NON-ROTATING RAM ROD LOCKING ASSEMBLY FOR BLOWOUT PREVENTER

Assignee: Hydril Company, Houston, Tex.
Filed: Sept. 8, 1971
Appl. No.: 178,713

ABSTRACT

A non-rotating ram rod locking assembly for a blowout preventer having a new and improved means for locking the ram in its sealing position, and means for preventing rotation of the ram rod itself during actuation of the locking assembly.

6 Claims, 5 Drawing Figures
NON-ROTATING RAM ROD LOCKING ASSEMBLY FOR BLOWOUT PREVENTER

BACKGROUND OF THE INVENTION

The field of this invention relates to blowout preventers, and parts thereof.

In U.S. Pat. No. 2,752,119, a blowout preventer is disclosed wherein the preventer ram is prevented from rotating by preventing the piston to which the ram is connected, from rotating, with a rigid connection between the piston and the ram rod and a non-rotating connection between the rod and the ram. Such construction thus places a limitation on the construction of the piston and/or its locking means therewith so that such piston does not rotate in its cylinder. Since it is difficult to maintain a fluid seal if the piston is not round, such prior construction as shown in U.S. Pat. No. 2,752,119 shows a locking assembly disposed eccentrically relative to the piston which is disadvantageous since it introduces a couple acting on the ram rod and/or seals and/or the ram therewith.

SUMMARY OF THE INVENTION

The present invention relates to a locking assembly for a blowout preventer ram wherein the ram may be locked in its sealing position by a rotating locking assembly, but means are provided for preventing rotation of the ram rod itself to thereby prevent transmission of such rotation of the locking assembly to the ram. The operating mechanism of the locking assembly is located in alignment with the longitudinal axis of the ram rod to prevent the creation of a couple acting on the rods and/or seals and/or ram. The locking assembly may have a rising stem or a non-rising stem, and may utilize the bore of the ram rod for the threaded portion of the locking assembly in either form because of the alignment of the operating mechanism of the locking assembly with the ram rod, whereby the extension or projection of the locking assembly from the piston cylinder is minimized.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical sectional view, partly in elevation, illustrating one form of the locking assembly of this invention in a typical blowout preventer; FIG. 2 is a sectional view taken on line 2—2 of FIG. 1; FIG. 3 is a view of the left hand portion of the apparatus shown in FIG. 1, but showing the locking assembly in the locked position; FIG. 4 is a view similar to FIG. 1, but showing a modified form of the assembly, wherein the stem is of the non-rising type; and FIG. 5 is a view of the left hand portion of the apparatus illustrated in FIG. 4 to show such apparatus in the locked position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the drawings, the letter A designates generally a blowout preventer which includes a conventional blowout preventer body B, a blowout preventer head or bonnet H, a ram R, and means C for moving the ram R from a closed or sealing position (FIG. 1) to an open position (not shown) and vice versa. A locking assembly, generally designated with the letter L is operably mounted with a ram rod 10 which in turn is connected to the ram R, preferably using a connector button 11, as will be more fully explained.

Considering the invention more in detail, the blowout preventer body B is provided with a longitudinally or vertically extending bore or opening 12 of conventional construction through which well pipe, wire line or well tools may pass in the known manner. The body B also has a laterally extending ram opening 14 for receiving the ram R and for forming a fluid seal therewith in any suitable manner. The ram opening 14 is in alignment with a ram cavity or recess 15 formed in the bonnet or head H.

The bonnet H is releasably connected to the body B by releasable bolts 13 or other suitable connecting means which extend through the bonnet H and into the body B. The head or bonnet H may be mounted with an known type of support so that it either swings accurately with respect to the body B after the bolts 13 are released from the body B so as to expose the ram R when the ram R is in the retracted position (not shown) within the ram cavity or recess 15. Alternatively, the head or bonnet H may move outwardly on any suitable supports (not shown) after the bolts 13 are released. It will also be understood that only one half of the blowout preventer is illustrated in FIG. 1, the other half is a duplicate of the portion which is illustrated.

It will also be understood that the ram R coacts with a corresponding ram R for closing off the bore 12 through the blowout preventer body B. For this purpose, the ram R has a resilient sealing member 16 with rigid plates 16a and 16b thereabove. The resilient portion 16 is preferably formed of synthetic or natural rubber so that it is yieldable when it engages the corresponding resilient portion on the other ram which is not shown. It will also be understood that the ram R may have a suitable curvature for sealing around the external surface of a pipe or pipe joint, as is well understood. Similarly, the ram C has a seal element 17 which engages the bore 14 of the preventer body B in a known manner to prevent the fluid pressure within the bore 12 from passing around the ram R.

The moving means C which is utilized for moving the ram R may be hydraulic, mechanical, manual or of any other suitable type. As illustrated in the drawings, such power means C includes a cylinder 20 which is connected by bolts (not shown) or any other suitable securing means to the head or bonnet H in any known manner so that under normal operating conditions, the cylinder 20 moves with the head or bonnet H. A cylinder liner 21 is suitably mounted within the cylinder 20 in the preferred form of the invention, with a piston 22 movable within such liner 21 in the known manner. The piston 22 is moved inwardly or in a right hand direction as viewed in FIG. 1 by hydraulic fluid or any other fluid pressure introduced through a fluid pressure line 23 into an annular space 21a between the liner 21 and the cylinder 20 in the known manner. It will be understood that the fluid pressure line 23 is only partially illustrated and it connects with a suitable source of fluid pressure.

For moving the piston 22 outwardly or in a direction to the left as viewed in FIG. 1, the fluid pressure is introduced through a line 25, a portion of which is illustrated in the drawings and which is suitably connected to a source of hydraulic fluid or other fluid under pressure in the known manner.
The ram rod 10 is of a special construction and it includes a reduced diameter portion 10a with an annular shoulder 10b for receiving and confining the piston 22 thereon. A notch 10c is formed in the ram rod 10 for receiving a split retaining ring 26 therein to secure the piston 22 to the ram rod 10. A retainer ring 27 which is in the form of a complete solid ring is secured to the piston 22 by a plurality of attaching means such as screws 27a so as to prevent the split ring 26 from inadvertently becoming released.

The ram rod extends through an opening 15a in the head or bonnet H and in which a plurality of seals 30, 31 and 32 are disposed for sealing engagement with the external surface of the ram rod 10. It will be understood that the particular sealing arrangement between the ram rod 10 and the seal or seals in the opening 15a may be varied within the scope of those skilled in the art.

The ram rod is hollow and is thus provided with a hollow bore 10d. A plug 10e is welded near the forward end of the bore 10d to seal such bore 10d and prevent fluid flow therethrough. The forward portion of the bore 10d is threaded at 10f to receive threads 11a which are a part of the connector button 11 and which serve to join the connector 11 directly to the ram rod 10. It is also desirable to have one or more welds 11b between the ram rod 10 and the connector button shaft as illustrated in FIG. 1.

The connector button 11 is preferably of a square or rectangular shape as best seen in FIG. 2 whereas the shaft 11c therewith is preferably round and of a smaller dimension. The shaft 11 fits within a reduced width slot 35 which is formed to the left of a larger button receiving slot 36 as viewed in FIG. 1. Preferably, the side walls 36a of the slot 36 are substantially vertical and are adapted to be engaged by the side surfaces 11d of the button 11 (FIG. 2). Such construction prevents the ram R from rotating relative to the button 11 and thus relative to the ram rod 10, which is desirable when the ram R has been moved to an exposed position out of the blowout preventer body B. Such construction would also be desirable if the ram R is round since it would assure alignment of the seals and the proper setting of the ram R in the sealing position.

A guide plate 40 is mounted in the bonnet recess or cavity 15 so as to be between the ram rod 10 and the bonnet H. Preferably, the guide plate 40 is connected by connecting screws 41 or any other suitable securing means so that such guide plate 40 moves with the bonnet H when it is moved to an open position after the bolts 13 have been released, as previously explained.

The guide plate 40 has a guide recess 40a with guide walls 40b formed on each side thereof which are in engagement with the side guide surfaces 11d of the connector button 11 so as to prevent relative rotation of the connector button with respect to such guide plate 40.

The guide plate 40 also extends upwardly into a recess 43 formed in the lower portion of the ram R, in the preferred form of the invention so that there is a coaction between guide surfaces 40c at each side of the guide plate 40 and adjacent side walls 43a in the recess 43. The coaction between the surfaces 40c and 43a guides the ram R as it moves inwardly and outwardly with respect to the guide plate 40 to prevent cocking or misalignment of the ram R. The coaction between such surfaces 40c and 43a could be omitted and the purposes of the invention heretofore described would still be accomplished.

The locking assembly L includes a rotatable stem 50 which extends into the cylinder 20 and has a threaded portion 51 therewith which engages with internal threads 10g within the hollow bore 10d of the ram rod 10. The stem 50 has a stop flange 52 disposed outwardly of the threaded locking sleeve portion 51 which is adapted to abut the end of the ram rod 10 when the stem 50 is in the telescoped position with the threaded portion 51 internally of the bore 10d. Also, the flange 52 is adapted to engage a stop surface 20a (FIG. 3) when the stem 50 has been moved to the locking position with the threaded portion 51 extended with respect to the ram rod 10 (FIG. 3). The flange 52 preferably has an anti-friction ring 52a therewith for abutment with the stop surface 20a.

The stem 50 extends through an opening 20b in the cylinder 20 and suitable seal 55 and wiper 56 are employed for engagement with the external surface of the stem 50. The stem 50 projects outwardly from the cylinder 20 and preferably a guard extension 57 is provided on the cylinder 20 for protecting the stem 50. Wrench flats 50a are provided on the stem 50 to facilitate engagement with a wrench so as to rotate the stem 50 and thereby rotate the threads 51 relative to the threads 50g. The form of the invention shown in FIGS. 1 and 3, insofar as the locking mechanism L is concerned, is known as the rising stem type in view of the longitudinal travel of the stem 50 relative to the cylinder 20.

In the operation or use of the form of the invention illustrated in the drawing and particularly FIGS. 1–3, the locking mechanism L is normally in the position illustrated in FIG. 1, with the threaded portion 51 of the stem 50 telescoped within the bore 10d of the ram rod 10. It is to be noted that the stem 50 is in alignment with the ram rod 10 so that the axes of the stem 50 and the rod 10 are coincidental. This is important for the reasons hereetofore described.

When it is desired to lock the ram R in the sealing position shown in FIG. 1, the stem 50 is rotated to thread the threaded portion 51 relative to the threads 10g, thereby causing longitudinal travel of the stem 50 and threaded portion 51 therewith to the left as viewed in FIG. 1. The piston 22 is at the inward position shown in FIG. 1 at that time. Continued rotation of the stem 50 moves it to the left or outwardly until the stop flange 52a engages the stop surface 20a. At that time, as seen in FIG. 3, the piston 22 is locked against any movement and therefore the ram R is locked against any movement. A reverse rotation of the stem 50 will return it to the telescoped position of FIG. 1 for subsequent normal operations of the ram R. During such rotation of the stem 50 and the threaded portion 51, the ram rod 10 is prevented from rotating due to the interengagement of the guide surfaces 40b and 11d, as heretofore explained. This assures that the rotation of the locking assembly L is not transmitted to the ram R, but at the same time, the present invention accomplishes the location of the stem 50 in direct alignment with the ram rod 10.

A modified form of the invention is illustrated in FIGS. 4 and 5 wherein identical parts to those shown in FIGS. 1–3 have the same letters and/or numerals. The locking assembly L-1 is modified as compared to the locking assembly L and it is known as the non-rising
stem type. Thus, the stem 150 in FIGS. 4 and 5 rotates but it does not move longitudinally. The stem 150 has a plurality of flat sides, preferably six in number and such flat sides fit within a similarly flat sided internal bore 151a of a threaded locking sleeve 151. The 5 threaded locking sleeve 151 is adapted to telescope within the bore 10d of the ram rod 10 in the same manner as the threaded portion 51 illustrated in FIG. 1. The threads 151b are in threaded engagement with threads 10g in the bore of the ram rod 10. Thus, as the stem 150 is rotated, it rotates the locking sleeve 151 to cause a threading or unthreading thereof with respect to the threads 10g, depending upon the direction of rotation of the stem 150.

The stem 150 projects through the cylinder 20 at the opening 20b and means are provided for preventing longitudinal travel of the stem 150. As illustrated in FIG. 4, such means includes a flange 150a which engages a surface 20a in the cylinder 20. A retaining split ring 150b is disposed at the outer portion of the cylinder 20 for preventing inward travel of the stem 150. As illustrated in FIG. 4, the outer operating end 150c has a plurality of flat surfaces for engagement by a wrench and it is a separate piece which is connected to the inner part of the stem 150 by one or more connecting pins 150d, or by any other suitable mechanism.

The operation of the form of the invention shown in FIGS. 4 and 5 is similar to that described in connection with FIGS. 1–3. Under normal operating conditions, the ram R is moved back and forth from the sealing position shown in FIG. 4 to the open or retracted position (not shown) wherein the ram R is disposed within the bonnet cavity 15, as will be well understood. When it is desired to lock the ram R in the sealing position shown in FIG. 4, the stem 150 is rotated by any suitable means, such as a wrench engaging the wrench flats 150f so as to cause a rotation of the locking sleeve 151 relative to the threads 10g to move same to the locking position shown in FIG. 5, wherein the left hand end of the sleeve 151 is in engagement with the flange 150a. In such position, the ram R is locked in the same manner as described heretofore in connection with FIG. 3. It also should be noted that the cover 156 shown in FIGS. 4 and 5 may be much shorter than required for the cover 56 since the stem 150 does not move longitudinally relative to the cylinder 20.

It will also be understood that by a reverse rotation of the stem 150, the locking sleeve 151 may be returned to its telescoped position within the bore 10d of the ram rod 10.

Although the guide plate 40 is shown as formed separately from the preventer body B and the bonnet H, it should be understood that the guide plate 40 could be omitted and instead the guide surfaces 40b could be formed in the bottom of the body B alone, or together with an extension thereof in the bottom of the bonnet B. The advantage of the separate guide plate 40 as illustrated resides in the maintenance of alignment of the ram R when returning the bonnet H to the closed position after replacing the ram R on the button 11.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

I claim:

1. A locking assembly for a blowout preventer ram, comprising:
   a blowout preventer body having a lateral opening for movement of a ram therein;
   a blowout preventer ram bonnet having a ram recess therein aligned with said lateral opening in said body;
   a blowout preventer ram adapted to move in and relative to said ram recess and said lateral opening for moving from a retracted position to a sealing position;
   a ram rod having connection with said ram and having a hollow bore;
   a piston cylinder mounted with said bonnet;
   a piston disposed in said cylinder and having connection with said ram rod;
   fixed guide means engaging said ram rod for preventing rotation of said ram rod;
   a rotatable locking element rotatably threaded in said bore of said hollow ram rod for rotation relative thereto for movement to and from a position locking the ram against longitudinal movement in the lateral opening of said body; and
   means for mounting said rotatable locking element for longitudinal movement with said ram rod.

2. The structure set forth in claim 1, including:
   a rotatable stem extending into said cylinder and projecting therefrom;
   means for preventing said stem from moving longitudinally in said cylinder when rotated;
   said locking element and said stem having co-acting surfaces for transmitting the rotation of said stem to said locking element and for effecting a longitudinal travel of said locking element relative to said stem to thereby move said locking element to and from said locking position.

3. The structure set forth in claim 1, wherein said guide means includes:
   a guide plate mounted in said ram recess of said bonnet and having a pocket with guide walls on each side thereof; and
   a connector button on said ram rod having a guide surface on each side thereof in sliding engagement with said guide walls.

4. The structure set forth in claim 1, including:
   a connector button on said ram rod having means co-acting with said ram for preventing rotation of said ram relative to said ram rod.

5. A locking assembly for a blowout preventer ram, comprising:
   a blowout preventer body having a lateral opening for movement of a ram therein;
   a blowout preventer ram bonnet having a ram recess therein aligned with said lateral opening in said body;
   a blowout preventer ram adapted to move in and relative to said ram recess and said lateral opening for moving from a retracted position to a sealing position;
   a ram rod having connection with said ram;
   a piston cylinder mounted with said bonnet;
   a piston disposed in said cylinder and having connection with said ram rod;
   fixed guide means engaging said ram rod for preventing rotation of said ram rod; and
   said guide means including a guide plate mounted in said ram recess of said bonnet and having at least
one guide surface and a connector button on said ram rod having a guide surface engageable with said guide surface on said guide plate for preventing rotation of said button and said ram rod therewith relative to said guide plate.

6. The structure set forth in claim 5, wherein:

said ram has a channel formed therein for receiving said guide plate; and

said channel and said guide plate have co-acting surfaces in engagement with each other to prevent said ram from rotating relative to said ram rod.