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2,488,931

PRODUCING EQUIPMENT FOR WELLS

Filed Dec. 16, 1944

3 Sheets-Sheet 1

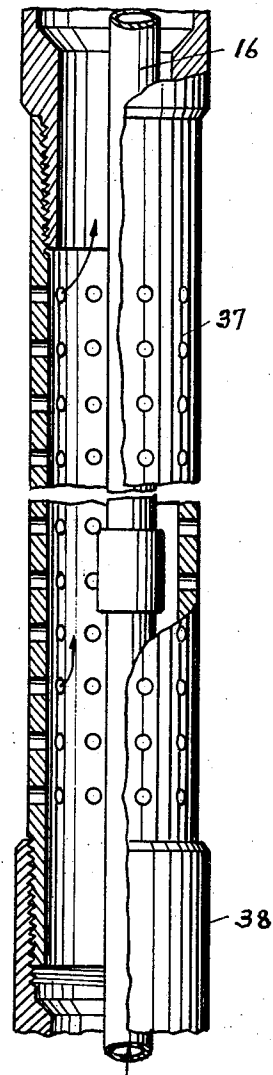
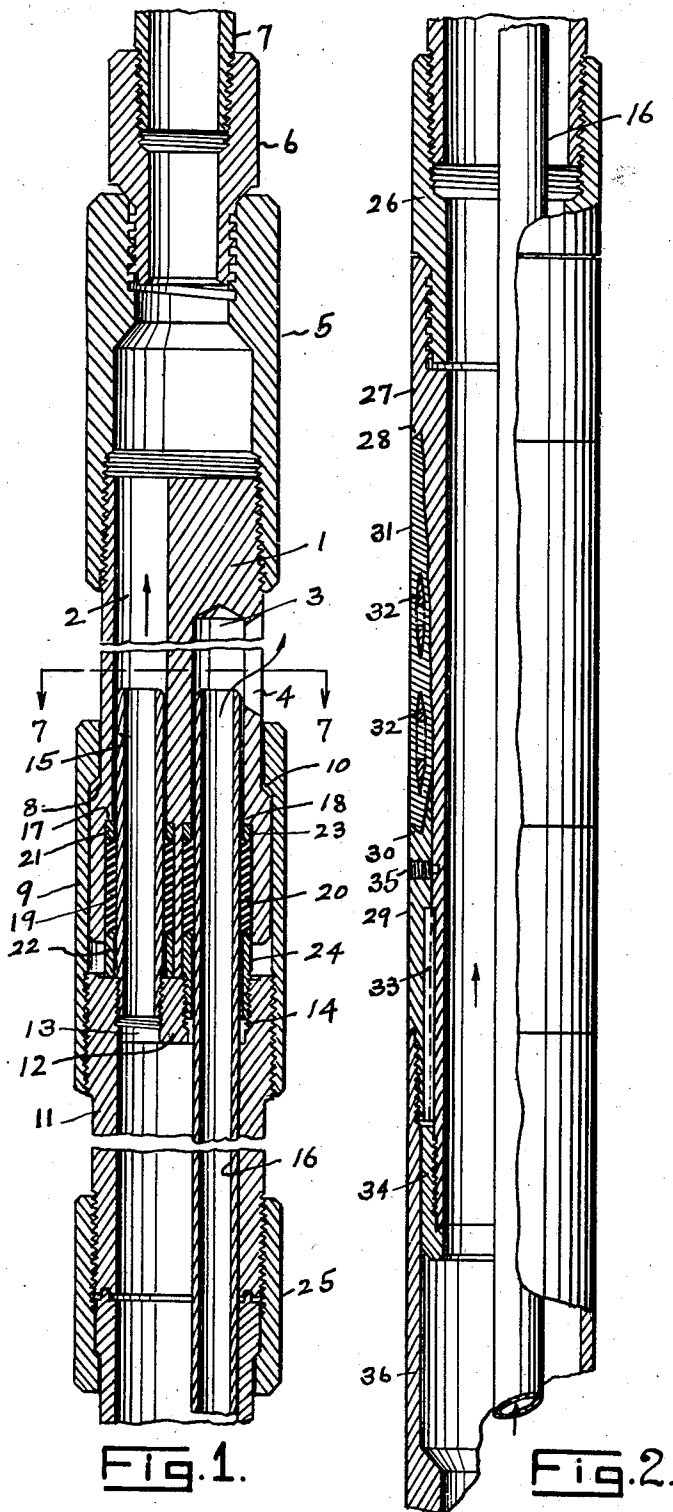


Fig. 3.

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3 Sheets-Sheet 2

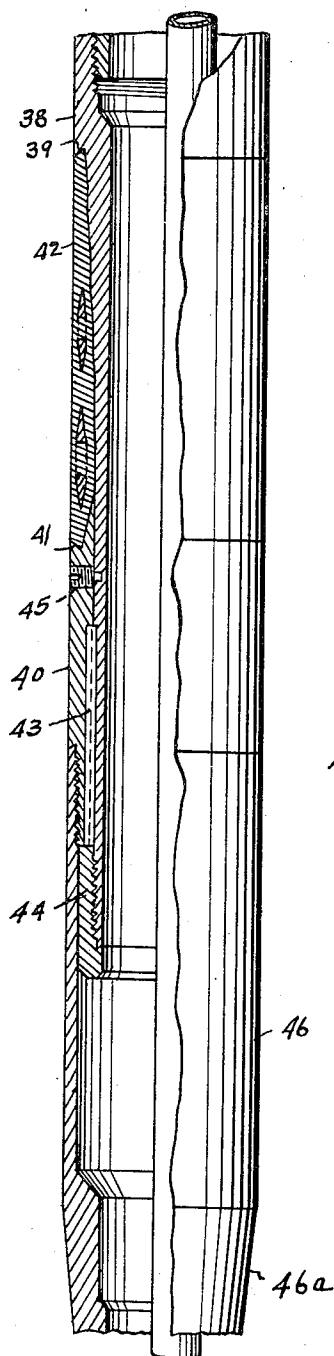


Fig. 4.

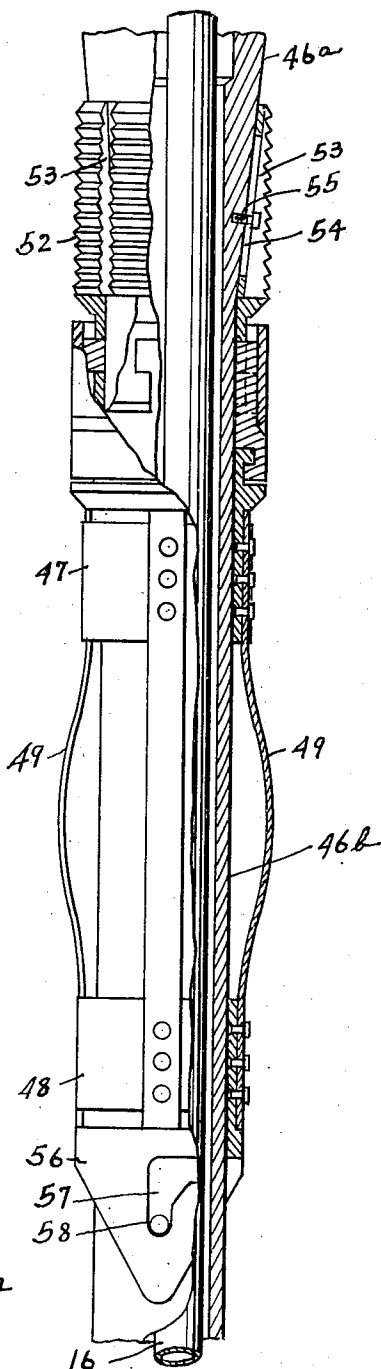


Fig. 5.

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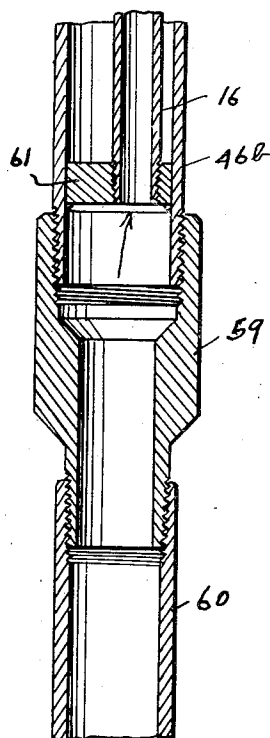


Fig. 6.

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3 Sheets-Sheet 3

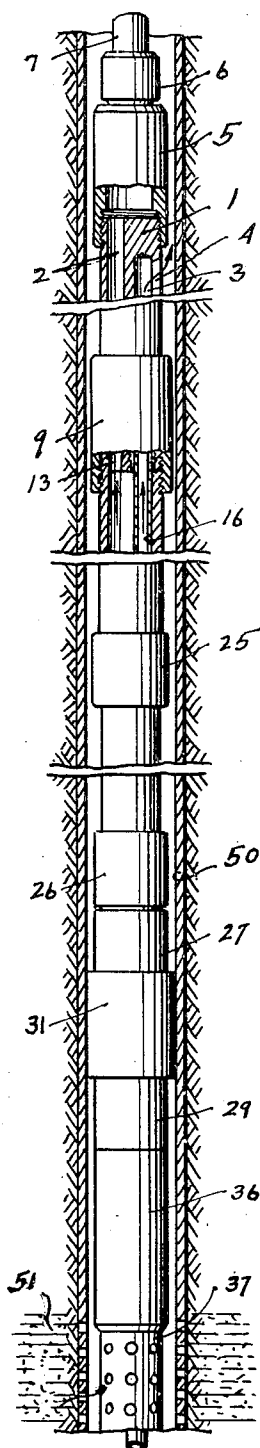


Fig. 8.

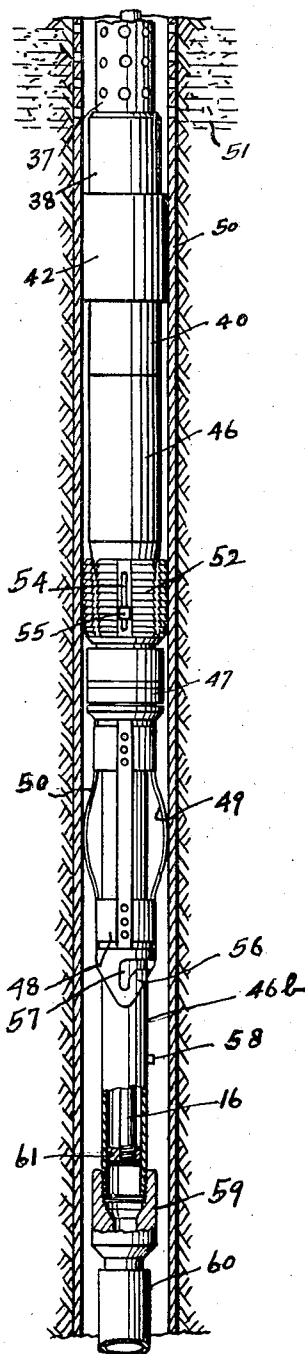


Fig. 9.

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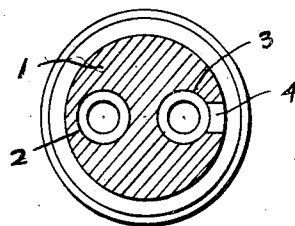


Fig. 7.

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UNITED STATES PATENT OFFICE

2,488,931

PRODUCING EQUIPMENT FOR WELLS

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6 Claims. (Cl. 166-2)

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This invention relates to producing equipment for wells.

An object of the invention is to provide a producing string of pipe whereby production from a well may be carried on from two or more producing strata simultaneously.

Another object of the invention is to provide equipment of the character described whereby producing strata in a well may be sealed off so that production may be carried on from either stratum independently of the other stratum, or strata, in the well.

The invention further embodies novel means for sealing the separate flow conduits so as to prevent leakage and to confine the flow from any particular stratum to the conduit provided for that stratum.

With the above and other objects in view the invention has particular relation to certain novel features of construction, arrangement of parts and use, an example of which is given in this specification and illustrated in the accompanying drawings, wherein:

Figure 1 shows a vertical, sectional view of the upper end of the equipment.

Figures 2, 3, 4 and 5 show side views, partly in section, of intermediate sections from above downwardly.

Figure 6 shows a vertical, sectional view of the lower end of the equipment.

Figure 7 shows a cross, sectional view taken on the line 7-7 of Figure 1; and

Figures 8 and 9 show elevational views of the upper and lower ends, respectively, of the complete equipment shown partly in section.

Referring now more particularly to the drawings wherein like numerals of reference designate the same parts in each of the figures, the numeral 1 designates a cylindrical head which is provided with the longitudinal bores 2 and 3. The bore 2 extends entirely through the head and the bore 3 extends from the lower end of the head only partly up through the head and its upper end terminates in the lateral outlet opening 4.

Screwed onto the upper end of the head there is a tubular coupling 5 and a tubular reducing nipple 6 is screwed into the upper end of said coupling forming a connection for the outlet pipe 7 which leads up to the tubing head or other flow connections of conventional construction.

The lower end of the head 1 is enlarged in outside diameter forming an external, annular, upwardly facing shoulder 8 and fitted over the head there is a flanged coupling 9 whose upper

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end is inwardly thickened forming an inside downwardly facing shoulder 10 engageable with the shoulder 8. The lower end of the coupling 9 is internally threaded and the upper end of a tubular section of pipe 11 is screwed into it. The upper end of this section of pipe has a cross web 12 formed integrally therewith and which has the internally threaded bores 13, 14 therethrough which are aligned with the bores 2 and 3, respectively.

There is an upstanding tubular nipple 15 whose lower end is screwed into the bore 13 and which extends up into the bore 2.

There is a flow tube 16 which will be more specifically described later herein but whose upper end telescopes up into the bore 3.

The lower ends of the bores 2 and 3 are enlarged internally forming the inside shoulders 17 and 18 therein and within these enlarged portions are the expansible sleeves 19 and 20 which surround the nipple 15 and the upper end of the flow tube 16, respectively. There is a metal ring which abuts the shoulder 17 and rests on the sleeve 19 and this sleeve is supported on a metal ring 22 which, in turn, is supported on the upper end of the pipe section 11.

A metal ring 23 abuts the shoulder 18 and is supported on the sleeve 20 and the lower end of this sleeve is supported on a metal sleeve 24 which surrounds the flow tube 16 and whose lower end is screwed into the bore 14.

It is to be noted that when the shoulder 10 hangs on the shoulder 8 the lower end of the head 1 will be spaced a distance above the upper end of the pipe section 11 so that when the producing equipment is set in the well casing, as hereinafter described, the weight of the head 1 and the equipment thereon, will exert an endwise compressive force on the packing sleeves 19 and 20 so as to form fluid tight seals about the nipple 15 and the upper end of the flow tube 16.

The pipe 11 may be formed of sections connected by a coupling, or couplings, as 25 and connected to its lower end is the tubular sub 26 to the lower end of which the upper, tubular, packer body 27 is connected. This body has an external, annular downwardly facing shoulder 28 thereon and spaced beneath said shoulder and surrounding said body there is the upper slip ring 29 which has the upwardly facing external annular shoulder 30 therearound beneath its upper end. An upper sleeve-like packer 31 surrounds the packer body 27 with its upper and lower ends abutting the upper and lower shoulders 28 and 30. The packer 31 is preferably

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formed of lead with hard metal rings as 32 imbedded therein terminating in upper end lower sharp edges as shown in Figure 2. These hard metal rings secure a more uniform expansion of the sleeve 31. The lower end of the packer body is splined to the slip ring 23 by means of the spline 33 so as to prevent independent rotation but so as to permit the body 27 to move downwardly relative to the slip ring. The slip ring is prevented from detachment from the body by means of a ring nut 34 screwed onto the lower end of the body. The slip ring is also pinned to the body by means of a shearable pin 35.

The lower end of the slip ring is threaded into the upper end of the pipe section 36 to the lower end of which a perforated section of screen pipe as 37 is connected.

Screwed onto the lower end of the screen pipe 37 there is a lower packer body 38 having an external annular downwardly facing shoulder 39 and around the lower end of the lower packer body 38 there is lower slip ring 40 having the external annular upwardly facing shoulder 41 beneath its upper end.

Surrounding the lower packer body there is a sleeve-like packer 42 whose upper end abuts the shoulder 39 and whose lower end abuts the shoulder 41. This packer is in all respects similar to the upper packer 31.

It may be here stated, however, that while a specific type of upper and lower packers have been shown any conventional type of packer may be used.

The slip ring 40 is splined on the body 38 by means of the spline 43 which permits said body 38 to move downwardly relative to the slip ring 40 but its upward movement is limited by the ring nut 44 which is screwed onto the lower end of said lower body 38. The slip ring 40 is also pinned to the body 38 by means of a frangible pin 45. The pin 45 is somewhat weaker than the pin 35 so that it will shear and the lower packer will be set, or expanded first, that is, before the expansion of the packer 31 as will be more fully explained later.

The numeral 46 designates a tubular slip carrier whose upper end is screwed onto the lower end of the slip ring 40, whose intermediate portion is formed into a downwardly tapering slip expander 46a and whose lower end is formed into the tubular extension 46b. Slidable on the extension 46b are the upper and lower collars 47 and 48 to which the upper and lower ends of the outwardly bowed springs 49 are attached. These springs frictionally engage the casing 50 with which the well bore is cased and this casing is perforated opposite the upper oil bearing stratum 51, as shown in Figure 8.

Loosely connected to the upper collar 47 and having a swivelling connection therewith are the casing engaging slips 52 whose inner sides are tapered to conform to the taper of the expander 46a and whose outer surfaces are toothed to engage the casing. Each slip has a longitudinal groove 53 on its outer surface and at the bottoms of the grooves are the longitudinal slots 54. Set screws 55 extend through said slots and are screwed into the expander 46a with their heads in said grooves. These set screws hold the slip jaws against the tapering surface of said expander.

The lower end of the lower collar 48 is formed into a J-hook 56 having the transverse J-slot 57 therein and a pin 58 is secured to the tubular extension 56b and works in said slot.

Screwed onto the lower end of said extension

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46b there is a lower tubular sub 59 suspended from which is a length of pipe 60.

Fastened in the lower end of the tubular extension 46b and closing said end there is a block 61. The flow tube 16 extends down through the producing string assembly as above described and its lower end is threaded through the block 61.

The apparatus is assembled as shown in Figures 1 to 6, inclusive, and is lowered into the well casing until the upper packing sleeve 31 is above the producing stratum 51 and the lower packer sleeve 52 is beneath said stratum. While being lowered the pin 58 will be located in the slot 57 so that the expander 46a cannot move downwardly relative to the slips and prematurely expand them. The producing string may then be elevated and turned to the left to carry the pin 58 out of the slot 57 and lowered. The slips will be held against downward movement by the springs 49 and the expander 46a will expand said slips into engagement with the well casing, as shown in Figure 9. The slip carrier and slip ring 40 will be thus anchored against further downward movement. The weight above will then shear the pin 45 and the lower packer body 38 will move downwardly thus expanding the lower sleeve like packer 42 into the position shown in Figure 9 to form a seal with the outer casing. The screen 37, pipe section 36 and the upper slip ring 29 are thereby held against further downward movement and thereupon the weight above will shear the pin 35 and the upper body 27 will move on downwardly and expand the packer 31 into the position shown in Figure 8 thus forming a seal with the outer casing 50. The producing stratum 51 will thus be sealed off from the strata above and beneath. Fluid flowing from beneath the lower packer will thus flow upwardly through the flow tube 16 and on up through the bore 3 and out through the side slot 4 and will pass on up to the ground surface through the casing; fluid flowing from the stratum 51 will flow in through the screen 37 and on up around the flow tube 16 and through the bore 2 and thence through the coupling 5, the nipple 6 and the outlet pipe 7.

The producing equipment will be provided, at the ground surface, with any conventional type of well head having flow connection leading therefrom and by means of which the flow from the different strata may be controlled.

What I claim is:

1. In producing equipment for wells, a tubular string, a head thereon having a longitudinal bore extending from the lower end thereof into the head and having a lateral outlet, a flow tube within the string whose upper end extends into said bore, an expansible seal in the head around said flow tube, said head having also a longitudinal bore extending from the lower end to the upper end thereof, a tubular nipple whose lower end is anchored to the string and which extends up into said last mentioned bore, an expansible seal in the head around the nipple, telescoping means connecting the head into the string, said head having a limited longitudinal movement relative to said connecting means, and means in the head arranged to engage the ends of the seals to support the seals and to apply a compressive force to said seals to expand said seals upon downward movement of the head relative to said connecting means.

2. In producing equipment for wells, a tubular string, a coupling connected in the string, a head having a limited longitudinal movement in the

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coupling, said head having a bore extending from the lower end thereof and terminating beneath the upper end thereof in a lateral outlet, a flow tube in the string whose upper end extends into said bore, an expansible seal in the head around said flow tube, said head having also a longitudinal bore extending entirely therethrough, a nipple supported by the string and extending up into said last mentioned bore, an expansible seal around said nipple and means in the head arranged to engage the ends of the seals and apply a compressive force to said seals to expand said seals upon downward movement of the head relative to the coupling.

3. Producing equipment for wells comprising, a tubular string, upper and lower expansible packers thereon adapted to form seals with the casing of the well above and below a producing stratum, said string being perforated between the packers to permit the inflow of fluid from said stratum, a closure for the lower end of the string, a head connected in the string by means of a telescoping connection and having a bore terminating in a side outlet, a flow tube within the string having its lower end anchored to said closure, said tube having its upper end extending telescopically within the bore in the head, an expansible seal around the upper portion of the tube confined within a recess in the head and having its lower end supported by the string with its upper end engaged by the head, said head having a second bore leading entirely therethrough from end to end, a tubular nipple anchored to the string and extending telescopically into the second bore of the head, an expansible seal around said nipple confined within a recess in the head and having its lower end supported by the string with its upper end engaged by the head, the telescoping connection between the head and the string permitting said head to be moved downwardly relative to the string, whereby the head applies a compressive force to the seals around the flow tube and tubular nipple to deform said seals into sealing position.

4. Producing equipment for wells comprising, a tubular string, a head on the upper end of the string having a bore therethrough which opens outside of the string, said head having a telescoping connection with the string, upper and lower expansible packers thereon adapted to form seals with the walls of the well above and below a producing stratum, said string being perforated between the packers to permit the inflow of fluid from said stratum, a flow tube within said string, the lower end of said flow tube being sealed with

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respect to the lower end of the string and communicating with the well bore beneath, and whose upper end telescopes and communicates with the bore in said head and through it with the well bore exterior of the string, said string and said flow tubing forming separate channels, one leading from the sealed off stratum and the other leading from the well beneath the string, a seal confined within the head between said head and the string and surrounding the upper portion of the flow tube sealing off around said tube, said seal being arranged to be expanded by the weight of the equipment mounted on the string when the head is telescoped relative to the string.

5. In producing equipment for wells, a tubular string having a coupling connected therein, a head telescopically connected with the coupling and normally in an extended position relative thereto, said head having a bore extending from the lower end thereof and terminating in a lateral outlet above the coupling, a flow tube extending through the string and having its upper end telescoping said bore, said bore having its lower portion formed with an annular recess, an expansible seal surrounding the flow tube and having its upper portion confined within the recess, and means attached to the lower end of the coupling for supporting the seal upon the flow tube, the head engaging the upper end of the seal whereby movement of said seal into a sealing position for sealing off between the tube and the bore of the head is effected when the head is telescoped from a normally extended position with respect to the coupling and supporting means.

6. Producing equipment as set forth in claim 5, together with a second bore extending entirely through the head from end to end thereof, a tubular conduit mounted within the second bore, and an expansible seal around said conduit confined within the head and supported by the string, whereby telescoping movement of the head with respect to the string moves said sealing means into sealing position around said conduit.

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