ANNULAR BLOWOUT PREVENTER WITH UPPER AND LOWER SPHERICAL SEALING SURFACES

The invention relates to blowout preventers.

U.S. Patent No. 3,667,721 generally describes an annular blowout preventer for closing and sealing on an open hole, a casing, drill pipe, tubing, or kelly in which the inner surface of the upper housing is a spherical surface.

The invention provides a blowout preventer adapted for use on an oil or gas well rig and having a lower housing, an upper housing, a resilient sealing means positioned between the housings, and piston means for actuating said sealing means, wherein the inner surface of the upper housing has a spherical surface,

The inner surface of the lower housing has a spherical surface, said spherical surfaces of the upper housing and the lower housing being concentric, and said resilient sealing means includes upper and lower spherical surfaces for co-acting with the spherical surfaces on the upper housing and lower housing, respectively, responsive to engagement of said sealing means by said piston means upon said actuation.

The present invention makes it possible to provide an annular blowout preventer in which the overall height is shorter, the hydraulic volume required to actuate the preventer is reduced by at least 50% thereby reducing the size of the required hydraulic actuating system, the closing time of the blowout preventer is reduced by about 50%, and the cost of the blowout preventer is substantially reduced.

According to a feature of the invention, the sealing means may include steel segments extending between the top and bottom of the sealing means in which the top and bottom of the steel segments have spherical surfaces.

According to further features of the invention, the blowout preventer may have a lower housing, an upper housing, a resilient sealing means positioned between the housings, a vertical bore coaxially positioned through the housing, and a vertically acting piston for actuating the sealing means in which the inner surface of the upper housing has a spherical surface extending to the bore, and the inner surface of the lower housing has a spherical surface extending to the bore, the spherical surfaces are concentric. The sealing means may include steel segments extending between the top and bottom o the sealing means and the top and bottom of the sealing means and of the steel segments are concentric spherical surfaces coacting with the spherical surfaces on the upper and lower housings. The upper and lower housings may each include a vertical

wall extending downwardly from the spherical surfaces on the upper and lower housings, and the vertically moving piston sealingly engages the vertical walls.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic view of subsea drilling rig in which a blowout preventer embodying the present invention may be used,

Figure 2 is an elevational view in cross section of a preferred embodiment of the present invention in the open and non-sealing position with a drilling string within the apparatus,

Figure 3 is a fragmentary elevational view, partly in cross section, taken along the line 3-3 of Figure 2,

Figure 4 is a fragmentary elevational view, in cross section, illustrating the blowout preventer of the present invention in the closed position around the drilling string,

Figure 5 is a fragmentary elevational view, in cross section, illustrating the blowout preventer of the present invention in a closed position in the open bore, and

Figure 6 is an enlarged perspective view of the metallic translating segments of the sealing element.

A blowout preventer according to the present invention is generally indicated by the reference numeral 10 and as shown in

Figure 1, for example only, as used in an offshore subsea drilling operation in which the blowout preventer 10 is actuated from a floating drilling rig 11 by control lines 12 and 14. However, the present apparatus 10 may be used on all types of drilling rigs whether they are underwater or not.

The blowout preventer 10, as best seen in Figure 2, may include an upper housing 16, and a lower housing 18, which are releasably secured together by a locking mechanism generally indicated by the reference numeral 20.

Axially aligned well tool receiving ports 22 and 24 are provided in the upper housing 16 and the lower housing 18, respectively, for receiving a well tool or drilling string 26 adapted to be axially moved within a coaxial bore 28 in the housings 16 and 18.

The sealing element generally indicated by the reference numeral 30 includes a resilient sealing means 32 positioned between the upper housing 16 and the lower housing 18 and is adapted to be selectively moved between a non-sealing position, as shown in Figure 2, to a sealing position, as shown in Figures 4 and 5. The sealing means 32 may include a continuous ring of resilient material such as natural or synthetic rubber. The seal 32 includes an inner bore 34 approximately equal to the diameter of the housing bore 28.

The sealing element 30 also includes a plurality of radially spaced translating means or steel segments 36 which are provided for slideably cooperating with the upper housing 16 and the lower housing 18 for converting vertical movement of an actuating means such as piston 38 into an inward motion of the sealing means 30 to provide a seal in the housing bore 28. Preferably, the radially spaced steel segments 36 are bonded to the resilient sealing ring 32. The actuating means or piston 38 is double acting and is moved vertically by fluid control lines

12 and 14.

While any suitable locking means may be utilized to secure the upper housing 16 to the lower housing 18 and seat the upper housing 16 on an adapter ring 40, the locking means may include an outer latch ring 42 having angled teeth which coact with a locking groove 44 in the lower housing 18, a locking ring 46 having a tapered surface which engages the tapered back surface of the latch ring 42 and bolts 48 for securing the locking ring to the upper body 16.

The inner surface 50 of the upper housing 16 includes a spherical surface which extends to the bore 28. In addition, the inner surface 52 of the lower housing 18 includes a spherical surface 52 which extends to the bore 28. The spherical surfaces 50 and 52 are concentric and serve to guide and control the path of movement of the sealing element 30.

In addition, the sealing means 30 include an upper surface 54 in which both the resilient sealing means 34 and the steel segments 36 have a spherical surface which conform to and coact with the spherical surface 50 of the upper housing 16. Similarly, the sealing means 30 including the resilient sealing means 32 and the steel segments 36 have a lower surface 56 which is spherical and coacts with the lower spherical surface 52 on the lower housing 18.

The metallic translating means or steel segments 36 as best seen in Figures 2-6, generally include a base 60 having a curved spherical surface 62 mating with spherical surface 52 and a top 64 having a curved spherical surface 66 which coacts with the spherical surface 50. The base 60 and top 64 are joined by a web 68. the surfaces 62 and 66 coact with the surfaces 52 and 50 to provide a low friction, metal-to-metal sliding surface during the inward closing action of the sealing element 30 to smoothly guide the sealing element 30 between the spherical

surfaces 50 and 52.

The inner surface of the upper housing 16 also includes a vertical wall 70 extending downwardly from the spherical surface 50. The inner surface of the lower housing 16 also includes a vertical wall 72 extending downwardly from the spherical surface 52. The vertically moving piston 38 sealingly engages the vertical walls 70 and 72 and moves from the contracted position shown in Figure 2 to the set position shown in Figures 4 and 5 into the space between the spherical surfaces 50 and 52. It is to be noted that the spherical surfaces 50 and 52 control and restrict the movement of the sealing element 30 to more positively control the movement and sealing action as the piston 38 moves upwardly as best seen in Figures 4 and 5. In addition, the structure of the present invention reduces the overall height of the blowout preventer 10, reduces the hydraulic volume required to close the blowout preventer 10 by at least 50% thereby decreasing the size of the controlling hydraulic system, and decreases the closing time by about 50% as well as providing a blowout preventer which costs substantially less. After initial sealing is achieved, pressure acting on the underside of the piston 38 aids in maintaining the blowout preventer in the sealed position. Opening of the preventer 10 is achieved by moving the piston 38 downwardly towards its initial position and the elastic characteristics of the sealing means 32 causes it to move outwardly between its containing two spherical surfaces 50 and 52 to the open position..



CLAIMS

1. A blowout preventer adapted for use on an oil or gas well rig and having a lower housing, an upper housing, a resilient sealing means positioned between the housings, and piston means for actuating said sealing means, wherein the inner surface of the upper housing has a spherical surface,

the inner surface of the lower housing has a spherical surface, said spherical surfaces of the upper housing and the lower housing being concentric, and said resilient sealing means includes upper and lower spherical surfaces for co-acting with the spherical surfaces on the upper housing and lower housing, respectively, responsive to engagement of said sealing means by said piston means upon said actuation.

2. A blowout preventer as claimed in Claim 1 wherein the sealing means includes steel segments extending between the top and bottom of the sealing means and the top and bottom of the steel segments have spherical surfaces.

3. A blowout preventer adapted for use on an oil or gas well rig and having a lower housing, and upper housing, a resilient sealing means positioned between the housings, a vertical bore coaxially positioned through the housings, and vertically acting piston means for actuating said sealing means, wherein the inner surface of the upper housing has a spherical surface extending to the bore,

the inner surface of the lower housing has a spherical surface extending to the bore,

the spherical surfaces of the upper and lower housings are concentric,

the sealing means include steel segments extending between the top and bottom of the sealing means, the top and bottom of the sealing means and of the steel segments being spherical surfaces coacting with the spherical surfaces on the upper and lower housings, and

said vertical moving piston is movable into the space between the spherical surfaces on the upper and lower housing

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for moving the sealing means towards the bore.

4. A blowout preventer as claimed in Claim 4 wherein the upper and lower housings each includes a vertical wall extending downwardly from the spherical surfaces on the upper and lower housings, and said piston sealingly engages the vertical walls.

5. A blowout preventer substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

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