Sept. 2, 1958 R. R. CROOKSTON ET AL 2,850,256

LATERALLY ADJUSTABLE BLOWOUT PREVENTER WITH INFLATABLE RAMS

Filed Nov. 10, 1955 3 Sheets-Sheet 1

FIG. 3.

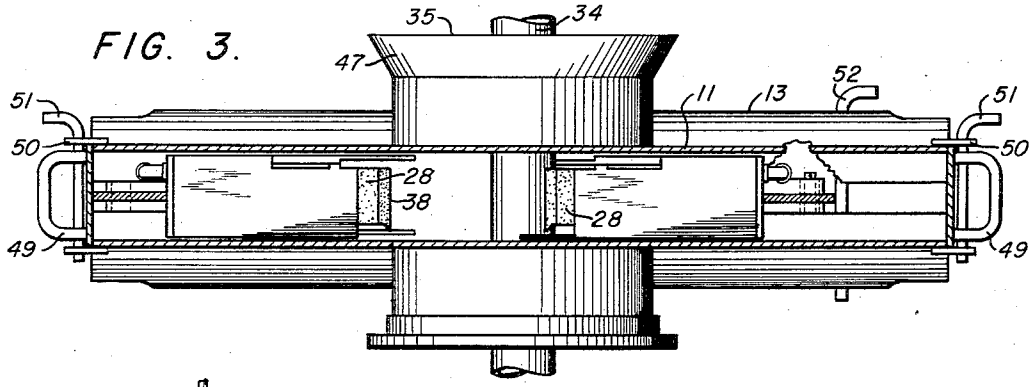
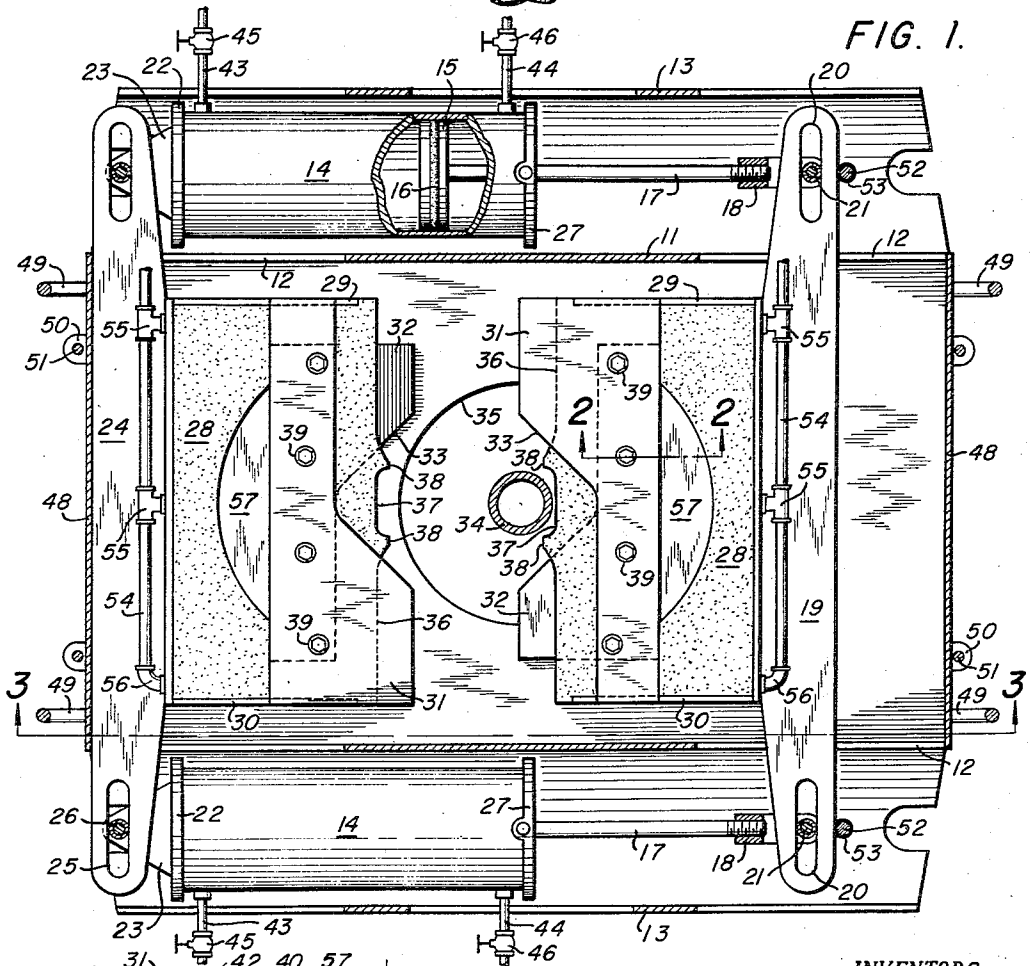


FIG. 1.



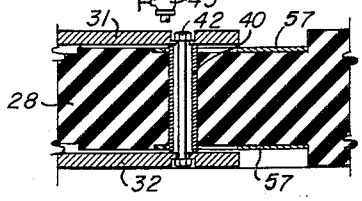


FIG. 2.

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LATERALLY ADJUSTABLE BLOWOUT PREVENTER WITH INFLATABLE RAMS

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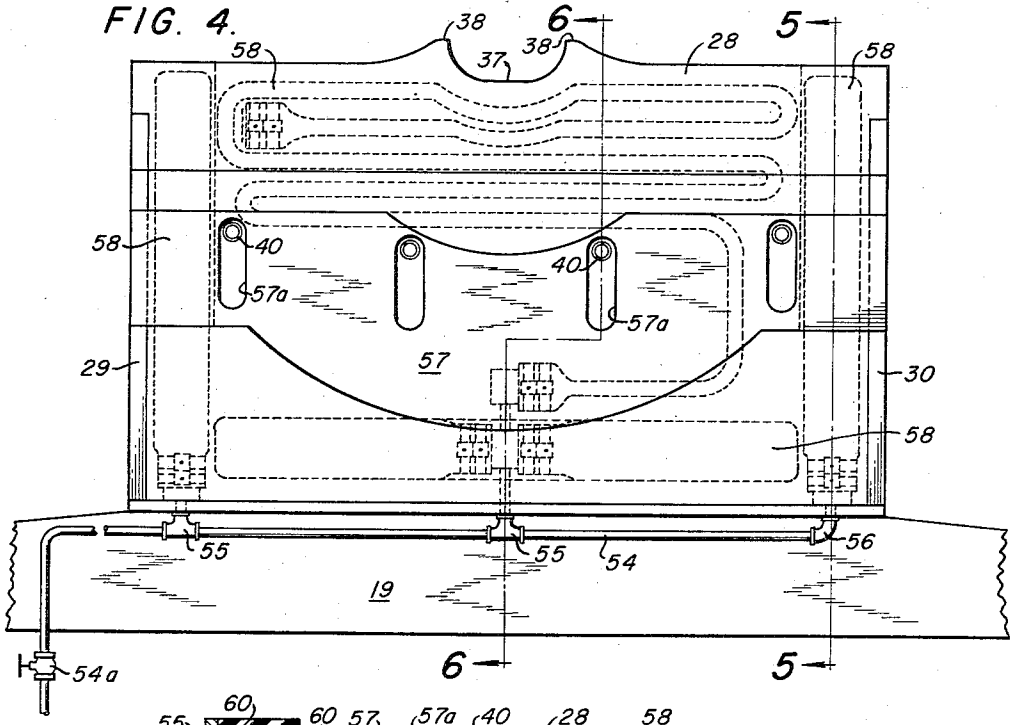
FIG. 4.



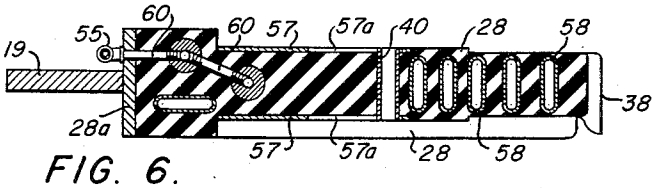


FIG. 6.

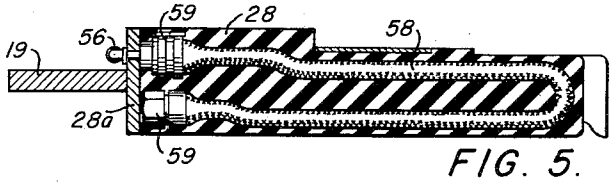


FIG. 5.

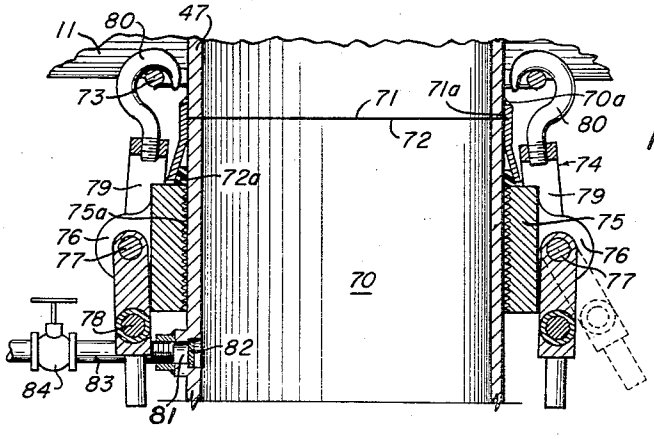


FIG. 7.

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FIG. 8.

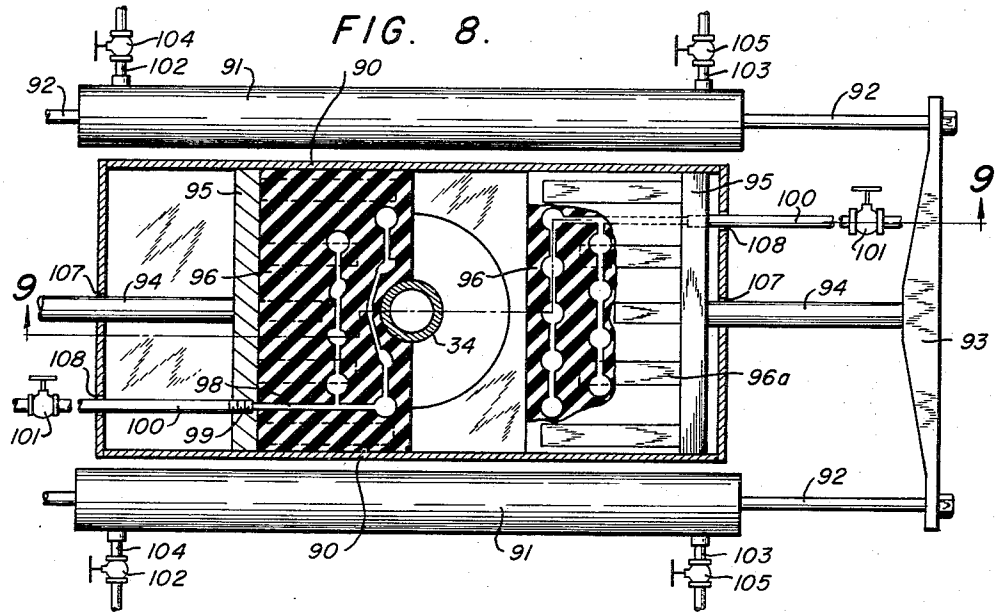
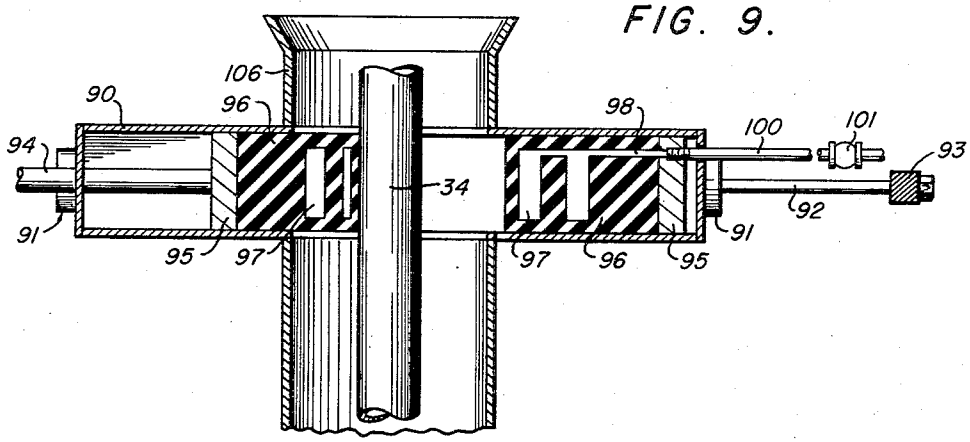


FIG. 9.



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United States Patent Office 2,850,256
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2,850,256

LATERALLY ADJUSTABLE BLOWOUT PREVENTER WITH INFLATABLE RAMS

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Application November 10, 1955, Serial No. 546,068
13 Claims. (Cl. 251—1)

The present invention is directed to an improved blowout preventer for controlling the pressure in a drilling well. More particularly, the invention is concerned with a blowout preventer for controlling blowouts in wells drilled to relatively shallow depths. In its more specific aspects, the invention is concerned with a blowout preventer for sealing the annulus between a drill pipe and a well casing.

The present invention may be briefly described as a blowout preventer comprising a housing adapted to be arranged on a well which has a central opening for receiving a section of pipe in the well. First and second rams are provided in the housing having opposed faces defining substantially semi-circular openings. Each ram comprises a deformable sealing body having fluid passageways therein for expanding the body in sealing engagement with the pipe on application or exertion of pressure in the fluid passageways. The rams are provided with means for confining the deformable sealing body against expansion excepting around the pipe. Power means are provided which are operatively connected to the rams for moving the opposing faces toward each other and around and into contact with the section of pipe.

In the blowout preventer of the present invention, the deformable sealing body is provided with sealing lips on the ends of the semi-circular openings which allow a tight seat to be made around the pipe on expansion of the body into sealing engagement therewith. The confining means are suitably vertically spaced apart, horizontally extending plates which provide a V-shaped opening for the deformable sealing body around the pipe. The confining means suitably may comprise vertically and horizontally spaced apart horizontally extending fingers for confining the sealing body.

The blowout preventer in accordance witht the present invention is suitably provided with means for locking the rams in sealing position before expanding the deformable body. This locking means may suitably be a hydraulic means or may be a mechanical means. The hydraulic locking means may be means for confining a non-compressible fluid in a piston and cylinder arrangement used to actuate the rams or suitably may be a locking pin engageable in an opening to lock the power means and thereby the rams or may suitably be a ratchet mechanism and/or the like.

The present invention is useful in closing in the annular space in a large annular conductor pipe through which a surface hole is drilled and in which wells of relatively shallow depth less than about 3000 feet are being drilled. In such wells or in the drilling of deeper wells, small, low-pressure pockets of gas are occasionally released. At such shallow depths, the larger, high-pressure blowout preventers usually employed in drilling wells have not yet been installed and consequently the low-pressure gas is usually free to blow in or run wild with no means available to control it. Rocks, debris, and other foreign matter may be blown up through the rotary table onto the derrick floor and frequently may set fire to and ignite the gas and cause injury to personnel and at the least considerable trouble and expense. In accordance with the present invention, a low-pressure blowout preventer is provided which eliminates these difficulties and allows

shutting in of the well and conducting the gas to a safe location for disposal, such as by burning or collection. The low-pressure blowout preventer of the present invention is self-centering and seals around the pipe regardless of the pipe's position whether it is in the center of the well casing or off-center, thus not requiring movement of the pipe, the rams moving to the pipe when the latter is off-center or otherwise.

The present invention may be further illustrated by reference to the drawing in which:

Fig. 1 is a top view, in partial section, looking downwardly on the blowout preventer of the present invention;

Fig. 2 is a sectional view taken along the lines 2—2 of Fig. 1;

Fig. 3 is a view, in partial section, taken along lines 3—3 of Fig. 1;

Fig. 4 is a view similar to that of Fig. 1 with parts removed to show the curved plate of Fig. 1 and the expansion means;

Fig. 5 is a view taken along the lines 5—5 of Fig. 4 illustrating the expansion means;

Fig. 6 is a view taken along the lines 6—6 of Fig. 4 showing in more detail the expansion means and means for supplying fluid thereto;

Fig. 7 is a partial sectional view showing the means for fastening the blowout preventer to surface casing and the means for conducting the gas to a safe location;

Fig. 8 is a top view, in partial section, of a modified blowout preventer in accordance with the present invention; and

Fig. 9 is a view taken along the lines 9—9 of Fig. 8.

In the drawing identical numerals will be employed to designate identical parts.

Referring now to Figs. 1 to 3, numeral 11, designates a housing provided with slots 12. Connected to the housing 11 on opposite sides thereof are cylindrical housings 13 in which are arranged piston cylinders 14 having pistons 15 arranged therein provided with a sealing means 16.

Connected to the pistons are piston arms or rods 17 which are slidably arranged to move through one or a leading head of the piston cylinders 14. The piston rods 17 are suitably connected by attaching means 18 to a yoke member 19 by means of a slot 20 and a pin 21 arrangement. The back ends 22 of the piston cylinders 14 are connected by brackets 23 to a second yoke 24 by a slot 25 and pin 26 arrangement. It will be seen that the piston rods 17 are slidably movable through the piston heads 27 of the piston cylinders 14.

Attached to the yokes 19 and 24 are identical ram members 28 constructed of a deformable or elastic material, such as natural or synthetic rubber, elastomer, and the like, which may suitably be confined between plates 29 and 30 in the housing 11.

The rams 28 are also confined between upper plates 31 and bottom plates 32, plates 31 and 32 cooperating with each other to provide V-shaped openings 33 for embracing a pipe section, such as 34, arranged in a central opening 35 of housing 11.

The rams 28 have opposing faces 36 which provide or define a substantially semi-circular opening 37, the ends of which define lips 38 which allow the rams to close and seal around the outer surface of pipe 34.

The plates 31 and 32 are provided with openings 39 which cooperate with metallic sleeves 40 which extend through the deformable ram member 28, the plates 31 and 32 being connected by bolts 42 in the sleeves 40.

The piston cylinders 14 are provided with conduits 43 and 44 by way of which air or hydraulic fluid may be introduced into piston cylinders 14 either ahead or behind piston 15. The conduits 43 and 44 are provided, respectively, with valves 45 and 46.

As shown in Fig. 3 particularly, the housing **11** is provided with a bell nipple **47** which serves as a guide for the pipe and also forms part of the housing **11**. The housing **11** is provided with end plates **48** and hand grips **49**, the end plates being connected to the housing **11** by brackets **50** and removable pins **51**.

The conduits **43** and **44** and valves **45** and **46** serve as a locking means for locking the piston **15** after the rams have been moved into sealing position around or into contact with the pipe **34** when a non-compressible fluid is employed to actuate the pistons **15**. When a compressible fluid is used to power the pistons **15**, the pistons **15** and the yokes **19** and **24** may suitably be locked into position by means of locking pins **52** being inserted manually or automatically in the ports or openings **53** in the cylindrical housings **13**, the locking pins **52** being inserted manually in the ports **53** and serve to lock the yokes **19** and **24** in position against movement once the rams **28** have been brought into position for sealing engagement with the pipe **34**.

Fluid is supplied to the rams **28** by means of conduit **54** connecting by **T**-shaped members **55** and elbows **56** to fluid passageways shown in more detail in Figs. 4 to 6, inclusive. The conduit **54** connects to a source of fluid pressure, not shown.

The rams **28** are each provided with a curved plate **57** which is described in more detail in Fig. 4.

Referring now to Fig. 4, the deformable body member of ram **28** arranged between plates **29** and **30** has curved plates **57** arranged above and below the rams **28** which are provided with a plurality of slots **57***a* through which the bolts **42** in sleeves **40** protrude. Slots **57***a* allow movement of the deformable ram **28** between the plates **57** when pressure is applied to expand the ram **28** as will be described.

As shown by dotted lines in Fig. 4 and in more detail in Figs. 5 and 6, the deformable ram body member **28** is provided with internal fluid passageways **58** which are suitable lengths of fire hose embedded in and vulcanized to the deformable body member **28**. These passageways or fire hoses **58** are connected by clamping or connecting means **59** to the conduit **54**.

The conduit **54** is suitably connected by means of a valve **54***a* to a source of fluid pressure which may be a compressible or non-compressible fluid. Air is a suitable compressible fluid and a suitable non-compressible fluid is water, oil, and the like. It is to be noted that internal conduits **60** provide communication with the lengths of fire hose **58** which are arranged transversely of the ram body **28** as shown.

With respect to Figs. 1 to 6, it is to be noted that the yokes **19** and **24** are attached, respectively, to the rams **28** by plate members **28***a* which serve to confine the ram body member **28**.

Referring now to Fig. 7, the body member **11** of the blowout preventer and the bell nipple **47** may suitably be connected to a surface casing, such as **70**, by placing the body member **11** including the bell nipple **47** such that the surface **71** frictionally contacts the surface **72** of the surface pipe **70**.

The housing **11** is provided with rings **73** to which is attached an attaching means generally indicated by the numeral **74** and comprises a split ring **75** having pipe engaging teeth **75***a* on its inner surface. The split ring **75** is provided with a bracket ring **76** which in turn has stub axles **77** and stub axles **78** to which are attached hook members **79** provided with hooks **80** which engage with the ring **73**. The dotted lines show the attaching means **74** in an unlocked position.

A seal is made between the surfaces **71** and **72** by providing a flared ring **71***a* which is attached such as by welding at point **70***a* to the bell nipple **47**. A seal between the flared ring **71***a* and the surface casing **70** is provided by a sealing ring **72***a*.

The surface pipe **70** has a port **81** which suitably may be closed by a frangible plug or disc **82**. The port **81** has a conduit **83** provided with a control valve **84** connected thereto such that when pressure develops in the pipe **70** and the blowout preventer of the present invention is closed, the frangible disc or plug **82** is ruptured at a predetermined pressure allowing the gas to be conducted to a safe location for disposition such as by burning or storing, collecting and the like.

Referring now to Figs. 8 and 9, a housing **90** is provided with piston cylinder assemblies **91** in which are arranged pistons, not shown, connected by piston rods **92** to yoke assembly **93**. It is to be noted that the pistons in the piston cylinder assemblies **91** are connected by piston rods **92** to yokes **93** on each end thereof.

Connected also to the yokes **93** by rods **94** are plates **95** which confine identical ram assemblies **96**. The ram assemblies **96** are provided with passageways **97** which connect by passageways **98** to ports **99** in plates **95** and thence by conduit **100** containing a valve **101** to a source of fluid pressure which may be a non-compressible or compressible fluid, such as has been described.

The piston cylinder arrangements **91** are provided with conduits **102** and **103** controlled by valves **104** and **105**, respectively, for introducing to the piston cylinder **91** a suitable fluid for actuating the pistons.

As shown more fully in Fig. 9, a bell nipple **106** is attached to and forms part of the housing **90**.

It is to be noted further that the housing **90** has openings **107** to provide for slidable movement of the rods **94** and openings **108** for the conduits **100**.

In employing the device of Figs. 1 to 7, inclusive, the blowout preventer is attached to the surface casing **70** such as with apparatus as has been shown in Fig. 7. Thereafter when it is desired to seal around the pipe **34**, fluid is admitted to the piston cylinders **14** to cause the rams **28** to move toward each other. As the semi-circular openings **37** embrace the outer surface of the pipe **34**, the rams **28** are locked in position by closing off valves **45** and **46** if a non-compressible fluid is used or by inserting the pins **52** in openings **53** if a compressible fluid is employed. Fluid pressure is then admitted to conduits **54**, by opening valves **54***a*, which is exerted into the internal passageways **58** and causes the rams **28**, by virtue of their being confined between plates **31** and **32**, to move into sealing engagement with the pipe to close off the annulus A between the pipe **34** and the bell nipple **47**. The lips **38** cooperate to form a positive seal and prevent any pressure from being blown up through the surface pipe **70** and the bell nipple **47**. By virtue of the locking means, the rams **28** cannot be moved away from each other, and by virtue of the confining means, such as plates **31** and **32**, and the plate **57**, the deformable or elastic seal must be formed around the pipe **34** and to seal same.

The piston cylinders **14** are confined or arranged loosely in the housings **13** which may be of general tubular shape. As the yokes **19** and **24** are actuated by pistons **15** through rods **17**, the cylinders **14** move depending on the position of the pipe **34** in opening **35**, the yokes **19** and **24**, by virtue of the slot and pin arrangements, **20** and **21** and **25** and **26**, respectively, are able to move correspondingly to position the rams **28** around and/or into contact with the outer surface of pipe **34** for sealing therearound.

It is to be noted that the upper plates **31** have an articulated movement, that is, as shown in Fig. 3 more clearly, the top or upper plate **31** on the left moves slidably over the top or upper plate on the right. The lower plates **32** also move over each other in a similar manner.

The curved plates **57** serve as guards or additional confining means for the ram bodies **28** and also as guides for the bolts **42** and sleeves **40** slidably arranged in slots **57***a*.

The embodiment of Figs. 8 and 9 operates in a similar

fashion to that of Figs. 1 to 7, the fingers **96***a* serving as confining means for the ram bodies or assemblies **96**.

It is to be emphasized that features of the present invention include the floating arrangement of the ram bodies in the blowout preventer housing which allows the ram bodies to center themselves with respect to the pipe and the inflating or expansion of the ram bodies after closing around or contacting the pipe and holding same in that position for expansion with fluid pressure.

The blowout preventer of the present invention, by virtue of the universal or semi-circular opening on the faces of the ram bodies **28** and the lips **38** provide a seal on expansion on pipe of small diameters, kelly joints, and the like. In short, the rams seal around small diameters and around hexagon, square, or circular shapes.

The hoses **58** as shown in Figs. 4, 5, and 6 are so arranged as to not only expand the rubber ram **28** and seal around the pipe in a horizontal manner but also to expand the rubber ram **28** vertically into sealing engagement with the upper and lower wall of the housing **11** thereby positively shutting off any pressure in the annulus between the pipe **34** and the casing **70**.

In employing the device of the present invention, relatively small pressure is employed to move the rams into sealing engagement and thereafter fluid pressure is exerted on the interior of the rams to cause a seal.

While the use of a compressible fluid, such as air, has been described, it is preferred to use a non-compressible fluid, such as oil, water, and the like.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and to secure by Letters Patent is:

1. A blowout preventer comprising a housing having an upper wall member and a lower wall member with the upper and lower wall members defining coaxial circular openings through which a section of pipe may be passed and said lower wall member having a means for attaching said housing in a fluid-tight manner to a section of casing coaxial with said central opening, a pair of ram assemblies slidably arranged in said housing and movable from a first position to a second position for embracing a section of pipe extending through the circular openings of the upper and lower wall members with a fluid-tight seal, each of said ram members comprising a plate member and a deformable sealing body vertically confined by said plate member and provided with fluid-tight passages expansible when subjected to fluid pressure, a pair of parallel piston and cylinder assemblies adapted to apply force along a line parallel to the longitudinal axis of said assemblies, means connecting said piston and cylinder assemblies with said pair of ram assemblies providing longitudinal and limited lateral movement of said ram assemblies whereby said ram assemblies may be moved along a line parallel to the longitudinal axes of the piston and cylinder assemblies and laterally movable in a direction at a right angle to said longitudinal axes of the piston and cylinder assemblies.

2. A blowout preventer in accordance with claim 1 in which the deformable sealing body of each of the ram assemblies is provided with sealing lips on its pipe embracing face.

3. A blowout preventer in accordance with claim 1 in which the plate member comprises vertically spaced apart horizontally extending plates which provide a V-shaped opening for the deformable sealing body around said pipe.

4. A blowout preventer in accordance with claim 1 in which the rams are provided with means for locking the rams in sealing position.

5. A blowout preventer in accordance with claim 1 in which the rams are provided with hydraulic means for locking the rams in sealing position before expanding the rams.

6. A blowout preventer in accordance with claim 1 in which the rams are provided with mechanical locking means for locking the rams in sealing position.

7. A blowout preventer in accordance with claim 1 in which said fluid tight passages are connected to means for supplying fluid under pressure thereto.

8. A device in accordance with claim 1 in which said ram sealing bodies consist of a rubber body with sections of fire hose embedded therein to form said fluid-tight passages expansible when subjected to fluid pressure.

9. A blowout preventer comprising, in combination, a housing having upper and lower horizontally extending walls defining central concentric openings for receiving a section of pipe, a first and second ram of an appreciably less width than said housing, the first side of said first ram and the first side of said second ram defining corresponding substantially semi-circular openings, each ram comprising a horizontally extending metal plate with a deformable sealing body having fluid passageways therein attached to said metal plate, a pair of piston and cylinder assemblies mounted in tubular passages and an assembly including slotted yokes mechanically connected to said rams having pins in said slots connecting said pair of piston and cylinder assemblies to said yokes whereby said rams are moved by said piston and cylinder assemblies along a predetermined line for opening and closing, and said rams are movable at right angles to said line for centering on a section of pipe in said blowout preventer, and means for expanding said deformable body by exerting fluid pressure in said passageways.

10. A blowout preventer comprising, in combination, a housing having a lower wall pierced by a circular opening of substantially the same size as the casing to which it is to be attached, fastening means on said housing for securing said lower wall to a well casing in a fluid-tight manner with the opening concentric with said casing, a pair of horizontally spaced piston and cylinder power assemblies carried by said housing, first and second ram assemblies, each of said ram assemblies comprising an upper plate slidably along the upper wall of said housing with the adjacent edges of the ram assemblies each defining a facing substantially semi-circular opening whereby when said ram members are moved together said semi-circular openings may embrace a section of pipe extending through said housing, the plate of said first ram having its upper surface in slidable contact with the lower surface of the plate of said second ram, a separate sealing member secured to the plate of each ram and consisting of a deformable rubber body having fire hose embedded therein with means adapted to connect said fire hose to a source of liquid under pressure, said ram members having substantially less width than said housing, a yoke having slotted openings, said yoke being mechanically connected to each ram member, and pins arranged in said slotted openings for securing said yoke to said piston and cylinder means whereby said ram members may move at right angles to the axis of movement of said piston and cylinder power means.

11. A blowout preventer in accordance with claim 10 in which the faces of the rams are provided with sealing lips.

12. A blowout preventer in accordance with claim 10 in which means are provided for locking said rams in position around a well pipe.

13. A blowout preventer in accordance with claim 10 in which the piston and cylinder means are provided with locking means for maintaining the rams in position around a well pipe.

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