3,399,901 TUBING BLOWOUT PREVENTER

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ABSTRACT OF THE DISCLOSURE

This blowout preventer used in oil and gas wells has a hollow body with a vertical bore and has coinciding lateral bores communicating with the vertical bore. In each lateral bore, there is a ram assembly and a seal assembly.

In one form of the invention, the ram assembly, for moving the seal assembly relative to the vertical bore, has an end plate slideable within the lateral bore and has a feed screw housing also slideable within the lateral bore with an outer elongated threaded end extending freely through the end plate. The feed screw housing is positioned within the lateral bore intermediate the end plate and a back plate. A feed screw is attached rotatably to the back plate and extends through the feed screw housing and its outer elongated end. A yoke element is dropped through an opening in the housing defining the lateral bore to lock the end plate in place so that by tightening a nut on the outer elongated threaded end of the feed screw housing, the feed screw housing and the end plate are drawn together to compress a packing therebetween into sealing engagement with the lateral bore.

Each seal assembly includes a top plate and a lower plate positioned on opposite sides of a resilient sealing element. A pin extends through the back plate of the ram assembly and attaches the top plate thereto. A similar pin attaches the lower plate to the back plate, so that both the top plate and the lower plate are movable relative to the sealing element.

This invention is concerned with a blowout preventer to be installed on a well head to confine pressure in the well, and is particularly concerned with a blowout preventer intended to be installed on the tubing head at the top of the well, and is arranged to provide a seal about a tubing string, a polished rod, wire line, or a like member extending therethrough; or it may be provided with solid rams therein which will close off the passage above the tubing head.

The blowout preventer hereinafter described and claimed is particularly designed for use in high temperature treatment of wells such as steam injection, down hole heater procedure, and in high temperature production installations wherein both the pressure and temperature to be confined are unusually high.

Means are provided to permit well pressure to communicate with the rear sides of the ram sealing members with the rams closed in order to allow the well pressure to assist in making the seal, to increase the sealing effect proportional to the increase in pressure from below, or to compensate for wear and deterioration of the seals on the rams.

It is therefore, a primary object of the invention to provide a blowout preventer wherein the pressure in the well therebelow is allowed to communicate with the area behind the rams while the rams are in sealing position to thereby permit the well pressure to assist in maintaining a tight seal by the ram sealing elements.

Another object of the invention is to provide in a tubing blowout preventer means whereby the rams are not sealed about their outside diameter until they are in closed position thereby facilitating the movement of the rams into closed position.

Still another object of the invention is to provide in a tubing blowout preventer a ram assembly wherein the upper and lower support plates thereof are permitted to move longitudinally with reference to the sealing material while the ram is being moved to closed position to thereby permit constantly applied compressive sealing force on the ram sealing material while being moved to closed position.

Another object of the invention is to provide in a tubing blowout preventer ram sealing assemblies which are easily removed and disassembled to permit the ram sealing element to be quickly and easily replaced.

A still further object of the invention is to provide in a tubing blowout preventer means for quickly and easily removing the ram assemblies and feed screws therefore to permit the changing of ram sealing assemblies and elements.

A general object of the invention is to provide a relatively inexpensive, easily operable and easily serviceable, yet highly effective, blowout preventer, which will contain extremely high pressures encountered in steam injection, downhole heater and high temperature production installations, as well as pressure in wells wherein high bottom hole pressure is encountered.

Other and further objects of the invention will become apparent upon reading the detailed specification hereinafter following and by referring to the drawings annexed hereto.

A suitable embodiment of the invention is shown in the attached drawings wherein,

FIGURE I is a half-sectional elevational view of the blowout preventer assembly as it would appear when attached to the well head, and wherein the rams are in sealing position about a polished rod,

FIGURE II is a perspective exploded view of one form of the ram sealing assembly which includes the ram sealing element and the upper and lower support plates therefor,

FIGURE III is an end elevational view of the upper support plate for the ram sealing assembly,

FIGURE IV is a cross-sectional elevational view taken along the line IV—IV of FIGURE III,

FIGURE V is a front end elevational view of the raw sealing element;

FIGURE VI is a side elevational view of the ram sealing element;

FIGURE VII is an end elevational view of the bottom support plate for the ram sealing assembly;

FIGURE VIII is a cross-sectional elevational view taken along the line VIII—VIII of FIGURE VII, and

FIGURE IX is an inner end elevational view of the back support plate for the ram sealing assembly.

Numerical references are employed to indicate the various parts shown in the drawings and like numerals indicate like parts throughout the various figures of the drawings.

Referring to the drawings, the numeral 1 indicates a hollow body having a vertical bore 1a therethrough.

Coinciding laterally extending, hollow, cylindrically shaped portions 2 and 3 are a part of, and extend from the body 1, providing aligned circular passages right angularly intersecting the bore 1a. The body 1 also includes hollow cylindrical neck portions 4 and 5 to which are connected the upper flange 6 and the lower flange 13.

A sealing flange 7 is secured to the upper flange 6 by means of threaded studs 11 which extend through coinciding passages in the flanges 6 and 7 and are secured thereto by means of nuts 9 and 10.
A sealing ring 8 is compressed in coinciding grooves 8a and 8b in the opposed faces of the flanges 6 and 7, to provide a seal therebetween.

A section of pipe 12, which may communicate with surface equipment (not shown), is threaded engaged at 12a to the sealing flange 7.

A flange 14, which may be a sealing flange, or which may be a flange at the upper end of a tubing head, is secured to the lower flange 13 by means of threaded studs 15 which are secured thereto by means of nuts 16.

A sealing ring 13a is pressed between coinciding grooves 13b and 13c, provided in the opposed faces of the flanges 13 and 14, to provide a seal therebetween.

The ram sealing assembly (there being one disposed in each of the cylindrical housing portions 2 and 3), includes a deformable resilient sealing element 17 which has an elongated portion 17a with flat upper and lower sides terminated at the inner end, with substantially right angular flanges 18 and 19 (see FIGURE II, V, and VI). Bolt receiving passages 20 and 21 are provided through the flanges 18 and 19 for the purposes hereinafter mentioned.

A semi-circular recess 23 is provided on the inner end of the extension portion 17a, which is arranged to receive the polished rod 24, or other tubular or rod-like element, about which the ram sealing elements may be sealed.

A top support plate 25 made of rigid material has a flat lower face 25a and a rounded upper face 25b, and a semi-circular recess 26 on the inner end thereof. The forward part of the upper surface is sloped slightly forward as indicated at 25c to facilitate the inward movement thereof. The top support plate is complementary to the ram sealing element 17 so that when placed in the area between the flange 15 and the outer end of the extension portion 17a it will provide a continuous cylindrical surface to fit within the circular bore of the body portions 2 and 3; and the recess 26 coincides with the recess 23.

Likewise, a bottom support plate 29 has a flat upper face 29a, a rounded lower face 29b and a semi-circular recess 30 on the outer end thereof. The bottom support plate 29 is complementary to the lower surface of the ram sealing element 17 between the lower flange 19 and outer end of the portion 17a so that when assembled therewith it provides a continuous cylindrical surface for slidably fitting in the circular bores of the outwardly extending portions 2 or 3 of the housing.

The circular ram back support plate 33 is made of rigid material and is arranged to abut against the rear side of the ram sealing element 17 and to slidably fit in the bores of the laterally extending portions 2 or 3 of the housing.

The lower support plate 29 has a bore 32 therethrough which communicates with an outer counterbore 31.

The pin 42 extends through the bore 32, counterbore 31, and passage 21 of the sealing element 17. The pin 42 has a threaded end 43 thereon which is threaded engaged with an interiorly threaded passage 37 in the back support plate 33. The pin 42 has an enlarged head 44 thereon which engages the outer end of the bore 32 to limit longitudinal movement therebetween.

The back support plate 33 has a passage 34 therethrough which is arranged to coincide with the passage 20 through the flange 18 of the rubber sealing element 17, and with a bore 27 in the inner end of the upper support plate 25.

The bolt 39 extends through the aligned passages 34, 20 and 27, and has a threaded end 40 thereon which may be threaded engaged with the threaded bore 28 in the inner end of the bore 27. The bolt 39 has an enlarged head 41 thereon, which is arranged to enter the counterbore 35 at the outer end of the bore 34, and limits the longitudinal movement between the bolt 39 and the back support plate 33.

A slot 36, which is open at its lower end, is provided on the rear face of the back support plate 33 and has an overhanging wall 38 about the outer side thereof, which provides a space 38a in which the head 46 of the feed screw 45 may be inserted from the open end of the slot 36 to provide a disengageable connection between the back plate 33 and the feed screw 45.

The feed screw housing 47 is threaded engaged at 45a about the feed screw 45 and has an annular lip 45b on the inner end thereof which is slidable disposed with relation to the inner surface of the lateral housing portions 2 or 3, as the case may be.

A gland 49 is slidable disposed in the outer end of the housing portions 2 or 3 and about the feed screw housing 47.

The resilient packing rings 50 are clamped between the annular flange 45b on the feed screw housing 47 and the inner end of the gland 49.

To compress the packing 50, a packing nut 51 is threaded engaged about the threaded end 52 of the feed screw housing 47 to move the lip 45b toward the inner end of the gland 49.

Packing rings 55 are disposed about the reduced diameter extension 48 of the feed screw 45, said packing rings 55 and end spacer rings 55a being disposed within a counterbore 47a provided in the outer end of the feed screw housing 47, and are abutted against a shoulder 47b provided by such counterbore.

The packing 55 is retained in place by a gland 56 which may be moved inwardly against the spacer ring 55a to compress the packing 55 by means of a gland nut 57 threaded engaged about the outer end of the feed screw housing 47.

A handle 58 is attached to the outer end of the feed screw 45 by means of a pin 60 which passes through the inner end of the handle and spacer ring 59 disposed about the extension 48 and the pin 60 is secured thereto by means of the snap rings about the ends thereof.

It will be noted that there is a bore 62 extending entirely through the bolt 42 which provides communication between the counterbore 31 and the space 63 at the rear of the ram assembly. Sufficient clearance is provided between the inner side of the support plate 29 and the polished rod 24 or other member about which the ram is disposed to allow communication between the area below the plate and counterbore 31.

The entire ram assembly, including the feed screw assembly, may be inserted in the lateral housing portions 2 or 3 and disengagably attached therein by a U-shaped yoke 53, having spaced legs 53a thereon, which are arranged to pass through coinciding spaced passages 53b and 53c in the wall of the housing portions 2 or 3 and through coinciding passages (not shown) through the end plate 49. The yoke 53 may be retained in place by a retainer pin 54 passed through the ends thereof.

The operation and function of the device hereinbefore described is as follows:

The ram is assembled in the manner shown in FIGURE 1 and inserted in the outward extending housing portions 2 or 3, and is retained therein by the yoke 53.

In order to move the sealing element 17 into sealing engagement about the polished rod 24, or other rod-like or tubular element about which a seal is desired, the feed screw 45 is rotated by the handle 58, thereby moving it inwardly. Such rotation moves the back support plate 33 inwardly, which in turn moves the sealing element 17, top support plate 25 and bottom support plate 29 toward the polished rod 24.

After engagement of the inner surfaces of ram sealing elements 17 with the polished rod 24, the continued forward movement of the back support plate 33 will compress and move the ram sealing element around the polished rod to provide a seal thereabout. The compression
of the sealing element 17 also causes expansion outwardly to provide a seal with the interior diameters of the housing portions 2 and 3.

As the seal 17 is expanded the pin 39 is permitted to move rearwardly through the bores 20 and 34; and the pin 42 is permitted to move forwardly through the bores 31, 50, 55 and counterbore 31. Therefore, the upper support plate 25 and lower support plate 29 are allowed to move with reference to the sealing element 17 as the sealing element is moved inwardly and expanded about the polished rod 24. Therefore, adequate sealing expansion is permitted about the member around which the sealing elements are sealed.

While the detachable sealing elements 17 are sealed about the member 24, it will be observed that pressure from below the sealing element is permitted to pass through the passage 62 through bolt 42 to communicate with the area 63 behind the ram sealing assembly. Therefore, the pressure from below the ram sealing assembly assists in moving the ram inwardly, and in maintaining it in sealing position. Any increased pressure below the ram sealing assembly will act against the inner end thereof to further increase the seal between same and the polished rod 24, or other element about which the seal is made.

The ram assembly may be replaced, or may be removed for replacement of the resilient sealing element 17 by simply loosening nut 51, removing the yoke 53 and withdrawing same from the housing portion 2 or 3.

A ram sealing assembly, consisting of the resilient sealing element 17, top plate 25, bottom plate 29, back plate 33, and bolts 42 and 39 may be removed from a ram assembly and replaced in its entirety by another seal assembly. Individual rubber sealing elements 17 may be quickly and easily replaced in the sealing assembly by simply removing the bolts 39 and 42 to disassemble the sealing element 17 from the plates 25, 29, and 33.

Other and further embodiments of our invention may be devised without departing from the spirit and scope of the appended claims.

Having described our invention we claim:

1. In a blowout preventer, a hollow body having a vertical bore therethrough, coinciding lateral bores communicating with the vertical bore; a ram assembly disengagably supported in each lateral bore; a seal assembly disengagably attached to the end of each ram assembly; means to move the seal assembly inwardly toward the vertical bore; means defining the passage communicating between the area below the seal assembly and the area behind the seal assembly to allow pressure from below the seal assembly to assist in moving the seal assembly inwardly, said ram assembly to move the seal assembly includes an end plate slideable within said lateral bore, feed screw housing means slideable within said lateral bore and having an outer elongated threaded end extending freely through the end plate, a feed screw threadedly engaged in the feed screw housing means; means disengagably attaching the feed screw to the back plate; packing means between said feed screw housing means and said end plate; means threaded on said outer elongated threaded end to move said feed screw housing means and said end plate relative to each other to compress said packing means into sealing engagement with said lateral bore; quick detachable means slideable through the end plate to lock the end plate relative to said lateral bore, and means to rotate the feed screw from exteriorly of the lateral bore.

2. In a blowout preventer, a hollow body having a vertical bore therethrough, coinciding lateral bores communicating with the vertical bore; a ram assembly disengagably supported in each lateral bore; a seal assembly disengagably attached to the inner end of each ram assembly, each seal assembly including a top plate, a lower plate, a back plate and a resilient sealing element disposed between the said plates, an upper connecting pin slideably extending through the back plate and the resilient sealing element and engaged with the top plate; and a lower connecting pin slideably extending through the lower plate and a resilient element and engaged with the back plate, so that the top plate and the lower plate are moveable relative to the sealing element, the edges of the sealing element being exposed between the edges of the said plates; means to move the seal assembly inwardly toward the vertical bore; and means defining the passage communicating between the area below the seal assembly and the area behind the seal assembly to allow pressure from below the seal assembly to assist in moving the seal assembly inwardly.

3. The combination called for in claim 2 wherein a passage extends through the lower connecting pin.

4. The combination called for in claim 1 wherein the means disengagably attaching the feed screw to the back plate comprises an undercut slot in the rear face of the back plate; and a head on the end of the feed screw inscrutable in the slot from the outer open end thereof.

5. The combination called for in claim 1 wherein the ram assembly is disengagably attached in the bore by a withdrawable yoke extending through the wall of the lateral bore and a part of the ram assembly.

6. In a blowout preventer, a hollow body having a vertical bore therethrough, coinciding lateral bores communicating with the vertical bore, a ram seal assembly including, a resilient seal member having a cylindrical end, an upper and lower relieved area on each side thereof spaced from the cylindrical end providing an elongated thinner portion having upper and lower flat sides, upper and lower flanges on the cylindrical end, and diametrically opposite upper and lower bolt receiving passages through the flanges; an upper support plate disposed slideably in the upper relieved area, said upper support plate having a flat inner side coinciding with the upper flat side of the thinner portion, and a curved outer side coinciding with the cylindrical surface on the upper flange; a lower support plate disposed slideably in the lower relieved area and having a flat upper side coinciding with the lower flat side of the thinner portion, and a curved outer side coinciding with the cylindrical surface on the lower flange; a circular back support plate disposed against the inner end of the seal member and having an outer surface coinciding with the outer cylindrical surface on the cylindrical end; upper and lower aligned bolt receiving passages in the back support plate, said upper aligned passages coinciding with the passage through the upper flange, and the lower aligned passages coinciding with the passage through the lower flange, a pin slideably extending through the upper flange passage and the coincident passage in the back plate and being threadedly engaged in the coincident passage in the top plate; and a pin slideably extending through the passage in the lower plate and the coinciding passage in the lower flange and being threadedly engaged in the lower passage in the back support plate.

7. The combination called for in claim 6 with the addition of an undercut slot on the rear face of the back plate which opens from the outer edge of the plate.

8. The combination called for in claim 6 with the addition of a passage through the lower pin.

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