Sept. 3, 1968 M. L. CROW ET AL 3,399,901

TUBING BLOWOUT PREVENTER

Filed May 13, 1965 2 Sheets-Sheet 1

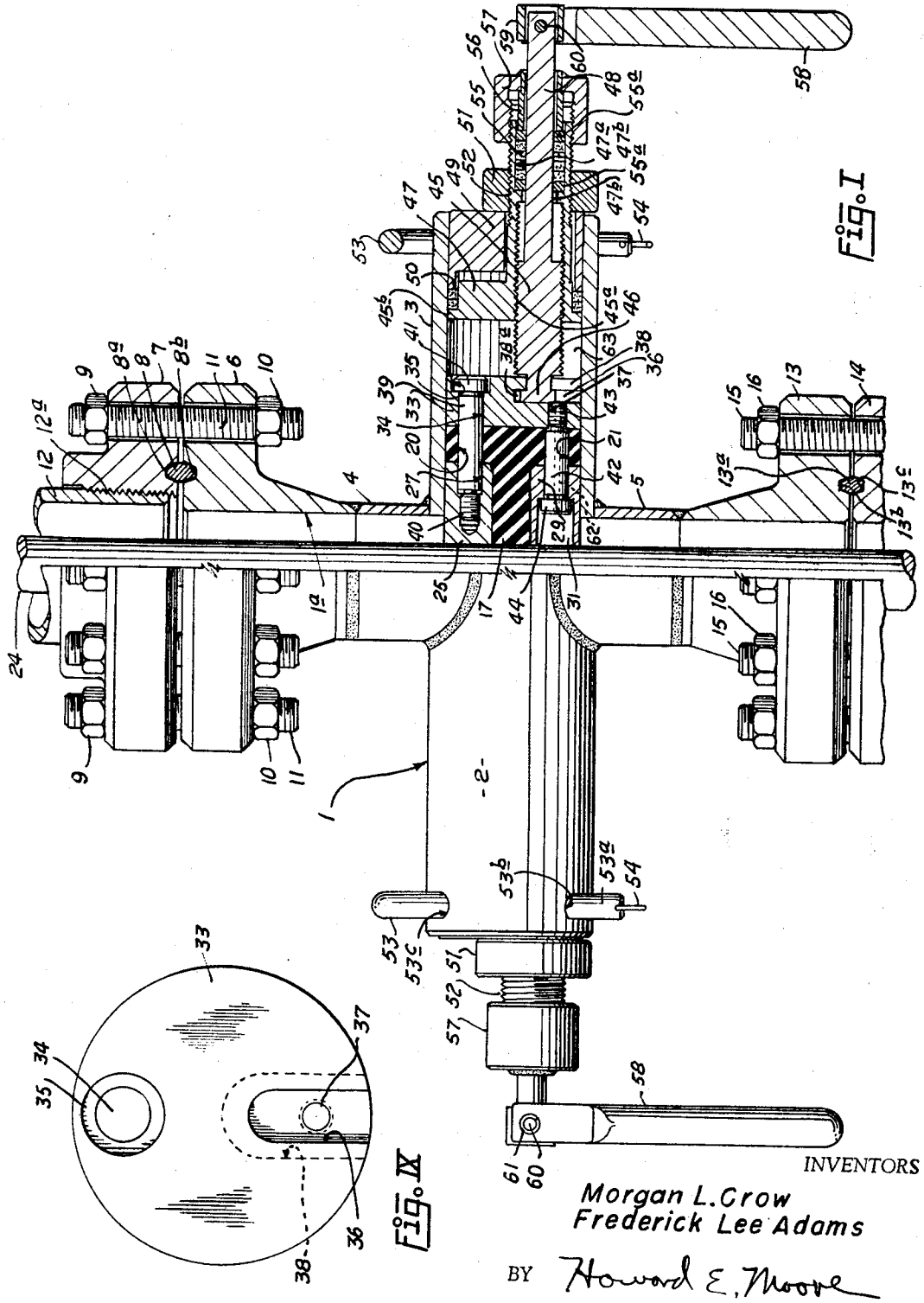

Fig. I

Fig. IX

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TUBING BLOWOUT PREVENTER

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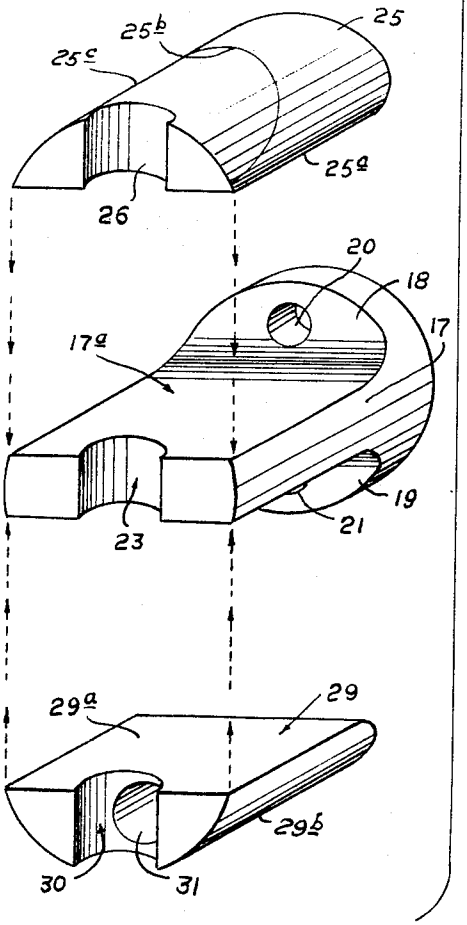

Fig. II

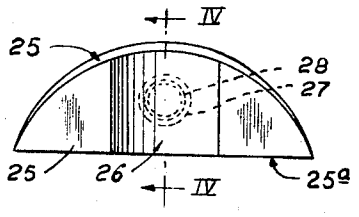

Fig. III

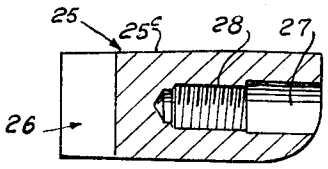

Fig. IV

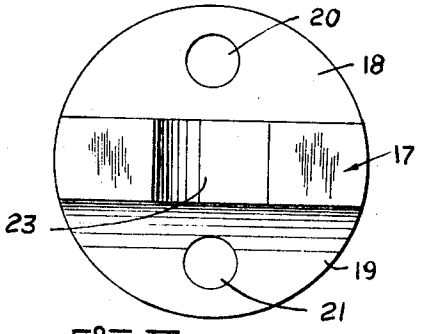

Fig. V

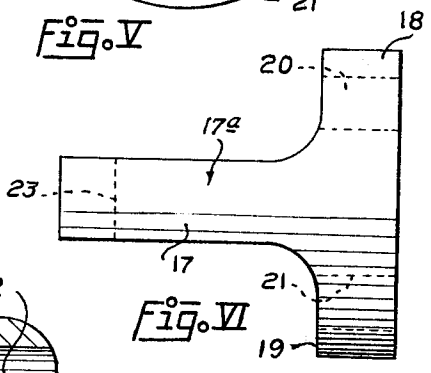

Fig. VI

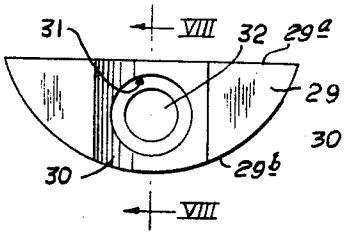

Fig. VII

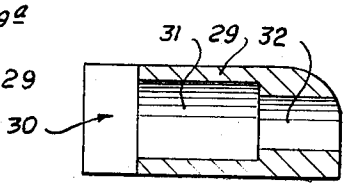

Fig. VIII

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3,399,901

TUBING BLOWOUT PREVENTER

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Filed May 13, 1965, Ser. No. 455,451
8 Claims. (Cl. 277—129)

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.

Still 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 therefor 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 confine 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.

Numeral 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 **1***a* 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 **1***a*. 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 **8***a* and **8***b* 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 threadedly engaged at **12***a* 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 **13***a* is pressed between coinciding grooves **13***b* and **13***c*, 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 **17***a* with flat upper and lower sides terminated at the inner end, with substantially right angular flanges **18** and **19** (see FIGURES 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 **17***a*, 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 **25***a* and a rounded upper face **25***b*, 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 **25***c* 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 **18** and the outer end of the extension portion **17***a* 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 **29***a*, a rounded lower face **29***b* 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 **17***a* 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 threadedly 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 threadedly 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 **38***a* 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 threadedly engaged at **45***a* about the feed screw **45** and has an annular lip **45***b* on the inner end thereof which is slidably disposed with relation to the inner surface of the lateral housing portions **2** or **3**, as the case may be.

A gland **49** is slidably 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 **45***b* on the feed screw housing **47** and the inner end of the gland **49**.

To compress the packing **50**, a packing nut **51** is threadedly engaged about the threaded end **52** of the feed screw housing **47** to move the lip **45***b* 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 **55***a* being disposed within a counterbore **47***a* provided in the outer end of the feed screw housing **47**, and are abutted against a shoulder **47***b* provided by such counterbore.

The packing **55** is retained in place by a gland **56** which may be moved inwardly against the spacer ring **55***a* to compress the packing **55** by means of a gland nut **57** threadedly 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 lower 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 disengageably attached therein by a U-shaped yoke **53**, having spaced legs **53***a* thereon, which are arranged to pass through coinciding spaced passages **53***b* and **53***c* 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 I 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 32 and 21 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 deformable 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 disengageably supported in each lateral bore; a seal assembly disengageably attached to the end of each ram assembly; means to move the seal assembly inwardly toward the vertical bore; means defining a 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 disengageably 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 disengageably supported in each lateral bore; a seal assembly disengageably 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 sealing 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 a 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 disengageably 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 insertable in the slot from the outer open end thereof.

5. The combination called for in claim 1 wherein the ram assembly is disengageably 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 upper, lower and back support plates, 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 coinciding passage in the back plate and being threadedly engaged in the coinciding 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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SAMUEL ROTHBERG, *Primary Examiner.*