United States Patent

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[54] **TOOL JOINT STRIPPING STATIONARY BLOWOUT PREVENTER WITH A RETRIEVABLE PACKING INSERT**
9 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **277/3,** 277/34, 277/185, 166/84, 251/1
[51] **Int. Cl.** **F16j 15/00,** F16j 15/40
[50] **Field of Search** 277/3, 66, 34, 185, 115, 6; 166/84; 251/1

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ABSTRACT: A stationary blowout preventer having a balloon-type packing unit with a central opening therein, a retrievable packing insert positioned within said opening by the engagement of a lower ring with the preventer and releaseably secured therein by hydraulically releaseable dogs latchingly engaging a latching notch in an upper ring, whereby a central rubber portion of the packing insert sealingly engages the pipe tool therethrough when the packing unit is pressurized by fluid. The blowout preventer has a fluid accumulator which absorbs the surge pressure and excess fluid to maintain a constant pressure on the packing insert as a pipe tool joint is stripped therethrough to maintain the sealing engagement between the insert and the pipe.

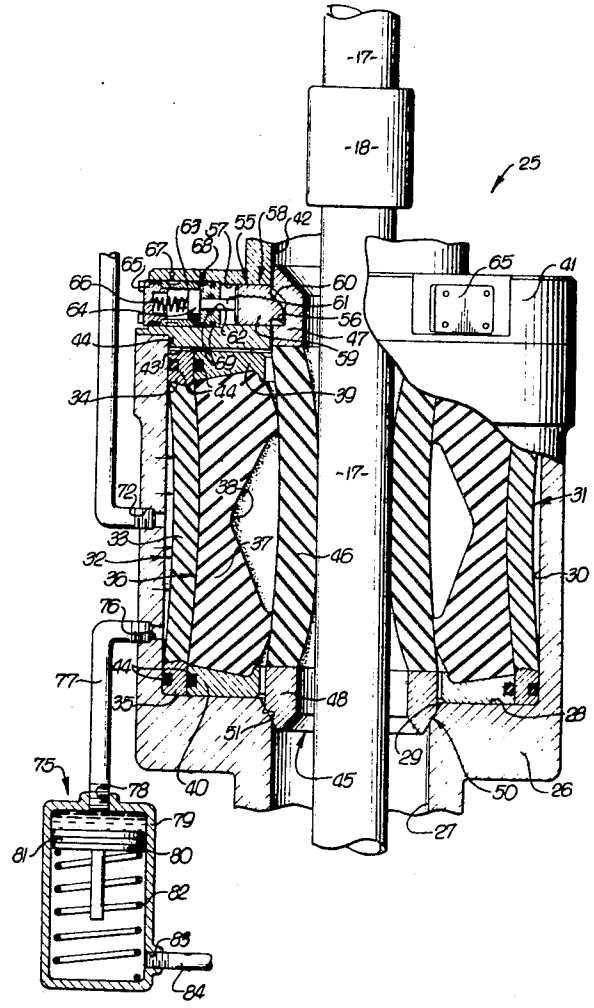

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FIG. 1.

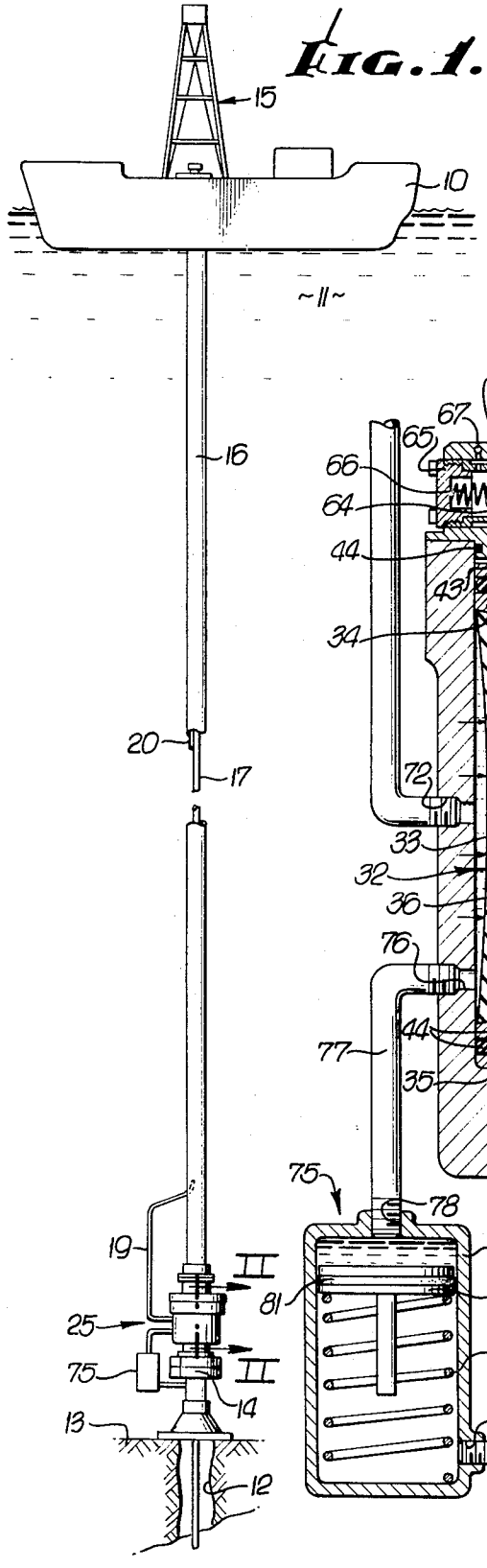

FIG. 2.

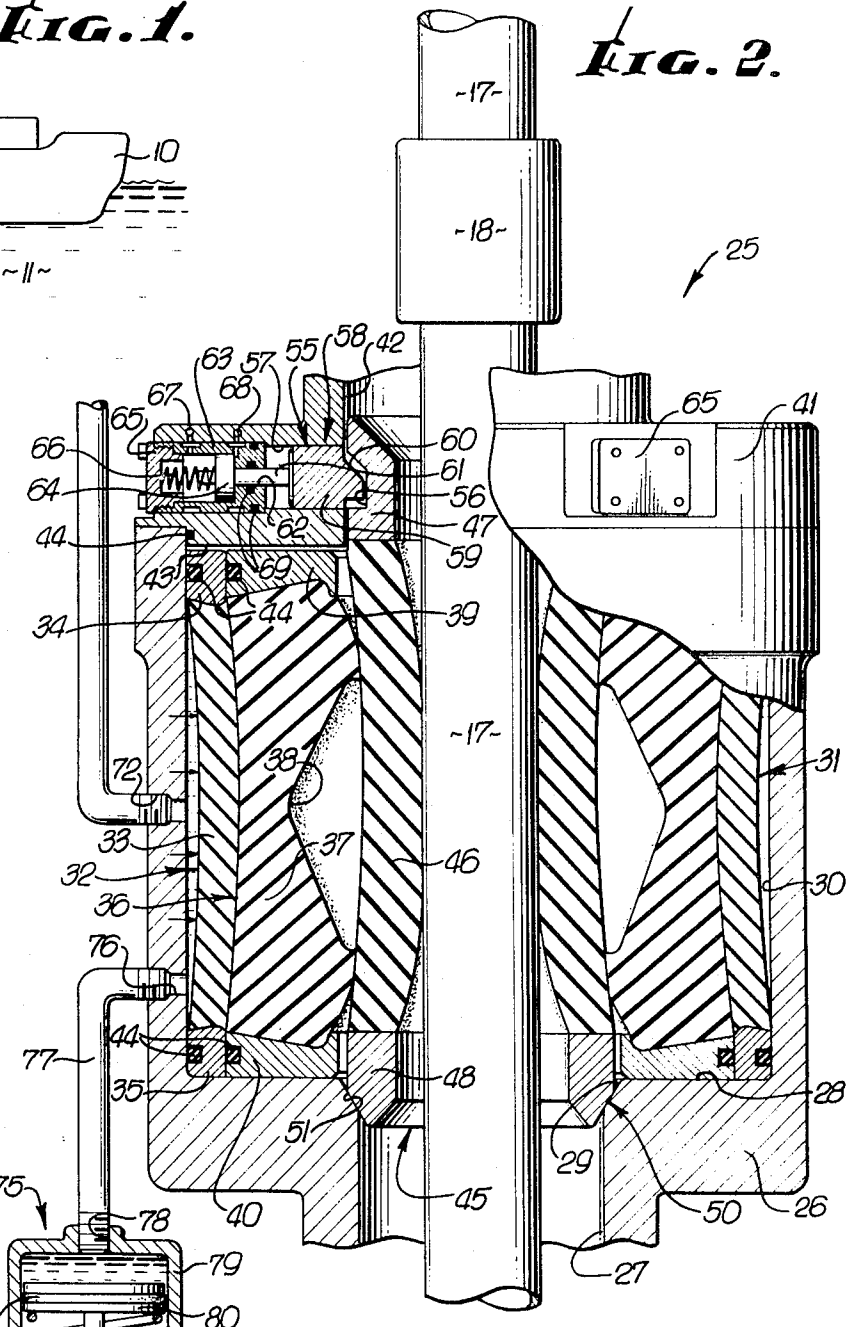

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FIG. 3.

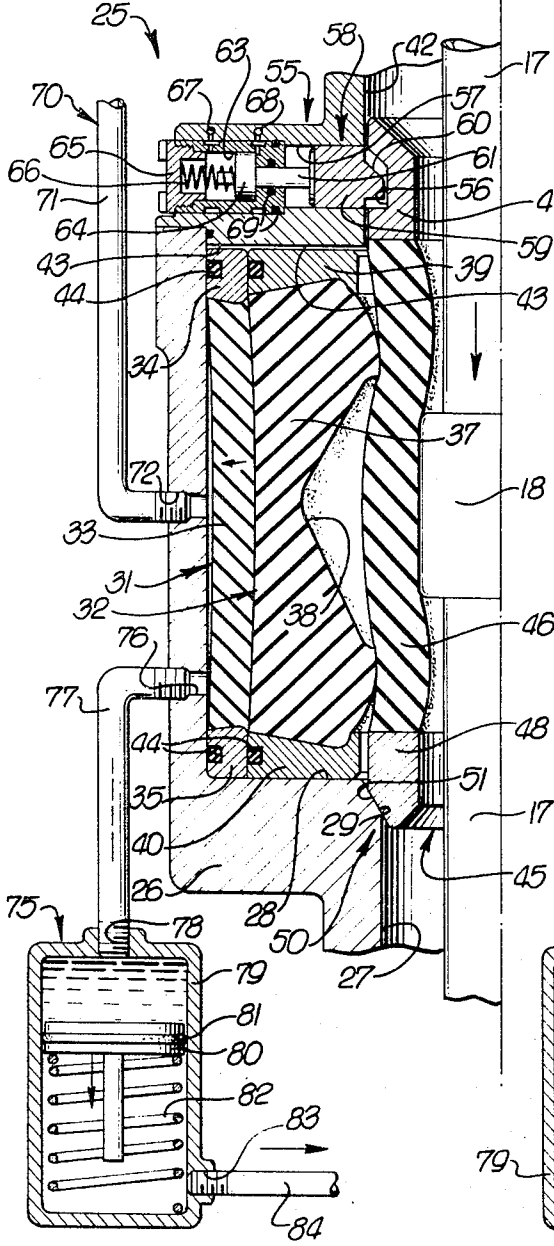
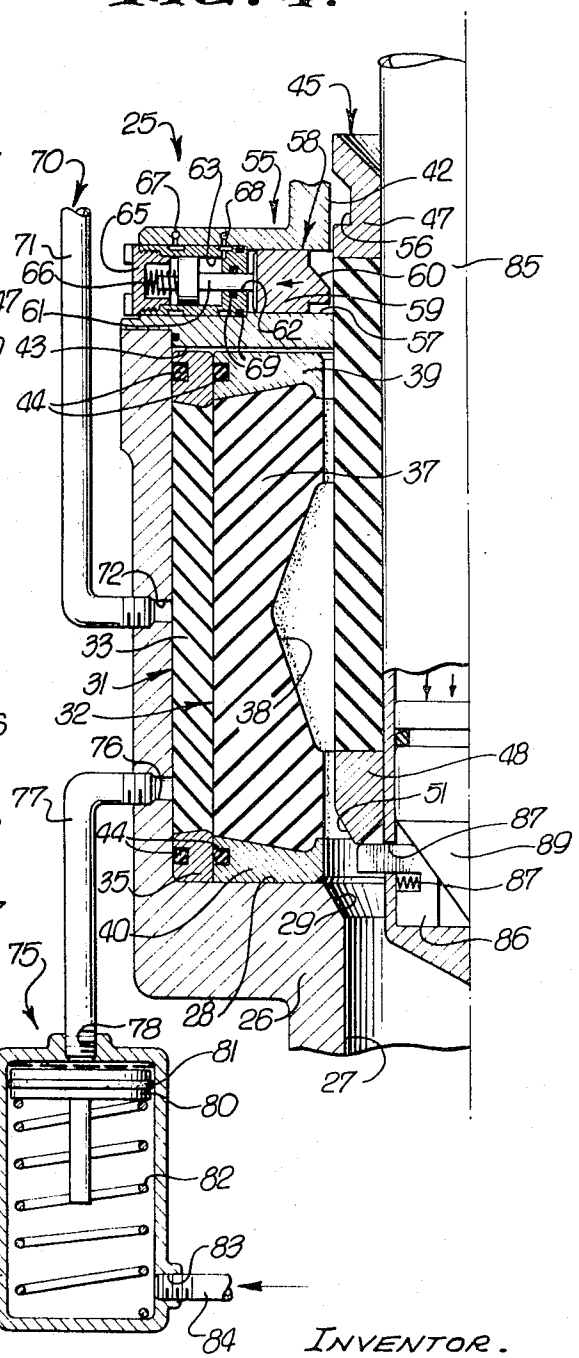


FIG. 4.



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TOOL JOINT STRIPPING STATIONARY BLOWOUT PREVENTER WITH A RETRIEVABLE PACKING INSERT

BACKGROUND OF THE INVENTION

This invention relates to stationary blowout preventers and more particularly to a stationary blowout preventer with a retrievable insert therein and a fluid accumulator attached thereto which permits the joints of a pipe tool to be stripped therethrough while a sealing engagement is maintained.

The oil well industry has had a continuing problem, associated with subsea drilling from a floating platform, of providing a suitable stationary blowout preventer that could strip tool joints i.e., pass the enlarged collars joining two pipe tools together, through the packing of the blowout preventer while the packing maintained a sealing engagement around the pipe tools and the tool joint. A subsea blowout preventer is mounted on the wellhead over the wellhole at the bottom of the sea and is used to hold the pressure within the well and to exclude the water therefrom. The stationary blowout preventer utilizes a radially compressible rubber packing unit which, in response to hydraulic fluid pressure from the surface, expands radially inwardly about a well tool inserted therethrough to sealingly engage the well tool. The well tool so engaged is commonly made up of a series of lengths of pipe tools joined together by collars or tool joints which usually have a larger diameter than the pipe tools themselves. When the subsea blowout preventer is closed about a drill pipe tool run therethrough, sooner or later a pipe tool joint must pass through the blowout preventer.

In the past, a string of stationary blowout preventers have been provided so that one blowout preventer may be open to admit the tool joint therethrough while others maintain the seal and so on until the tool joint is through the blowout preventer string. However, if the tool joint is in a position close to the blowout preventer, the vertical motion of the floating platform because of waves is transferred to the pipe tool and pulls the tool joint back through the blowout preventer. When this occurs, conventional blowout preventers are damaged, sometimes to the point of being inoperative, and must be replaced by dismantling the wellhead on the bottom of the sea.

Therefore, it is the primary object of this invention to provide a subsea stationary blowout preventer that will strip tool joints therethrough when closed.

It is another object of this invention to provide such a blowout preventer which will maintain a seal around the drill pipe as the tool joint is being stripped therethrough.

It is yet another object of this invention to provide such a subsea stationary blowout preventer that will strip a tool joint therethrough without damage to the preventer to make it inoperative.

It is a further object of this invention to provide such a subsea stationary blowout preventer with a retrievable packing insert which will strip tool joints therethrough.

It is yet a further object of this invention to provide such a blowout preventer with such a packing insert which is automatically properly positioned within the blowout preventer as it is lowered therethrough.

It is yet another object of this invention to provide such a blowout preventer with such a packing insert which is releaseably latchingly maintained therein after positioning.

It is yet a further object of this invention to provide such a stationary blowout preventer with such a packing insert having an accumulator system which absorbs the incompressible fluid maintaining the packing in sealing engagement with the pipe therethrough and returns the fluid so absorbed to maintain the pressure and the sealing engagement between the packing and the pipe tool after the joint has passed therethrough.

It is yet another object of this invention to provide such a stationary blowout preventer with such a packing insert which may, in an emergency, be used as a rotary blowout preventer, with the wear on the packing seal from the rotating pipe therethrough being on the retrievable packing insert which is replaceable from the surface.

SUMMARY OF THE INVENTION

The stationary blowout preventer of this invention has a radially compressible annular packing mounted therein and a central bore therethrough for receiving a retrievable packing insert to seal about a tool run thereto upon radial compression of the annular packing by hydraulic fluid pressure. The retrievable packing insert is automatically positioned by the engagement of a landing shoulder thereof with the bore of the blowout preventer and releaseably latchingly secured to the blowout preventer by hydraulically releasable dogs engaging a latching notch in the packing. The blowout preventer is also provided with an accumulator apparatus which absorbs the surge pressure and excess hydraulic fluid as a tool joint passes through the pacing insert and the blowout preventer and returns the fluid afterward to maintain the sealing engagement therebetween.

These and other objects and advantages of the stationary blowout preventer of this invention will become apparent from the following detailed description and drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a schematic representation, in elevation, of a floating vessel positioned above a subsea well having a wellhead with an improved stationary blowout preventer apparatus according to this invention;

FIG. 2 is an enlarged cross section elevational view of the stationary blowout preventer apparatus of FIG. 1 taken along the plane II—II;

FIG. 3 is a view of a portion of FIG. 2 showing a drill pipe and collar passing through the stationary blowout preventer apparatus of FIG. 1; and

FIG. 4 is a view similar to FIG. 3 showing a retrieving tool removing the packing insert from the stationary blowout preventer apparatus of FIG. 1.

Referring now to the aforedescribed FIGS. and especially to FIG. 1, a floating vessel or barge **10** is positioned by suitable anchor means (not shown) in a body of water or sea **11** over a wellhole **12** in the sea bottom **13** and having mounted thereover a subsea wellhead **14**. A conventional drilling rig **15** is provided on the barge or vessel **10** for running a conduit riser **16** from the barge **10** to the wellhead **14** to guide individual lengths of drill pipe tools **17** connected together by collars **18** into the wellhead **14**. The conduit riser **16** also contains hydraulic pressure lines **19** and return lines **20** therein for connection to the subsea wellhead **14**.

The subsea wellhead **14** includes an improved stationary blowout preventer apparatus with a stationary blowout preventer **25**, a removable or retrievable packing insert **45**, means positioning the insert **50**, and latching means for releasably latching the insert **45** therein. The blowout preventer **25** also has connected thereto a fluid accumulator means **75** for absorbing the surge pressure caused by a pipe collar passing through the packing insert **45** of the blowout preventer **25** and then restoring the pressure to the blowout preventer **25** and the packing insert **45**.

As best illustrated in FIG. 2, the stationary blowout preventer apparatus **25** includes a preventer body or housing **26** having a lower central bore **27** meeting a horizontal annular surface **28** at a chamfered landing shoulder **29**, and an upper cylindrical internal surface **30** extending upwardly from the annular surface **28** to the open top of the preventer body **26**.

An annular packing unit indicated generally at **31** is inserted into the open top of the preventer body **26**. The packing unit is of the pure bag or balloon type and an outer annular or tubular element **32** having a central rubber portion **33** mounted between upper and lower reinforcing rings **34** and **35**. An inner annular or tubular element **36** is positioned within the

outer tubular element 32 and also contains a central rubber portion 37 with a radially inwardly opening V-notch 38, and upper and lower reinforcing rings 39 and 40.

A preventer cap 41 is conventionally mounted by bolts to the preventer body 26 to close the open upper end thereof. The preventer cap 41 has an upper central bore 42 axially aligned with the center bore 27 of the preventer body 26 but of a slightly larger diameter and a flat annular surface 43 which is parallel to the horizontal annular surface 28 of the preventer body 26 but spaced a distance therefrom to form a housing chamber. The two horizontal annular surfaces 28 and 43 engage the upper and lower, inner and outer rings 39 and 34 and 35 and 40, respectively, to locate and maintain the packing unit 31 in a housing chamber within the blowout preventer 25. A suitable number of seals 44 are provided to seal the cap 41, the rings 28, 34, 39 and 43 and the body 26.

The removable or retrievable packing insert 45 is annular or tubular in shape and includes a central rubber portion 46, mounted between a rigid upper ring 47 and a rigid lower ring 48. The insert 45 has an external diameter slightly less than the internal diameter of the upper central bore 42 but slightly greater than the internal diameter at the lower central bore 27, and an internal diameter greater than both the external diameter of the drill pipe tools 17 and the collars or tool joints 18.

The packing insert 45 is for insertion into the stationary blowout preventer 25 and includes means, indicated generally at 50, for properly positioning the insert within the stationary blowout preventer 25. In the preferred embodiment, the means for positioning the packing insert 50 includes a chamfered landing shoulder 51 on the lower metal ring 48 and the chamfered landing shoulder 29 of the preventer body 26 which engage, because the lower ring 48 has a greater diameter than the lower central bore 27, as the retrievable packing insert 45 is slid into the blowout preventer 25. This engagement halts downward movement of the packing insert 45 at the proper position within the blowout preventer 25.

The blowout preventer 25 and the packing insert 45 have latching means, indicated generally at 55, associated therewith for releasably latching the packing insert 45 to the stationary blowout preventer 25. In the preferred embodiment, the latching means 55 includes a circumferentially outwardly opening latching notch or groove 56 on the upper ring 47, and radial openings 57 through the preventer cap 41 containing movable dog means 58 for releasable engagement with the latching notch or groove 56.

The movable dog means 58 includes a dog 59 slidably inserted in each radial opening 57. The dog 59 has a downwardly sloping radially inwardly extending nose 60 for mating insertion into the latching notch 56. The dog 59 is connected to a piston rod 61 extending radially outwardly therefrom and through an opening 62 in a hollow cylinder 63 secured to the preventer cap 41 in each opening 57. The outward end of the piston rod 61 is conventionally attached to a piston 64 movably positioned with the cylinder 63.

The cylinder 63 has its outward end closed by a cylinder cap 65 having a spring 66 extending radially inward from the end thereof and engaging the radially outward end of the piston 64 to bias the piston 64 radially inwardly and thereby bias the dog 59 also radially inwardly. The cylinder 63 has a pair of openings 67 and 68 adjacent either end of the cylinder, operably connected to surface-controlled fluid supply lines (not shown) part of the pressure lines 19. The cylinder piston assembly is provided with a suitable number of seals 69 to prevent the escape of fluid or pressure therein.

The dog 59 is moved from the latching position shown in FIGS. 2 and 3, radially outwardly to the open position shown in FIG. 4 against the biasing action of the spring 5 by a differential fluid pressure via the openings 67 and 68, and upon release of the differential fluid pressure is returned to the latching position of FIGS. 2 and 3 by the biasing of spring 65.

The stationary blowout preventer 25 also has means indicated generally at 70 associated therewith or selectively applying hydraulic fluid pressure thereto. In the preferred embodiment, the means 70 includes a pressure line 71, one of the pressure lines 19, is attached to the preventer body 26 and supplies fluid under pressure through inlet opening 72 in the preventer body 26 to the space between outward surface of the rubber portion 33 of the outer element 32, and the upper cylindrical internal surface 30 of the preventer body 26, as is best seen in FIG. 1.

The fluid accumulator means 75 includes an outlet opening 76 through the preventer body 26. A line 77 from the opening 76 conducts the fluid into an opening 78 in the upper end of an accumulator cylinder 79. The accumulator cylinder 79 has a vertically slidable piston 80 therein suitably sealed by seals 81 to maintain the fluid in the cylinder 79 on the top thereof. A spring 82 is mounted within the cylinder 79 between the bottom of the piston 80 and the bottom of the cylinder 79 to bias the piston 80 upwardly. The cylinder 79 also has a lower opening 83 to line 84 containing pressurized gas which acts as a balance between the spring 82 and the fluid above the piston 80.

As the pressure on the fluid in the blowout preventer 25 increases, it drives the piston 80 lower against the biasing of the spring 82 and the pressurized gas to permit more of the fluid to escape out of the blowout preventer 25. Conversely, when the pressure on the fluid in the blowout preventer drops, the biasing of spring 82 and the pressurized gas raises the piston 80 to drive the fluid thereabove back into the blowout preventer.

The packing insert 45 is slid in the stationary blowout preventer 25 from the vessel 10 by sliding a drill pipe tool 17 therethrough and then mounting a pin sub (not shown) below the packing insert 45 and above the bit (not shown). The drill pipe tool 17 with the packing insert 45 is lowered down the conduit riser 16. As the lower ring 48 of the packing insert 45 reaches the blowout preventer 25, the landing shoulder 51 engages the sloping nose 60 of the dog 59 and slides it radially outwardly against the biasing of the spring 66 in the open position permitting the packing unit 45 to pass thereby.

As best seen in FIG. 4, the packing insert 45 slides through the upper central bore 42, and through the blowout preventer 25 until landing shoulder 51 engages the chamfered landing shoulder to halt the downward movement of and position the packing insert 45 properly in the blowout preventer 25.

When the packing insert 45 is being positioned within the stationary blowout preventer 25, the slope nose 60 of the dog 59 is slid radially inwardly by the spring 66 into latching notch 56 which is simultaneously aligned therewith. The nose 60 of the dog 59 engages the latching notch 56 on the upper ring 47 to hold the insert 45 within the blowout preventer 25.

The blowout preventer 25 is actuated from the surface vessel 10 by hydraulic fluid under pressure supplied through pressure line 71, through inlet opening 72 into the stationary blowout preventer 25 space between the upper cylindrical internal surface 30 and the outward surface of the central rubber portion 33 of the outer tubular element 32 to expand the outward surface of the rubber portion 33 in the outer tubular element 32 bulging the center thereof radially inwardly to bulge the rubber portion 37 of the inner tubular element 36 radially inwardly to press the central rubber portion 46 to the packing insert 45 radially inwardly until the inner surface thereof sealingly engages the drill pipe 17 run therethrough. The pressure on the exterior surface of the rubber 33 of the outer element 32 is also exerted on the piston 80 of the fluid accumulator 75 but is balanced by the spring 82 and the gas pressure from the well.

If, for some reason, such as the vessel 10 bobbing up and down on the surface of the sea 11, a collar or tool joint 18 is forced through the blowout preventer 25, as is shown in FIG. 3, the passage of the collar 18 locally expands the center rubber portion 46 of the retrievable packing insert 45 with the balance of the center rubber portion 46 surrounding the pipe 17 to sealingly engage the pipe tool 17 and the collar 18 as the collar 18 passes therethrough. The bulging of the rubber 46 in turn presses against the rubber portion 37 of the inner tubular

element 36 to press against the rubber portion 33 of the outer tubular element 32 to raise the hydraulic pressure between the outward surface of the rubber portion 33 and the internal surface 30 of the preventer body 26. Because the fluid is essentially incompressible in order for any expansion of the rubber portions 46, 37 and 33 to occur, the surge pressure applied to the fluid must exhaust some of the fluid therein. The fluid should not be forced up the pressure line 71, and so it exhausts into the fluid accumulator 75 through the opening 76 and the line 77 and opening 78 into the cylinder 79 on the upper side of the piston as is shown in FIG. 3. The piston 80 is driven downwardly thereby against the biasing of spring 82 in the pressure of the wellhead 14 as has been previously explained.

Once the collar 18 is through the blowout preventer 25, the additional pressure is released and the biasing of the spring 82 and the gas pressure in the wellhead 14, acting against the bottom side of the piston 80, returns the fluid above the piston 80 via opening 78, line 77 opening line 76 to the space between the rubber portion 33 of the outer element 32 and the upper cylindrical internal surface 30 of the preventer body 26 to maintain the central rubber portion 46 of the packing unit 45 in sealing engagement with the pipe 17. This action occurs as many time as the collar 18 on the drill pipe 17 is forced through the blowout preventer 25.

If after repeated use, the rubber portion 46 of the packing insert 45 is thought to be worn, the pacing insert 45 may be removed from the blowout preventer 25 for inspection at the surface. To remove the packing insert 45, the pressure in the pressure lines 19 is released, permitting the central rubber 46, the rubber 37, and the rubber 33 to return to the open position shown in FIG. 4.

A retrieving tool 85 is attached to the drill pipe 17. The retrieving tool 85, as shown in FIG. 4, includes radially movable flanges 86 extending through openings 87 in the retrieving tool 85. The flanges 86 are biased by springs 88 radially inwardly. The retrieving tool 85 also contains a wedge 89 which drives the flanges 86 radially outwardly against the spring biasing.

The retrieving tool 85 is lowered through the packing insert 45 with the flanges 86 retracted, and the wedge 89 is driven downwardly spreading the flanges 86 radially outwardly until they will engage the lower metal ring 48 of the packing insert 45. With the flanges 86 of the retrieving tool 85 extended radially outwardly, the tool 85 is raised until the flanges 86 thereof engage the lower metal ring 48.

The latching means 55 is then released by supplying fluid under pressure through opening 68 to the radially inward end of the piston 64 moving the piston 64, the piston rod 61 and the dog 59 radially outwardly against the biasing of spring 65, to move the sloped nose 60 out of the latching notch 56 in the upper metal ring 47. As seen in FIG. 4, this releases the packing insert 45, so that the retrieving tool 85 and the packing insert 45 can be raised by raising drill pipe 17 using derrick 15 to the barge or vessel 10 where the insert 45 can be inspected and replaced if need be by repeating the insertion operation.

Thus the improved stationary blowout preventer according to this invention adds a retrievable packing insert with means positioning the packing insert within the blowout preventer and latching means securing the packing insert within the blowout preventer, and adds a fluid accumulator to facilitate the action of the packing insert in allowing the collar of a drill pipe to pass therethrough without breaking the sealing engagement between the rubber of the packing insert and the drill pipe.

I claim:

1. In a blowout preventer apparatus having a radially compressible annular packing mounted within a housing chamber, said housing having an upper and lower bore communicating with said chamber and being axially aligned with each other and with said annular packing to receive a tool therethrough about which such packing is adapted to seal, the improvement comprising the provision of:

an annular packing insert of rubberlike material concentrically positioned within said preventer apparatus annular packing, said insert being provided with an end ring of rigid material having a circumferential latch dog receiving latching notch, and

means associated with said preventer apparatus for removably positioning said insert within said preventer apparatus packing whereupon said insert seals about a tool run therethrough upon radial compression of said preventer apparatus packing about said packing insert, said preventer apparatus being provided with latching means including a radially movable dog means for engaging said latching notch to releasably secure said insert within said apparatus.

2. The apparatus of claim 1 wherein:

said preventer apparatus is provided with a landing shoulder in said lower bore below said preventer packing and said radially movable dog means is movable into and out of said upper bore, and

said packing insert includes upper and lower rigid end rings at opposite ends thereof, said upper ring including the circumferential dog receiving notch to receive said dog means when aligned thereto and said lower ring having a

3. In a blowout preventer having a packing radially compressed by fluid, the improvement comprising the provision of:

a resilient packing insert of tubular configuration sized to pass therethrough a tool or drill pipe and larger tool joints or the like, said insert having rigid end rings at opposite ends thereof, the lower of said end rings having a first landing shoulder for landing on a second landing shoulder in the blowout preventer, and an upper ring having a circumferential latching notch;

hydraulically operated latch means on said preventer having a dog radially movable into and out of latching engagement with said notch;

said packing insert being inserted into said blowout preventer with said first and second landing shoulders positioning said insert, and said latching means and said latching notch maintaining said insert in position whereby said fluid compresses said packing to compress said packing insert about the tool run therethrough; and

fluid accumulator means associated with said preventer for accumulating fluid from said blowout preventer on the running of the tool joint through said insert and said packing to maintain sealing engagement therebetween.

4. The blowout preventer apparatus as in claim 3 wherein said fluid accumulator means returns the said hydraulic fluid after the tool joint is through said blowout preventer apparatus to radially compress the annular packing in sealing engagement about the tool run therethrough.

5. In a subsea well blowout preventer apparatus having a radially flexible annular packing mounted within a housing chamber, said housing having upper and lower bores communicating with said chamber and being axially aligned with each other and with said annular packing to receive a tool having spaced larger diameter portions therethrough and about which such packing is radially compressible, the improvement comprising the provision of:

annular packing insert means having a body of rubberlike radially flexible material with rigid end rings secured thereto for concurrent insertion into said preventer apparatus annular packing through said housing upper bore, said body and end rings having an inner bore therethrough sized to receive said tool large diameter portions freely therethrough when in a relaxed condition; and

means associated with said preventer apparatus and at least one of said insert end rings for removably positioning said insert means within said preventer apparatus packing with said insert bore aligned with said housing bores, whereupon radial compression of said annular packing about said insert means radially compresses said insert

body of rubberlike radially flexible material into sealing engagement about said tool and tool large diameter portions run therethrough.

6. The improvement in blowout preventer apparatus of claim 5 wherein said preventer apparatus includes means for applying hydraulic fluid pressure upon said apparatus packing to compress the same radially about said insert and wherein:

hydraulic fluid accumulator means are associated with said preventer apparatus for receiving hydraulic fluid from said preventer apparatus upon sudden expansion of said insert and apparatus packing due to passage of a tool joint or the like run therethrough; and

wherein said accumulator includes means for maintaining a generally constant internal pressure upon said hydraulic fluid accumulated therein as the volume of hydraulic fluid accumulated in said accumulator changes to thereby maintain the pressure of said hydraulic fluid maintaining a seal between said insert and tool being run therethrough.

7. The improvement in blowout preventer apparatus of claim 5 wherein a riser conduit is connected between the housing upper bore and a vessel or platform at the surface of the sea, and

said annular packing insert means is provided with an external configuration allowing it to be lowered through said riser conduit and housing upper bore into said preventer apparatus packing.

8. The improvement in blowout preventer apparatus of claim 7 wherein:

said means for removably positioning said insert within said preventer apparatus includes latching means associated with the preventer apparatus for latching said insert thereto in response to actuation thereof from a remote location.

9. In a blowout preventer apparatus having an annular packing mounted within a housing chamber and being radially compressible by hydraulic fluid, said annular packing receiving a tool with larger diameter tool portions therethrough, said packing being sized to permit the passage of both said tool and said tool portions therethrough and being adapted to seal against both on radial compression, the improvement comprising the provision of:

hydraulic fluid accumulator means associated with said preventer apparatus for receiving hydraulic fluid from said preventer apparatus upon sudden expansion of said packing due to the passage of the larger diameter tool portions therethrough; and

means associated with said fluid accumulator means for maintaining a generally constant pressure within said accumulator means acting upon said hydraulic fluid accumulated therein to allow receipt of hydraulic fluid from said annular packing into said accumulator while maintaining a generally constant hydraulic fluid pressure within said packing to maintain a seal between the packing and the tool being run therethrough.