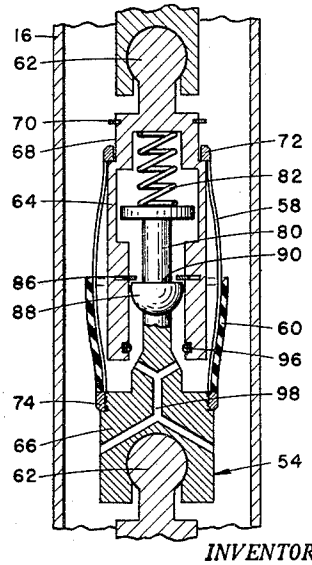

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FIG. 5.

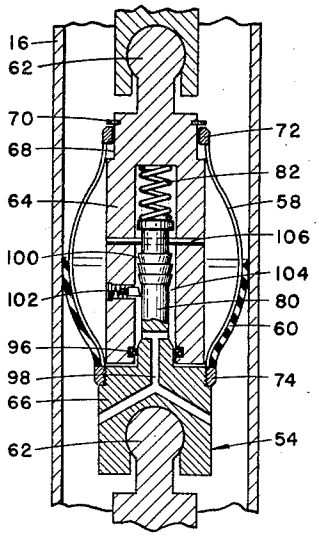


FIG. 6.

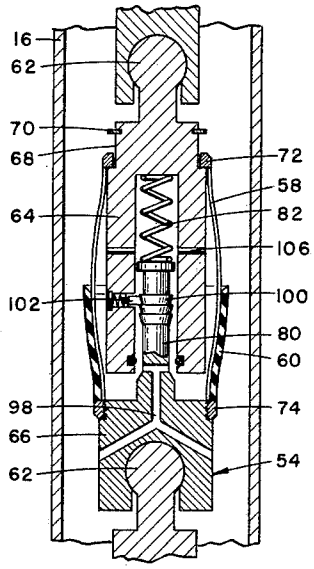


FIG. 7.

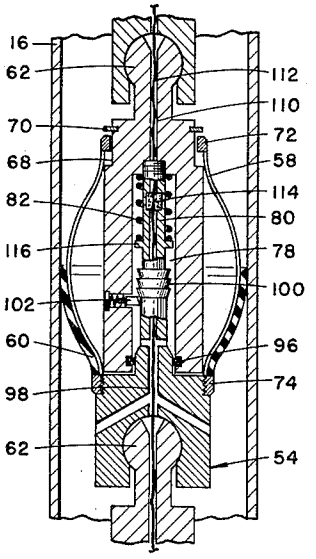
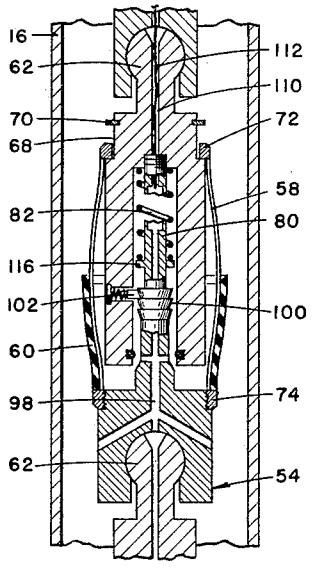


FIG. 8.



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United States Patent Office 3,070,167 Patented Dec. 25, 1962

3,070,167

DEVICE FOR PUMPING TOOLS INTO WELLS

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Filed July 30, 1959, Ser. No. 830,672
5 Claims. (Cl. 166—153)

This invention relates to oil and gas wells. More particularly, this invention relates to tools for performing workover operations in oil and gas wells.

When using certain tools in performing workover operations, it is often necessary that the friction be minimized as the tool is removed from the well. This is particularly so when pumping tools are used to pump other members such as tubular extension members to an offshore well from an onshore location. After the extension member has been properly located within the offshore well, the tool used to pump the extension member into the well must be removed by wireline. In currently used pumping tools, cup packers are used to permit the pumping of the tool into the well. Mowever, if the tool is removed by wireline, these cup packers are in continuous engagement with the tubing. The resulting friction is often undesirable.

The tool to be described herein includes at least one collapsible cup-shaped packer which is mounted about a plurality of elongated spring members which are normally biased outwardly to engage the side of the tubing as the tool is pumped from the onshore location to the offshore well. Means are provided for collapsing the springs and the cup-shaped packer mounted upon the springs, prior to the removal of the tool from the well by wireline. With the springs and packer in the collapsed position, the friction during removal of the tool from the well is kept to a minimum.

The operation of the device, as well as the many other advantages, will be further understood by reference to the following detailed description and drawings in which:

FIG. 1 and FIG. 1A are schematic elevational views showing the tool being used to pump an extension member into a well from the shoreline;

FIG. 2 is a schematic elevational view showing the tool being removed after an extension member has been locked into position within the well;

FIG. 3 is an elevational view partly in section showing the relative positions of the parts of the new tool as it is being pumped into the well;

FIG. 4 is an elevational view partly in section showing the position of the parts as the tool of FIG. 3 is removed from the well;

FIG. 5 is an elevational view partly in section showing another embodiment of the invention with the parts in the position as the tool is pumped into the well;

FIG. 6 is an elevational view partly in section showing the embodiment of FIG. 5 with the parts in the positions assumed as the tool is being removed from the well;

FIG. 7 is an elevational view partly in section showing still another embodiment of the invention with the parts in position assumed as the tool is pumped into the well; and

FIG. 8 is an elevational view partly in section showing the relative positions of the parts, as the embodiment of FIG. 7 is removed from the well.

Referring to FIGS. 1, 1A, and 2, a borehole is shown penetrating the earth and traversing subsurface formations 10 and 11. The borehole includes the usual casing 12 which is cemented to the side of the borehole by means of cement 14.

Production tubing 16 extends into the well and terminates at a point above the bottom of the well. The production tubing 16 extends through a wellhead 18 and connects with a short radius bend pipe 20. The short radius bend pipe 20 is coupled to a laterally extending conduit 22 by means of a coupling means 24. The well, short radius bend pipe 20, and laterally extending pipe 22 are all below the water line 26.

Pipe 22 extends to the shore 28. A lubricator 30 is connected to the pipe 22. Valves 32 and 34 are provided at the extremities of lubricator 30.

Extending from the lubricator 30 is a conduit 36. Fluid may be pumped into the lubricator 30, laterally extending pipe 22, bend 20, and production tubing 16 by means of pump 38.

Extending through the packing means 40 is a circulating flow line 41. The flow line 41 extends up to the wellhead 18 where it is attached to a laterally extending conduit 43 which leads to a pump 45 located onshore.

FIG. 1A shows a tubular extension member 42 which is being pumped into position within the well. The tubular extension 42 includes an extension hanger 44 containing locking dogs 46. A packer 48 is also included about the extension hanger 44. The extension member 42 is locked into position within the production tubing 16 by the provision of a landing nipple 50 provided in the production tubing 16.

The landing nipple 50 includes a recess 52 for receiving the locking dogs 46. The extension member 42 is made of flexible material so that it can be passed through the short radius bend pipe 20.

The flexible extension member 42 has been pumped into the desired position by use of the new and novel pumping tool indicated generally by the numeral 54.

FIG. 2 shows the new tool 54 being removed from the production tubing 16 after the flexible extension member 42 has been securely locked in position within the production tubing 16.

The new and novel tool 54 includes at least one collapsible cup-shaped member indicated generally by the numeral 56. In the figures shown there are two spaced-apart collapsible members 56.

The collapsible members 56 include a plurality of elongated springs 58. The number of springs may vary and usually ranges in number from 4 to 10 and forms a basket about the pumping tool 54.

The cup-shaped packer 60 is mounted upon the lower half of the elongated springs 58. Springs 58 are normally biased outwardly into contact with the inside of the tubing 16. This provides a piston-like means so that the tool 54 can be pumped through the laterally extending tubing 22, the short radius bend pipe 20, and the tubing 16.

As stated above, it is highly desirable that the friction be eliminated as the tool is removed from the well to the earth's surface. Thus, means are provided in this new tool to collapse the elongated springs 58 and the cup-shaped packer 60 mounted upon the springs 58, prior to the removal of the tool 54 from the well.

One collapsing means is illustrated in FIGS. 3 and 4. Referring to these figures, it is seen that the tool 54 includes a plurality of members connected together by knuckle joints 62. The knuckle joints 62 are provided to permit the tool to be pumped past bends in the tubing system such as short radius bend 20. Each of the elongated springs 58 has one end mounted about a first elongated member 64 and the other end mounted to a second member 66.

A shoulder 68 is provided on the outside surface of the elongated member 64. A metal ring 70 is also provided about the outside surface of member 64 and spaced above the shoulder 68. Thus, the shoulder 68 and the metal ring 70 provide a groove into which is fitted a collar

member 72 to which the upper portion of each elongated spring 58 is connected.

The lower extremity of each of the springs 58 terminate in a collar member 74 which is threadedly connected on the upper outside surface of the lower member 66 by mating threads 76.

The elongated member 64 has a chamber 78 formed therein. The chamber 78 receives an upper portion of the lower member 66. The upper portion 80 of member 66 is of smaller diameter than the lower portion of member 66.

A compression spring 82 is mounted within the chamber 78 and adapted to exert a force against the top portion of member 80.

Mounted within a groove 84 formed within the inside portion of elongated member 64 and extending laterally therein is a split-ring 86. Groove 84 is of such size as to permit outward movement of the split-ring 86 when a predetermined force is exerted against the split-ring 86.

Mounted about the smaller diameter portion 80 and above the split-ring 86 is a member 88 having angular portions resting upon the split-ring 86 and a flat upper edge 90. The particular member shown in FIGS. 3 and 4 is frusto spherical. However, it is to be understood that other shapes can be used having angular sides and a flat top. For example, a frusto-conical shaped member can be used.

In operating the embodiment shown in FIGS. 3 and 4, the tool 54 is pumped from the shoreline into the tubing 16. In this manner, the tubular extension member 42 is properly located. The springs 58 are biased outwardly in contact with the inside surface of production tubing 16. After the extension member 42 has been properly located, the elongated member 64 can be held stationary or moved upwardly by means of the wireline 92 connected to the fishing neck 94. At the same time, hydraulic pressure is exerted against the inside of the cup-shaped packer 60. When the predetermined pressure is obtained, member 88 is passed through the split-ring member 86. The compression spring 82 aids in forcing member 88 through the split-ring 86. Thus, the lower member 66 is slidably moved longitudinally with respect to the upper elongated member 64. This collapses the elongated spring members 58 and cup-shaped packer 60 as shown in FIG. 4.

The tool 54 may then be removed to the earth's surface without friction. The flat surface 90 of member 88 locks the members in the collapsed position. An O-ring fluid seal 96 and fluid by-pass 98 are provided to facilitate the removal of the tool 54.

FIGS. 5 and 6 show a second embodiment of means for preventing the collapse of the springs and packer until the application of a predetermined pressure and means for holding the collapsed members in the collapsed position.

In FIGS. 5 and 6, the means for holding the elongated springs 58 and cup-shaped packer 60 in the collapsed position includes a plurality of vertically spaced rachet teeth 100 formed on the outer periphery of the smaller diameter portion 80 of member 66. Spring biased pawls 102 are mounted in the upper elongated member 64 and extend into the chamber 104 below the ratchet teeth 100.

When the tool 54 is held stationary or moved upwardly by the wireline 92 and fluid pressure applied against the cup-shaped swab, the shear pin 106 is broken. Member 66 and the smaller diameter portion 80 are then moved downwardly by the force of compression spring 82 to collapse the collapsible members. Slidable member 66 is held in its lower position by the spring biased pawls 102 which engage the upper flat portions of ratchet teeth 100.

FIGS. 7 and 8 show still another means for preventing the movement of member 66 until the application of a predetermined pressure and means for holding the cup-shaped packer in the collapsed position. Like members refer to like parts of the previous figures.

In FIGS. 7 and 8, an elongated hole 110 is formed through the axis of the tool 54. Extending through the hole 110 is a conductor wire cable 112.

In this embodiment, the upper end of the smaller diameter portion 80 is securely connected to the top of the chamber 78. A small cavity is formed in the upper portion of the smaller portion 80 in which is deposited a charge of powder 114 which can be exploded by the application of an electrical current through the cable 112.

A transverse shoulder 116 is provided about the smaller diameter portion 80 above the rachet teeth 100. The compression spring 82 exerts a force against the shoulder 116.

When it is desired to collapse the elongated springs 58 and cup-shaped packer 60, an electrical current is fed through the conductor wire cable 112 to explode the powder charge 114. The explosion fractures the extreme upper portion of member 80. Thereafter, by holding the tool 54 stationary or moving it upwardly by wireline while applying fluid pressure to the packer 60, the lower member 66 can be moved downwardly to collapse the elongated springs 58 and cup-shaped packer 60. These members are held in the collapsed position by the spring biased pawls 102 which engage rachet teeth 100.

Although this invention is of particular utility in the reworking of submarine wells, it could also have application as a swabbing assembly in any other type of well with slight modification. For example, it has been common practice to stimulate production by hydraulic fracturing. Swabbing of sand-laden fluid subsequent to fracturing sometimes causes sticking of the swab in the well. This invention prevents sticking of the swab and possible breaking of the swab line by collapsing the swab cup, permittin the sand to fall past the swab. When the tool is used for this purpose, the knuckle joints may not be necessary and can be eliminated.

We claim:

1. A tool for use in performing workover operations in wells comprising: an upper elongated member having an elongated chamber formed therein; a lower member having an upper smaller portion, said smaller portion telescopically extending into said elongated chamber; a plurality of arcuately spaced outwardly biased elongated springs, each spring having one end mounted about the upper elongated member and the other end mounted to the lower member; a cup-shaped packer connected to the lower member and covering approximately half the length of each of the elongated springs, whereby the elongated springs and cup-shaped packer can be collapsed by the application of pressure against the cup-shaped packer to move the lower member when the upper elongated member is held relatively stationary; and means for holding the elongated springs and cup-shaped packer in the collapsed position.

2. A tool for use in performing workover operations in wells comprising: an upper elongated member having an elongated chamber formed therein; a lower member having an upper smaller portion, said smaller portion telescopically extending into said elongated chamber; a compression spring mounted within the chamber and exerting a force downwardly upon the top of said smaller portion; a shear pin mounted through the upper portion of the smaller diameter portion of the lower member and connected to the inside surfaces of the upper elongated member which form said chamber; a plurality of arcuately spaced outwardly biased elongated springs, each spring having one end mounted about the upper elongated member and the other end mounted to the lower member; a cup-shaped packer connected to the lower member and covering approximately half the length of each of the elongated springs, whereby upon the application of a predetermined force against the cup-shaped packer, the shear pin is sheared and the lower member is moved to collapse the elongated springs and cup-shaped packer when the upper elongated member is held against movement;

and means for holding the elongated springs and cup-shaped packer in the collapsed position.

3. A tool in accordance with claim 2 wherein the means for holding the elongated springs and cup-shaped packer in the collapsed position includes ratchet teeth formed on the outer periphery of the smaller diameter portion of the lower member, and spring biased pawls mounted in the upper elongated member and extending into the chamber below the rachet teeth whereby the lower member can be moved downwardly only with respect to the upper elongated member.

4. A tool for use in performing workover operations in wells comprising: an upper elongated member having an elongated chamber formed therein; a lower member having an upper smaller portion, said smaller portion extending into said elongated chamber; a plurality of arcuately spaced outwardly biased elongated springs, each spring having one end mounted about the upper elongated member and the other end mounted to the lower member; a cup-shaped packer connected to the lower member and covering approximately half the length of each of the elongated springs; a split-ring resiliently mounted transversely in the vertical inside surface of the upper elongated member; a split-ring actuating member having angled sides and a flat upper edge forming a part of the smaller diameter portion and adapted to pass through the split-ring upon the application of a predetermined force against the cup-shaped packer; and a compression spring within the chamber exerting a force against the top of said smaller diameter portion, whereby upon the application of said predetermined force against the lower member, the elongated springs and cup-shaped packer are locked in a collapsed position.

5. A tool for use in performing workover operations in wells comprising: an upper elongated member having an elongated chamber formed therein; a lower member having an upper smaller portion, said smaller portion extending through said elongated chamber and connected to the upper elongated member; a plurality of arcuately spaced outwardly biased elongated springs, each spring having one end mounted about the upper elongated member and the other end mounted to the lower member; a cup-shaped packer connected to the lower member and covering approximately half the length of each of the elongated springs; an electrical conductor extending through the upper member; a powder charge embedded in the upper portion of the smaller diameter portion and exploded by the application of an electrical current through the conductor cable; a compression spring mounted in the upper part of the chamber exerting a force against the smaller diameter portion tending to separate said upper and lower members; rachet teeth formed on the outer periphery of the smaller diameter portion of the lower member, and spring biased pawls mounted in the upper elongated member and extending into the chamber below the rachet teeth whereby upon detonation of the powder the extreme upper section of the smaller diameter portion is broken so that the application of fluid pressure against the cup-shaped packer locks the elongated springs and cup-shaped packer in a collapsed position.

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