Oct. 16, 1945. H. ALLEN 2,387,106

BLOWOUT PREVENTER

Filed April 11, 1942 3 Sheets-Sheet 1

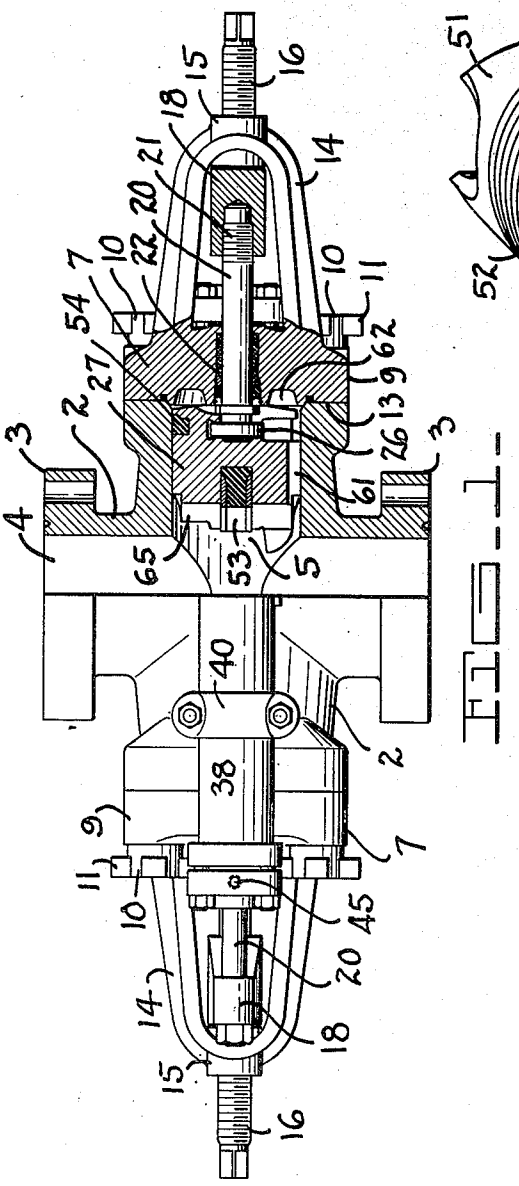


FIG. 1.

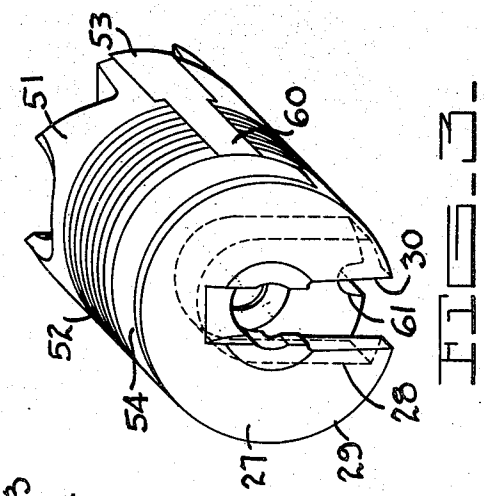


FIG. 3.

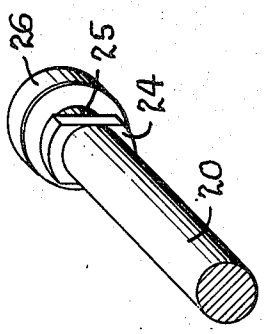


FIG. 2.

HERBERT. ALLEN
INVENTOR

BY Lester B. Clark

ATTORNEY.

Oct. 16, 1945. H. ALLEN 2,387,106

BLOWOUT PREVENTER

Filed April 11, 1942 3 Sheets-Sheet 2

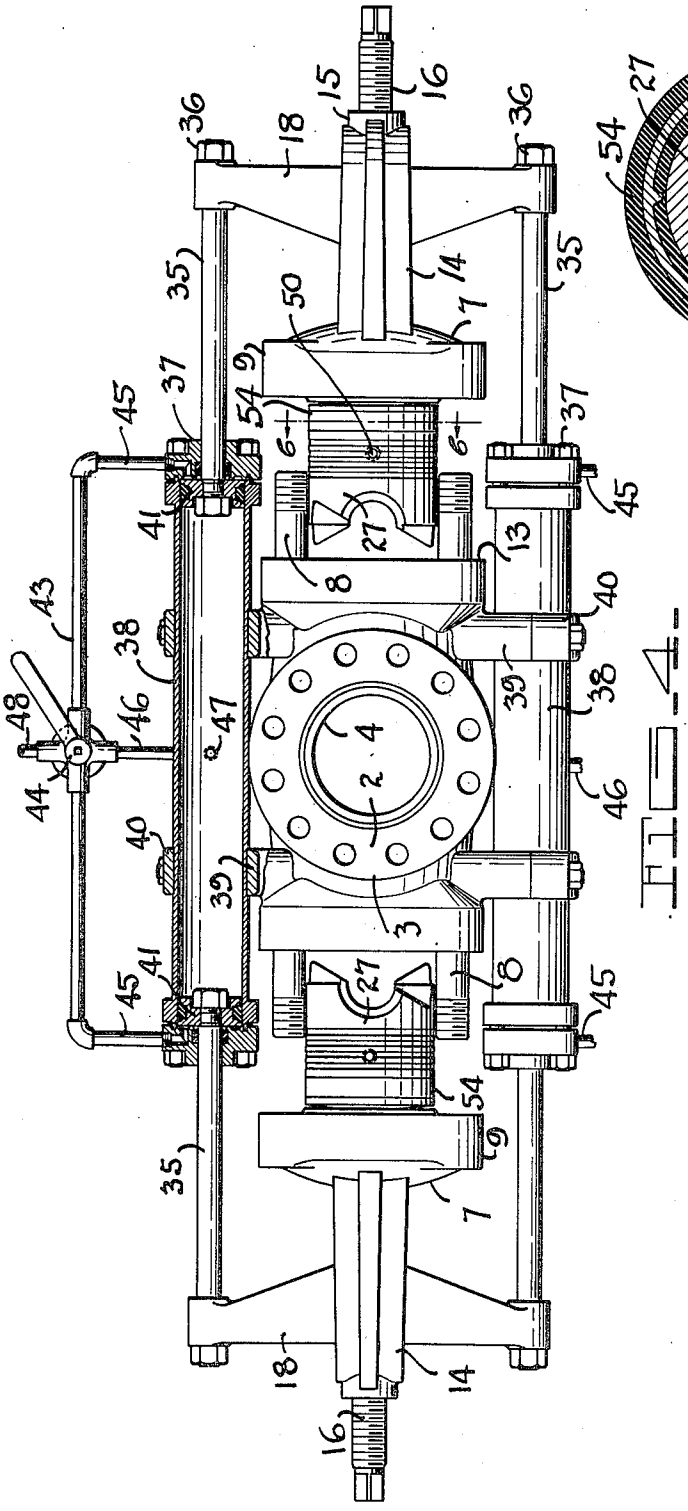


FIG. 4.

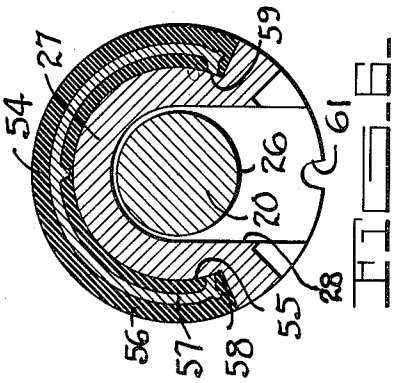


FIG. 5.

HERBERT ALLEN
INVENTOR

BY Lester B. Clark.

ATTORNEY.

Oct. 16, 1945. H. ALLEN 2,387,106

BLOWOUT PREVENTER

Filed April 11, 1942 3 Sheets-Sheet 3

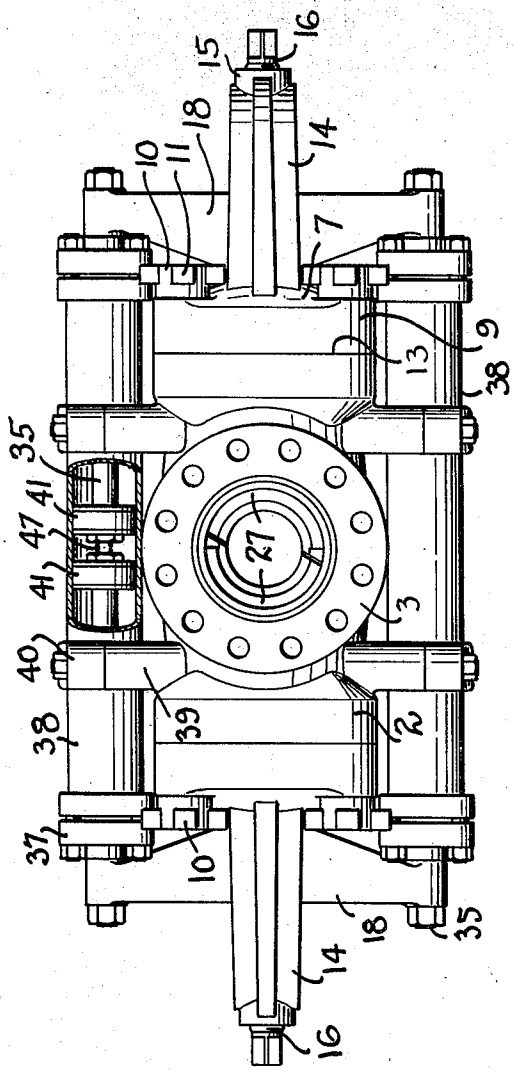


FIG-5-

HERBERT ALLEN
INVENTOR

BY Lester B Clark,

ATTORNEY.

Patented Oct. 16, 1945

2,387,106

UNITED STATES PATENT OFFICE

2,387,106

BLOWOUT PREVENTER

Herbert Allen, Houston, Tex., assignor to Cameron Iron Works, Houston, Tex.

Application April 11, 1942, Serial No. 438,527

14 Claims. (Cl. 137—139)

The invention relates to a blowout preventer.

In the drilling of deeper and deeper wells higher pressures are encountered and the equipment for controlling such pressures of necessity becomes heavier and more massive. Such heavier equipment is difficult to handle and the present invention therefore relates to a high pressure blowout preventer wherein the pressure can be applied not only for the opening and closing of the ram members, but also for the purpose of inserting and removing the ram members relative to the blowout preventer housing.

In the use of blowout preventers to be closed about a pipe in the well the ram members have a recess therein so that the two ram members cooperate together to fit closely about the pipe and form a seal. Whenever a different diameter pipe is run into the well it is necessary to change the ram so as to provide a pair of rams forming a recess which will fit about the particular pipe which is then in the well. In view of the massive construction of the ram members, the fact that they must fit tightly in the chambers in the housing, and the fact that they are usually covered with heavy grease as well as grit and mud, makes the changing of the ram a rather difficult and time-consuming operation. The present blowout preventer has been constructed with a view of permitting quick changing of the rams and also provides a construction wherein fluid pressure can be utilized in pulling the rams from the preventer housing so that they can be readily changed, and for also forcing the rams back into the housing into an operative position.

It is one of the objects of the invention to provide a quick change ram construction in high pressure blowout preventers.

Another object of the invention is to provide a blowout preventer wherein fluid pressure is utilized for removing and inserting the rams.

Still another object of the invention is to provide a blowout preventer bonnet structure to which a ram may be readily connected.

Still another object of the invention is to provide a construction wherein a minimum number of fastening members are utilized in clamping the bonnet to the preventer housing.

It is also an object of the invention to provide a fluid pressure mechanism for operating the rams of a blowout preventer wherein such mechanism can move beyond the normal stroke of the ram in order to remove the ram from the preventer housing.

Still another object of the invention is to provide a stem for blowout preventer rams to which the ram can be readily connected or removed but wherein the stem will hold the ram against rotation.

Still another object of the invention is to provide a minimum number of connecting members for a blowout preventer bonnet.

It is also an object of the invention to provide an operative yoke and bonnet assembly for blowout preventers.

A still further object of the invention is to provide an arrangement of packing for blowout preventer rams which can be readily attached to the rams and removed therefrom and which will form a seal about the upper half of the ram so as to exclude the well pressure therefrom.

Still another object of the invention is to provide a blowout preventer wherein the well pressure is applied to a greater area behind the ram than on the forward face of the ram after the ram is closed, so that the well pressure will tend to hold the ram in closed and sealed position.

Other and further objects of the invention will be more fully apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a side elevation, partially in section, of the assembled blowout preventer.

Fig. 2 is a perspective view of part of the ram stem.

Fig. 3 is a perspective view of the ram member disconnected from the stem.

Fig. 4 is a top plan view looking down on the blowout preventer with one of the operating cylinders in section and showing the rams as having been withdrawn from the housing by the application of fluid pressure.

Fig. 5 is a top plan view with the rams in closed position and the bonnets connected to the preventer body.

Fig. 6 is a transverse section taken on the line 6—6 of Fig. 4 and showing the construction of the ram, packing and stem.

In Fig. 1 the blowout preventer body is shown at 2 and preferably has the upper and lower flanges 3 by which it is connected to the well head. This body has the vertical passage 4 and the ram chambers 5 therein. Each of the chambers 5 is closed by the bonnet assembly 7 which is connected to the body by a plurality of stud bolts 8 which project from the body and pass through suitable openings in the flange 9 of the bonnet. It is important to note that in the form shown in the drawings only four of these studs 8 have been provided and that each stud is arranged to receive a hammer lug nut 10. These

nuts, as best seen in Fig. 5, are relatively massive and have the lugs 11 thereon which are adapted to be struck with a hammer in order to tighten and loosen the nuts. They are of such large diameter that they may be tightened very securely and in this manner clamp the bonnet rigidly to the body. Heretofore some twenty to twenty-four stud bolts have been used in connecting the flanges, so that it should be apparent that a tremendous saving of time and energy has been effected by providing but four such nuts.

The bonnet assembly is made up of the flange 9 which is arranged to fit against the end face 13 of the extension which provides the ram chamber 5. This flange carries a yoke 14 having a bearing 15 therein which is threaded to receive the spindle 16. This spindle is rotatably mounted so that it may be turned to abut a head or crossarm 18 which extends through the yoke 14 to force the arm toward the housing by manual force or to lock the arm against outward movement. A ram stem 20 is threaded at 21 into this crossarm and extends through a packing assembly 22 in the flange 9.

The inner end of this stem has a non-circular lug 24 thereon which is spaced by a neck portion 25 from the head 26 on the stem. This construction is provided in order to receive the ram 27 which has a channel 28 extending transversely of the rear end 29 of the ram and spaced inwardly from the end by the flanges 30. This channel 28 is of a width to receive the head 26, with the lug 24 sliding in the groove between the inner edges of the flanges 30. The ram will drop down over the head until it arrives at the position shown in Fig. 1, and when thus positioned the ram is held against rotation relative to the stem 20, and the stem 20 is firmly secured by the threads 21 in the crossarm 18.

In order to reciprocate the ram from the open position of Fig. 1 to the closed position of Fig. 5, the piston rods 35 are connected to each end of each of the crossarms 18 and secured to the arm by the nuts 36. Each of these piston rods extends through the cap 37 on the end of a pressure or operating cylinder 38, one of these cylinders being positioned at each side of the preventer body and supported thereon by the arms 39. The cylinders are removable relative to the arms by disconnecting the retainer blocks 40.

Each of the cylinders 38 contains a pair of pistons 41, one of which is positioned on each of the rods 35 in order to control the movement of the rams. Each piston is slidably mounted in its cylinder.

With the parts in the position of Fig. 4 with the rams 27 inserted over the head 26 and in position to be moved into the chamber 5, the pistons will be at the outer ends of the cylinders.

In order to move the pistons a fluid pressure control piping is shown at 43. This arrangement includes the control valve 44 which can admit or release pressure through the piping 45 to each end of the cylinders 38, and an additional connection 46 to admit or release pressure at the centers of the cylinders through the ports 47. The connection 48 may lead from a source of pressure, and the rear side of the valve 44 (not shown) may contain an exhaust or release for the pressure from either the pipes 45 or 46. In this manner the single valve 44 will serve to manipulate the pistons and the rams.

With the parts in the position of Fig. 4, if pressure is admitted to the ends 45, the pistons at the opposite ends of the cylinder will move toward each other, causing the crossarm 18 and the bonnet construction to move inwardly, thus forcing the rams into the chambers 5. Any desired pressure may be applied and the rams forced into the housing. The bonnet flange 9 is brought against the face 13 so that the hammer lug nuts 10 may be employed to anchor the bonnet to the body.

It seems apparent from the relative position of the parts in Fig. 4 that when either bonnet is connected and the corresponding ram is retracted until it engages the bonnet as in Fig. 1, the pistons 41 connected to each ram will not have moved to the centers of their respective cylinders but that there will be a sufficient additional space in each cylinder to permit additional movement of the pistons so as to effect the closing of the rams by sliding opposite ram assemblies toward each other, as seen in the position of Fig. 5. This sliding movement is permitted by the spindle 16 because such spindle merely abuts the arm 18 but by tightening of the spindle 16, the ram can be locked in closed position or it can be closed by manual operation of the spindle.

During the normal operation of the rams in actual practice, when the rams are closed the pistons will be in the position of Fig. 5. When pressure is introduced at the port 47 the pistons will move out until the ram abuts the flange 9 of the bonnet, at which time the pistons will have moved outwardly for only a portion of the length of the cylinder. When, however, it is desired to withdraw the rams for repair or to change rams, the hammer lug nuts 10 will be loosened and removed and the application of pressure at the port 47 will be effective to move the pistons beyond their normal stroke in operating the rams and to apply pressure to withdraw the rams to the position of Fig. 4, pulling them out of the housing completely.

Each ram may have a threaded socket 58 therein to which a bolt or spindle can be connected so that a hoist may be used to lift the ram from the stem in changing the ram. In inserting the ram, the reverse procedure will be followed.

The ram construction is best seen in Figs. 3 and 6 wherein the metal body 51 of the ram is shown as having a plurality of grooves 52 thereabout which will receive grease or lubricant to lubricate the movement of the ram. A particular type of packing 53 is shown as extending across the front face and along the sides of the ram. This packing is the same as that disclosed in my prior Patent No. 2,194,255 granted March 19, 1940.

In order to provide a seal around the upper or crown portion of the rear of the ram, a special packing 54 has been provided. This packing is seen in section in Fig. 6 as having been deposited in a groove 55 which is somewhat more than a semi-circle. The packing is a body of rubber or similar material 56 with a springlike member 57 incorporated therein which is somewhat resilient so that the portion or end 58 of the packing tends to snap over the ram and the resiliency of the member 57 tends to hold the packing in place. The ends 59 of this member extend to the inner face of the packing so as to position it rigidly against the base of the groove. This packing abuts against the ends of the lug portions 60 of the side packing 53 so that a complete seal is formed across the face of the ram, at the center and around the top and rear portion of the ram. The discontinuity of the packing 54 around the bottom of the ram leaves space for and permits

the ram to have a groove or slot 61 in its lower face which extends axially of the ram to admit pressure into the rear portion 62 of the chamber 5 behind the ram. Thus, when the ram is open, the total forces exerted by the pressure on the front and rear surfaces of the ram will be equalized, except that the total force exerted on the front of the ram will exceed that on the rear of the ram by an amount equal to the total force which the same pressure would exert on the cross section area of the stem. Therefore, in order to close the ram, it is necessary to exert through the stem from the outside only that amount of force necessary to overcome the total force which the well pressure would exert on the area of the stem alone as distinguished from the area of the front face of the ram, plus, of course, a sufficient amount of force to overcome friction. The ram may, therefore, be moved with only a fraction of the external force which would be necessary if the pressures on the front and rear faces of the ram were not equalized to the extent indicated.

As the ram moves to closed position around the pipe, however, the packing 53 will form a seal with the pipe and the side 60 will form a seal with the preventer housing. These seals cut off the well pressure from the upper forward part 65 of the ram, while the entire rear face of the ram is still exposed to the well pressure. Thus, if the rams are closed and sealed there will be a predominating pressure on the rear of the ram from the well, tending to hold the ram closed. This is true because of the extent of the sealing of the packing 54, the lugs 60 and the front packing 53.

It seems apparent that a very high pressure ratio for closing the rams has been provided and with the design of the parts as actually used, the pressure ratio is about 10 to 1 so that, for instance, if a source of pressure of, say 1000 pounds is available in the piping 43, then the blowout preventer could be closed against a well pressure of 10,000 pounds. This is true because the area of the two pistons tending to close each ram is ten times the area of the ram stem or screw, while the area of the ram itself is balanced except for the area of the stem.

In operation it is probable that one or the other of the rams may slide more readily than the other so that one ram may close and then an increase or a continuation of the pressure may cause the other ram to close.

Broadly, the invention contemplates a high pressure fluid operated blowout preventer wherein the rams can be quickly changed and are manipulated by fluid pressure.

What is claimed is:

1. A high pressure blowout preventer including a body, ram chambers therein, a ram in each chamber, a head closing each chamber, a stem extending through each head and connected to the ram, a crossarm on each stem, a piston connected to each end of the crossarm, and a pressure cylinder at each side of the body in which the two pistons on the same end of the body are movable by the application of pressure so as to open or close both rams.

2. A high pressure blowout preventer including a body, ram chambers therein, a ram in each chamber, a head closing each chamber, a stem extending through each head and connected to the ram, a crossarm on each stem, a piston connected to each end of the crossarm, and a pressure cylinder at each side of the body in which the two pistons on the same end of the body are movable by the application of pressure so as to open or close both rams, said cylinders being of a length to permit movement of said pistons to effect withdrawal of said rams from the body upon release of said heads.

3. A high pressure blowout preventer including a body, ram chambers therein, a ram in each chamber, a head closing each chamber, a stem extending through each head and connected to the ram, a crossarm on each stem, a piston connected to each end of the crossarm, a pressure cylinder at each side of the body in which the two pistons on the same end of the body are movable by the application of pressure so as to open or close both rams, said cylinders being of a length to permit movement of said pistons to effect withdrawal of said rams from the body upon release of said heads, and means which are quickly operable to affix and release said head relative to said body.

4. A blowout preventer including a body having a vertical passage therethrough, rams therein movable transversely to open or close said passage, means to move said rams including pressure cylinders on opposite sides of said rams and a connection from a piston in each of said cylinders to each of said rams, and means to control the flow of pressure to the cylinders to move the pistons so that said rams may be forced into or withdrawn from said body.

5. In a blowout preventer having a body a well passage therethru, lateral chambers extending from the passage, and rams movable therein to close the passage, means to move said rams including a pair of hydraulic cylinders, pistons in each cylinder connected to each ram, said cylinders being constructed to actuate said pistons to withdraw said rams from the body.

6. A packing for circular rams to seal the upper portion thereof in the ram cylinder including a curved portion somewhat in excess of one-half and less than the full circumference of the ram, and a springlike reenforcing member therein to clamp said packing to the ram as it passes beyond a diameter of the ram.

7. In combination with a ram type of blowout preventer for wells a pair of power cylinders on opposite sides of the rams for operating the rams of the blowout preventer, a pair of pistons in each cylinder, one piston in each cylinder being connected to each ram, means to introduce pressure fluid into said cylinders respectively between the pistons therein to open the rams and behind the pistons to close the rams.

8. A power cylinder for operating the rams of a blowout preventer, a pair of pistons in said cylinder each of which is connectable to a ram, means to introduce pressure fluid into said cylinder between the pistons to open the rams and behind the pistons to close the rams, said cylinder being of a length to move the pistons beyond the travel required for normal operation so that such abnormal movement will effect withdrawal of the rams from the preventer.

9. A ram and head assembly for blowout preventers including a head, a ram stem slidable therethrough, a ram removably positioned on said stem, a U-shaped yoke on said head, a crossarm connected to move said stem and extending through said yoke, power means connected to said crossarm to move said stem, ram, and crossarm with respect to said head and yoke, and a locking spindle threaded through said yoke to move or to lock said stem and crossarm.

10. A ram and head assembly for hydraulically

operable blowout preventers including a head, a ram stem slidable therethrough, a ram removably positioned on said stem, an open yoke on said head, a hydraulically operable crossarm on said stem extending laterally through the open portion of said yoke, hydraulic power means connected to the laterally extending parts of said crossarm to move said stem, ram and crossarm with respect to said head and yoke, and a lock member on said yoke movable against said crossarm to confine or limit the movement of the stem and ram.

11. A ram for blowout preventers including a cylindrical body, a longitudinal passage along the underside of said body, a packing across the front and along the sides of said body, a packing groove across the upper portion only of the ram at the rear and crossing the ends of the side packings, and a crown type of packing in said groove including an arcuate springlike reenforcing and retaining means in said crown packing and extending more than halfway and less than completely around said body to inherently hold the packing in the groove.

12. A ram and head assembly for blowout preventers, including a head, a ram stem slidable therethrough, a ram removably positioned on said stem, an open U-shaped yoke on said head, and a power operated crosshead on said stem extending through said yoke to move said ram, said stem and ram having non-circular engaging portions to prevent rotation of said ram, and power means connected to said crosshead at a position spaced from said stem to move said stem, ram and crosshead with respect to said head and yoke.

13. A blowout preventer for wells, including a body, a pair of rams mounted in slideways therein and slidable toward and away from each other to close the well passage, means carried by said body to simultaneously apply an equal and uniform pressure to actuate each of said rams, said rams being removable from said means in a lateral direction with respect to the direction of movement of the rams in said slideways, said means being of an extent to withdraw and support the rams outside of said body and beyond said slideways to permit such lateral movement of the rams.

14. A device of the character described, comprising a body having a slideway therein, and a passage therethrough, a ram mounted in said slideway and slidable toward and from said passage, means carried by said body to actuate said ram, said ram being removable from said means in a lateral direction with respect to the direction of movement of the ram in said slideway, and said means being of an extent to withdraw and to support said ram outside of said body and beyond said slideway and to permit such lateral movement of the ram.

HERBERT ALLEN.