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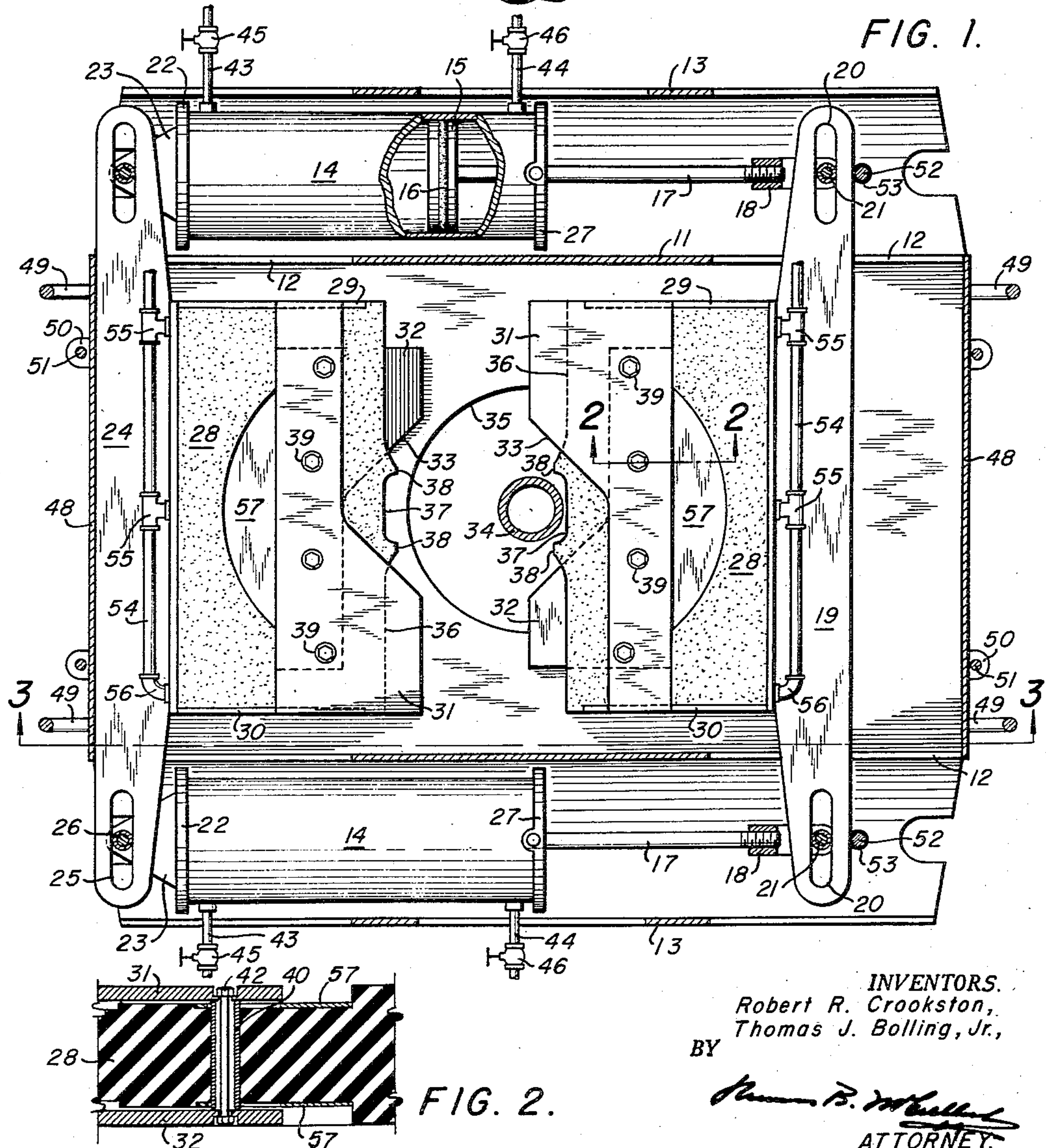
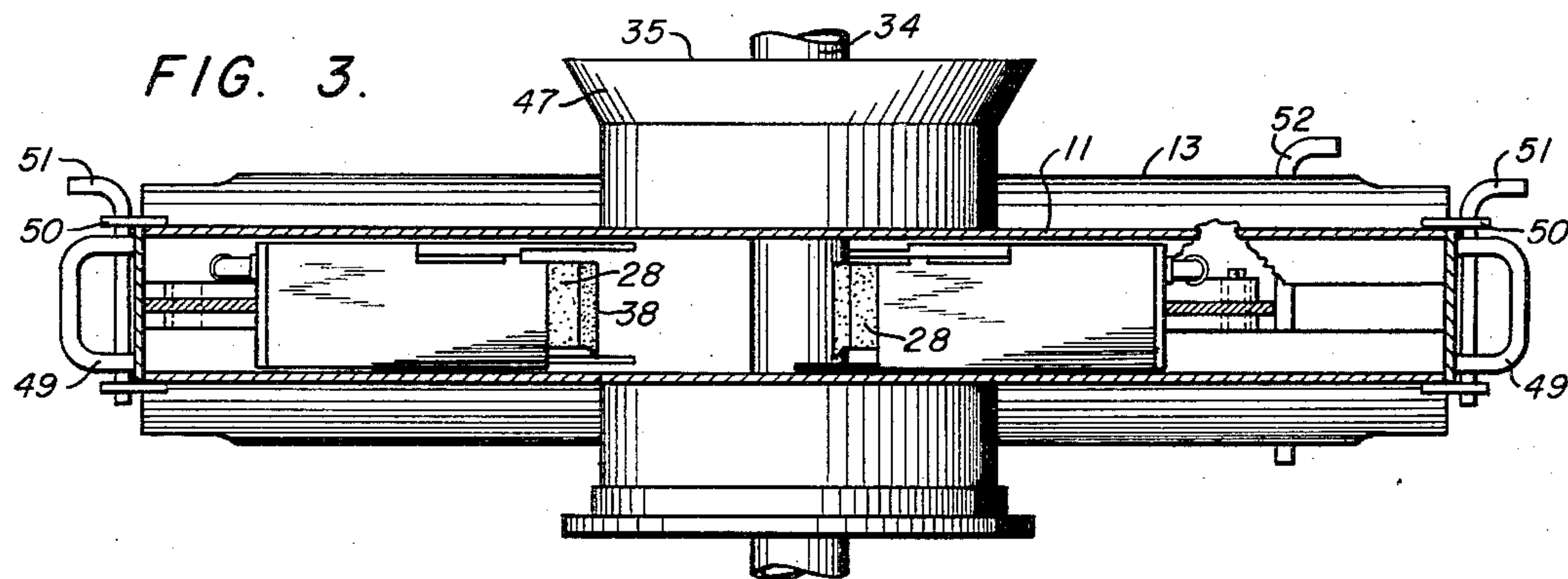
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2,850,256

LATERALLY ADJUSTABLE BLOWOUT PREVENTER WITH INFLATABLE RAMS

Filed Nov. 10, 1955

3 Sheets-Sheet 1



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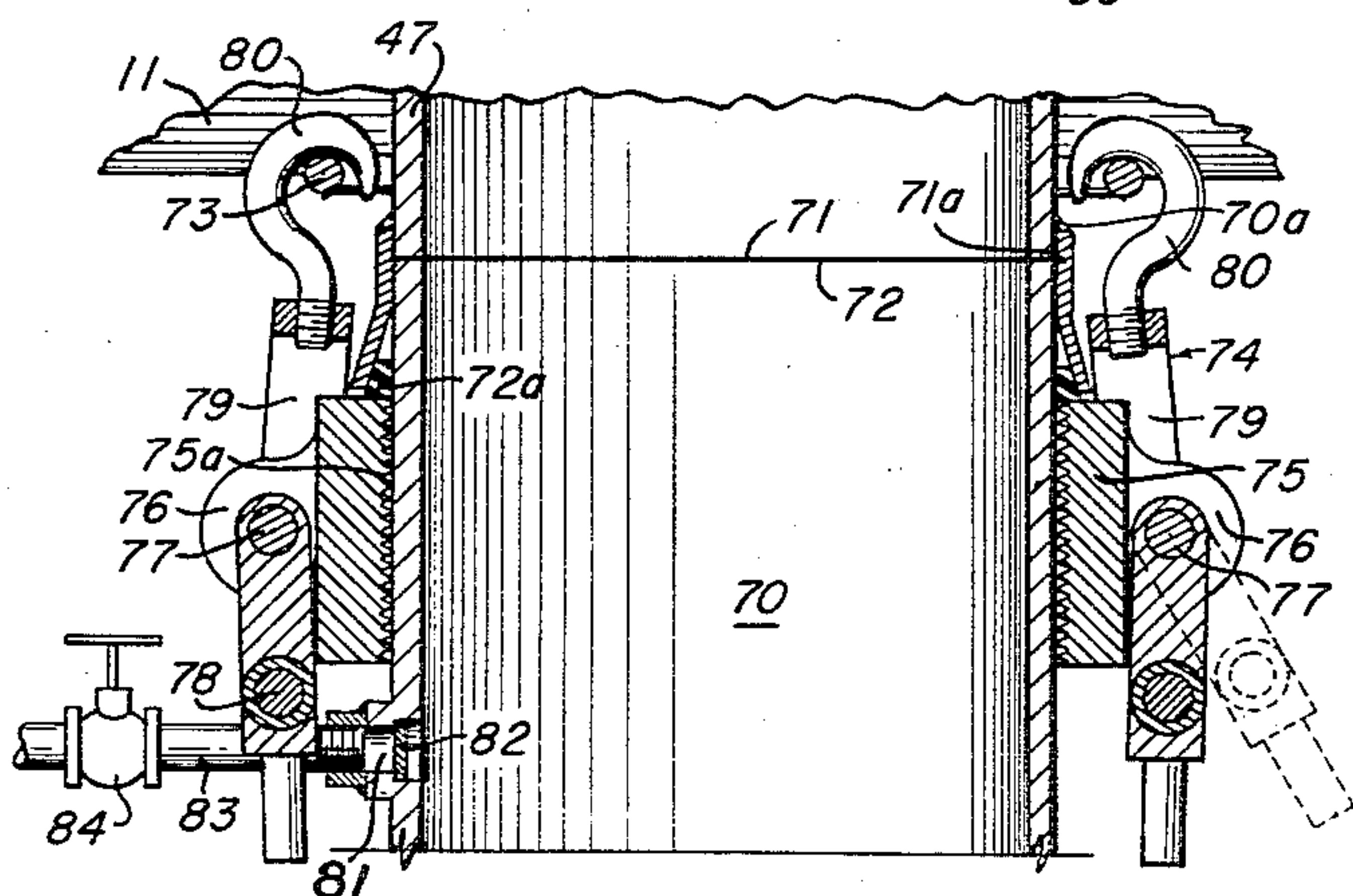
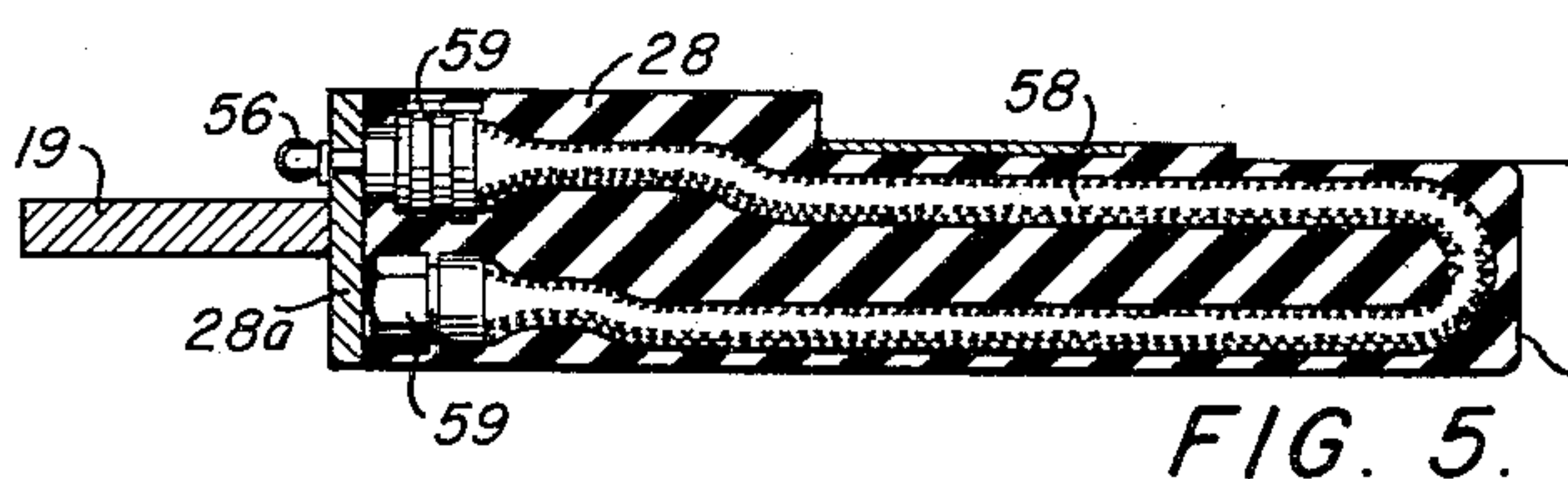
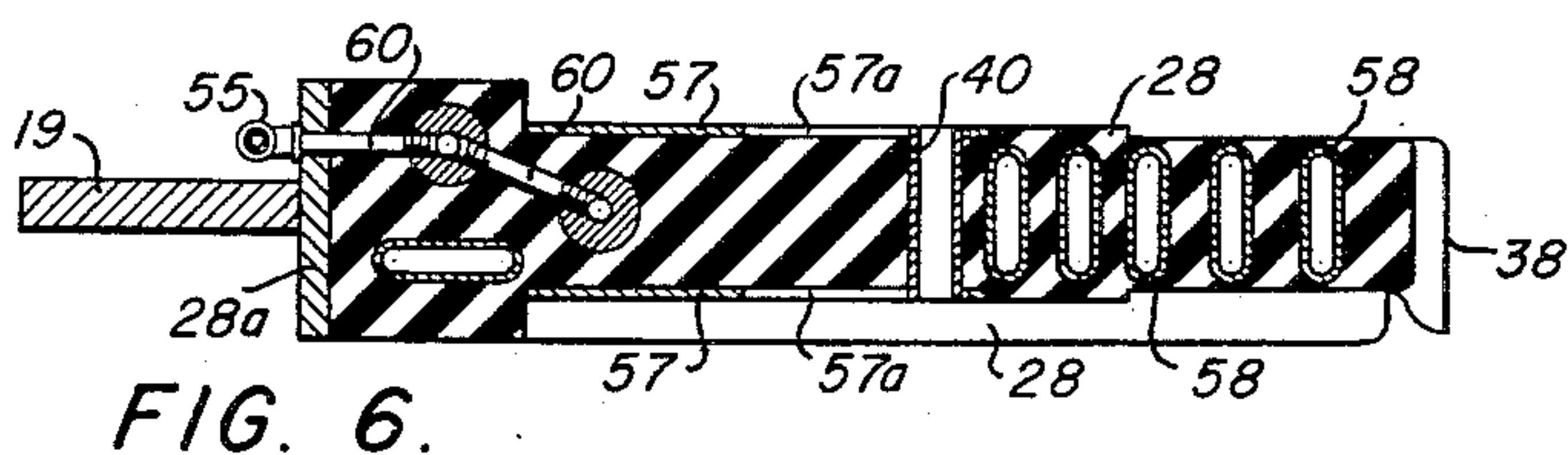
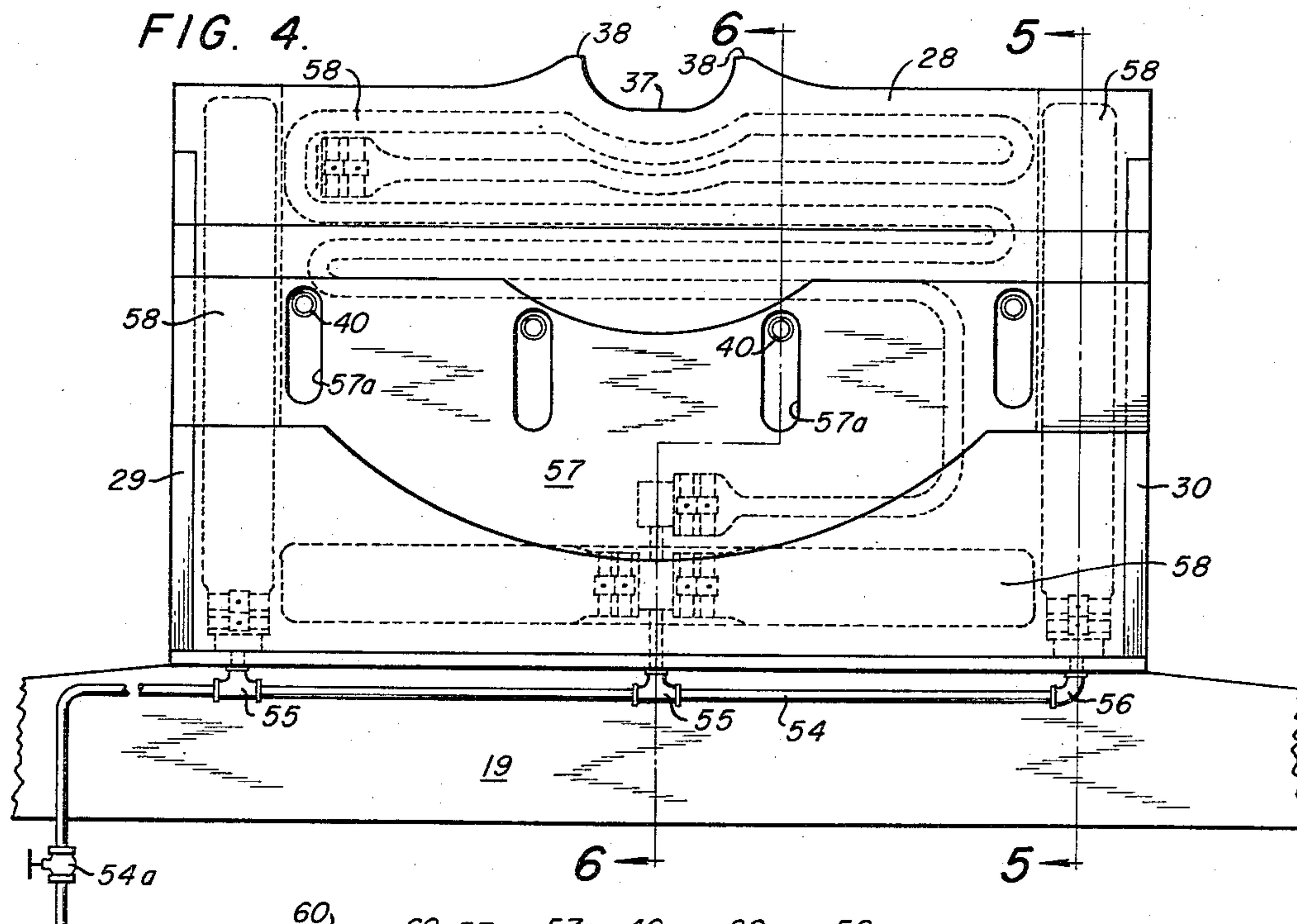
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LATERALLY ADJUSTABLE BLOWOUT PREVENTER WITH INFLATABLE RAMS

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3 Sheets-Sheet 2



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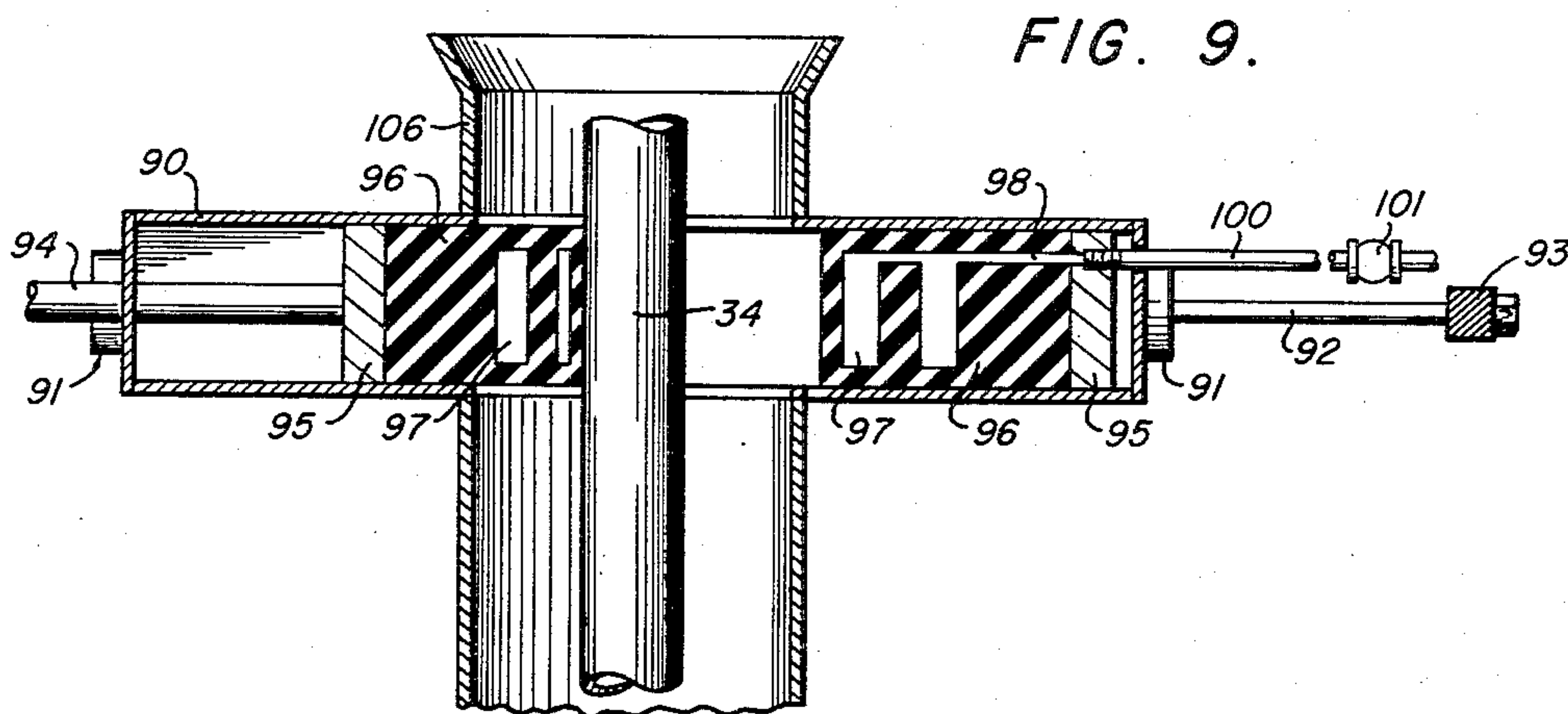
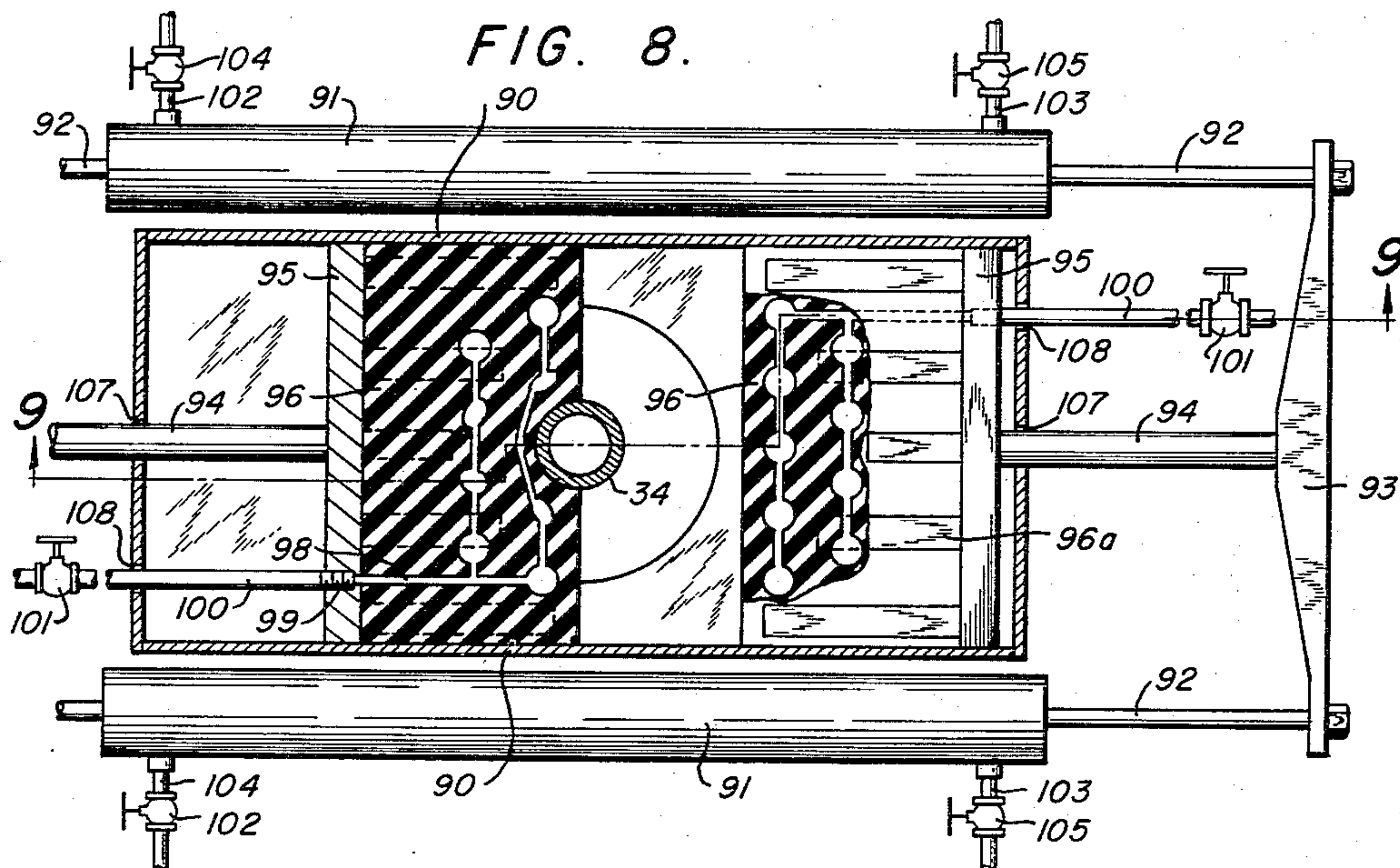
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LATERALLY ADJUSTABLE BLOWOUT PREVENTER WITH INFLATABLE RAMS

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3 Sheets-Sheet 3



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2,850,256

LATERALLY ADJUSTABLE BLOWOUT PREVENTER WITH INFLATABLE RAMS

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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 with 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

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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.

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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 57a through which the bolts 42 in sleeves 40 protrude. Slots 57a 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 54a 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 28a 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 75a 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 71a which is attached such as by welding at point 70a to the bell nipple 47. A seal between the flared ring 71a and the surface casing 70 is provided by a sealing ring 72a.

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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 54a, 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 57a.

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

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fashion to that of Figs. 1 to 7, the fingers 96a 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.

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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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