June 26, 1962 C. M. BOUVIER 3,040,763

OPERATING MEANS FOR BLOW-OUT PREVENTER FOR OIL WELLS

Filed Aug. 29, 1960 3 Sheets-Sheet 1

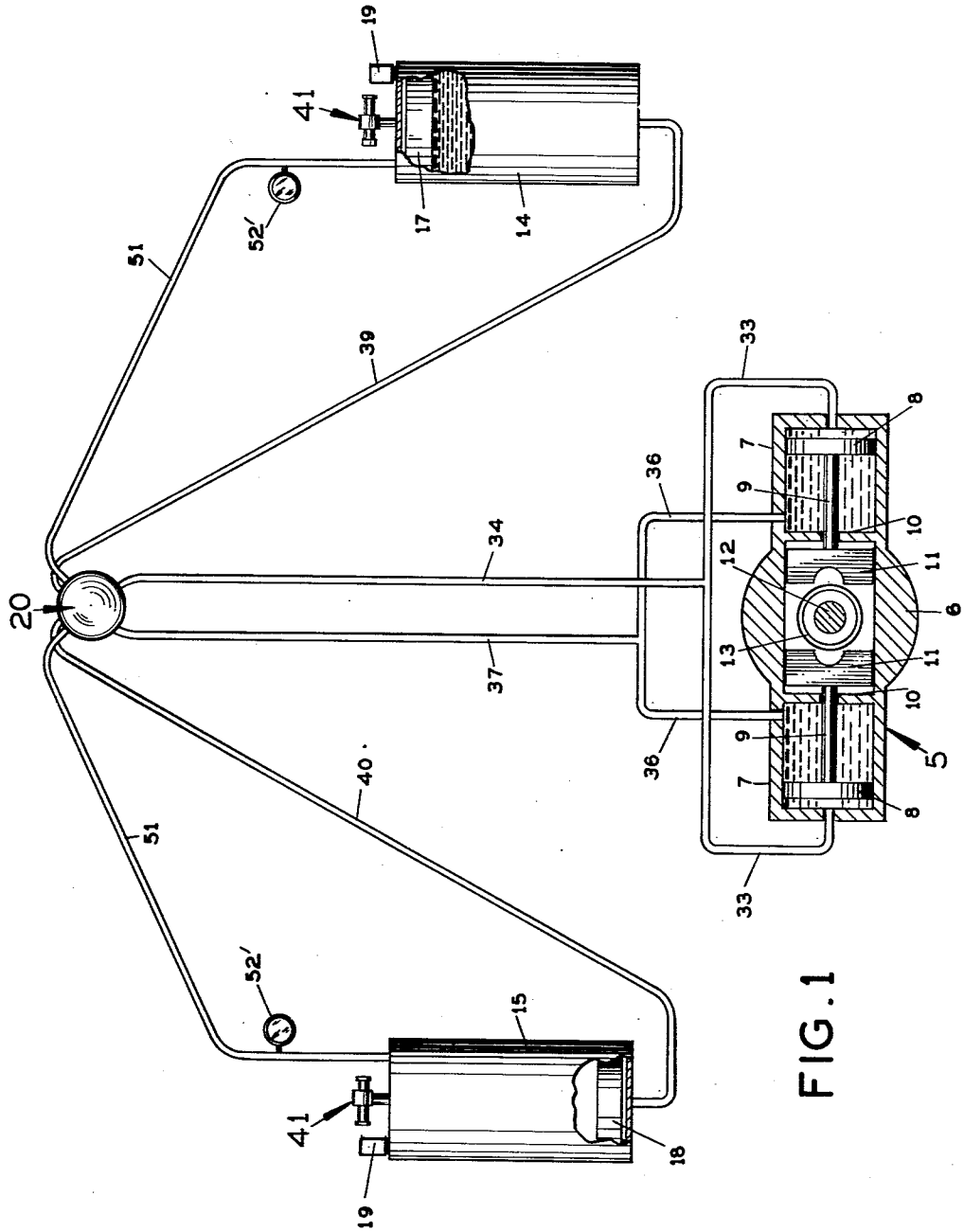


FIG. 1

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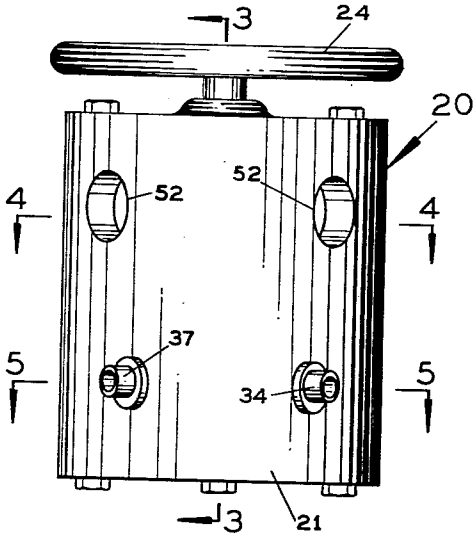


FIG. 2

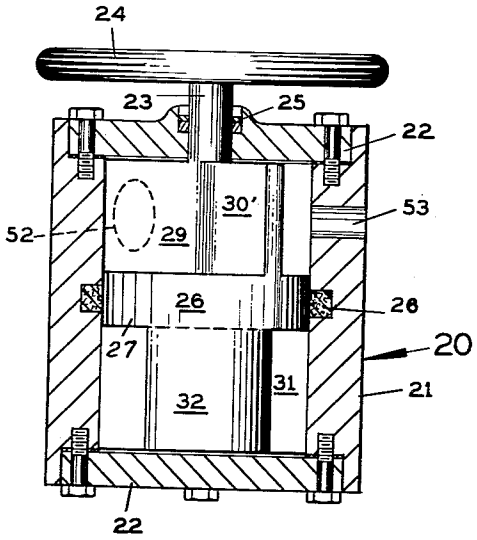


FIG. 3

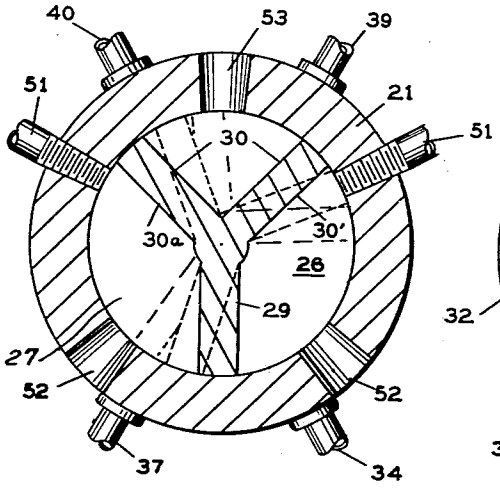


FIG. 4

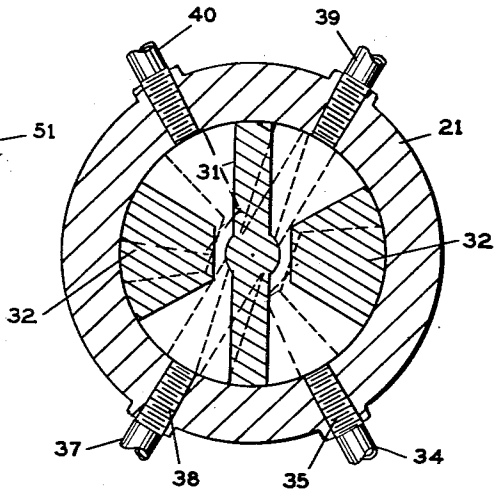


FIG. 5

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Filed Aug. 29, 1960 3 Sheets-Sheet 3

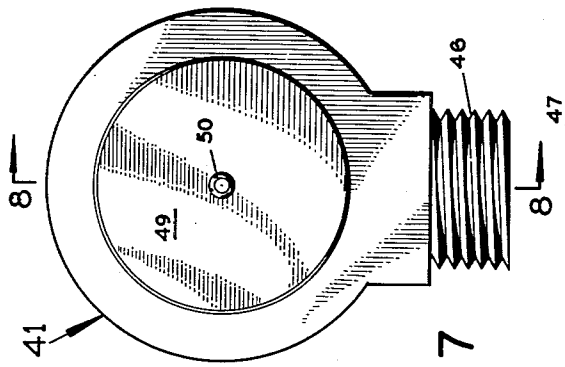


FIG. 7

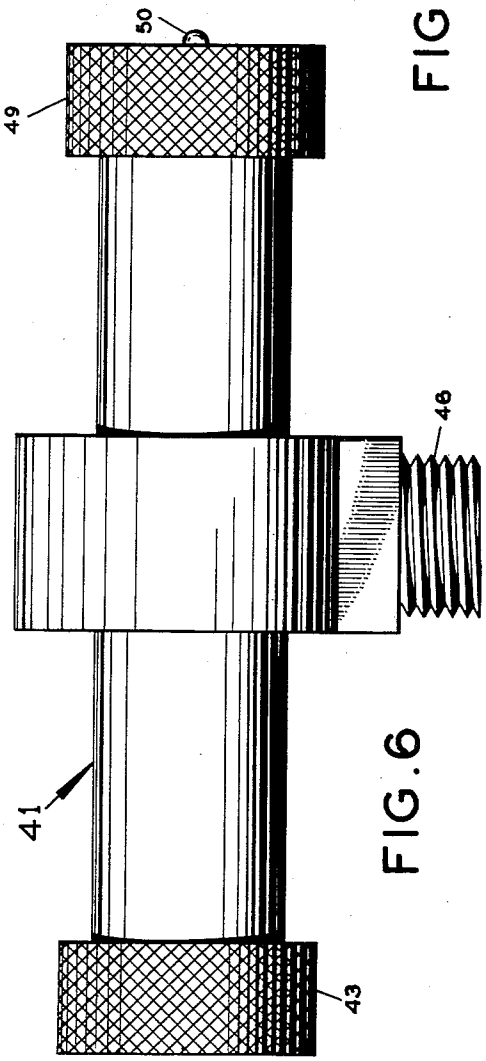


FIG. 6

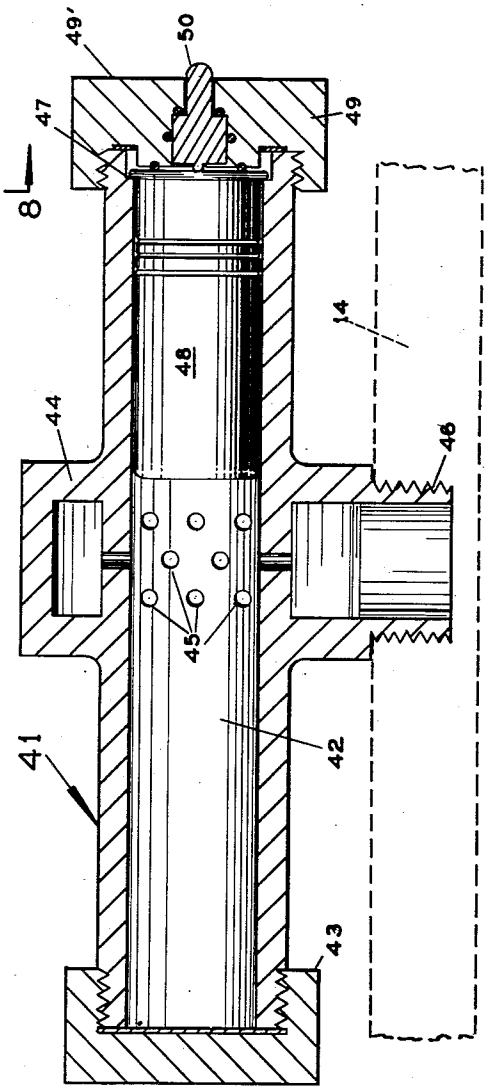


FIG. 8

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OPERATING MEANS FOR BLOW-OUT PREVENTER FOR OIL WELLS

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Filed Aug. 29, 1960, Ser. No. 52,589
9 Claims. (Cl. 137—68)

This invention relates generally to blowout preventers for oil wells and has particular reference to means for remotely actuating the blowout preventer to and from a closure position with respect to the oil well. The blowout preventer which is primarily intended to be secured to the upper end of a well casing to provide for sealing or closing off the annular space between the well casing or one of the larger pipes in a well and the well tubing or one of the other smaller pipes in a well.

Blowout preventers are basically old in the art and the invention of this application resides in providing novel means for controlling the actuation of the hydraulic means that normally functions to close and open a blowout preventer and the blowout preventer as illustrated, is primarily more or less diagrammatic and is only shown to coordinate a complete system that includes the blowout preventer in its circuit.

Blowout preventers have heretofore been actuated by hydraulic mediums that have been pressurized by pumps or the like to be stored under pressure in an accumulator until such time as the blowout preventer is to be actuated and it frequently happens that the pressure upon the hydraulic medium has been dissipated.

In the present application the blowout preventer operating mechanism comprises a pair of hydraulic cylinders, each having a floating piston therein and with the pistons rising and falling within the cylinders under the influence of pressurized hydraulic fluid. In each instance of the hydraulic cylinders, pressure is not imparted to the cylinder and the piston therein until the blowout preventer is to be actuated. The medium for pressurizing the hydraulic fluid comprises an explosive device that generates the required pressure and this pressure is directed, through the medium of control means to that cylinder that is to be pressurized and with the cylinders each representing a hydraulic closing member and a hydraulic opening member and, when the pressure is generated for instance in the hydraulic closing member, the pressure will be against the piston in that member that will force the hydraulic fluid from the cylinder through certain conduits to a master control valve and through the master control valve to a conduit leading to opposite ends of the blowout preventer to actuate ram devices that are shifted into sealing engagement with the well apparatus, simultaneously, fluid is displaced from the opening side of the blowout preventer to be bypassed through the master valve to enter the bottom of the opening cylinder where it will elevate the piston therein and it should be borne in mind, that the hydraulic system of this invention is primarily a closed circuit.

Novel features of construction and operation of the invention will be more clearly apparent during the course of the following description, reference being had to the accompanying drawings wherein has been illustrated a preferred form of the device and wherein like characters of reference are employed to denote like parts throughout the several figures.

In the drawings:

FIGURE 1 is a view illustrating the component elements of this invention in cooperative relationship to a conventional blowout preventer,

FIGURE 2 is a side elevation of a master valve employed in the system for controlling the flow of pressurized mediums and to constitute relief means to vent certain elements of the structure,

FIGURE 3 is a section taken substantially on line 3—3 of FIGURE 2 but illustrating the valve plug in elevation,

FIGURE 4 is a section taken substantially on line 4—4 of FIGURE 2,

FIGURE 5 is a section taken substantially on line 5—5 of FIGURE 2,

FIGURE 6 is a side elevation of a pressure generating device,

FIGURE 7 is a right hand end view of the device of FIGURE 6, and

FIGURE 8 is a longitudinal section taken substantially on line 8—8 of FIGURE 7.

Referring specifically to the drawings and particularly to FIGURE 1, there has been illustrated generally a blowout preventer for oil wells, indicated as a whole by the numeral **5**. The blowout preventer is conventional and as here illustrated is more or less diagrammatic. The blowout preventer embodies a casing **6** that is connected in any conventional manner to the upper end of the oil well. The casing **6** is provided with radial and opposed cylinder extensions **7**, each carrying a piston **8** that is fast to a piston rod **9**. The rods **9** in each instance operate through suitable openings in partitions **10**, and their inner ends are connected to ram devices **11**. The ram devices are of any well known construction and are adapted to engage either a drill pipe **12** or other pipe leading into the well in order to successfully block the passage of pressurized oil from the well casing **13**. No attempt has been made to detail specifically the several features of the blowout preventer, since the invention is not concerned therewith. Suffice is to say that the pistons **8** are movable in opposite directions by pressurized hydraulic medium at the convenience or will of the operator.

Disposed at any desirable location with respect to the oil well but usually at a relatively safe distance are actuating cylinders **14** and **15**. The cylinders **14** and **15** are closed at their opposite ends. Each cylinder has operatively disposed therein a relatively floating piston **17** and **18**. Each cylinder **14** and **15** is provided with any suitable maximum pressure relief valve **19**.

Adapted to have controlling connection with the cylinders **14** and **15**, through the medium of conduits, is a master valve, indicated as a whole by the numeral **20**. The master valve **20** has been shown more clearly in FIGURES 2–5 inclusive and includes a cylindrical casing **21**, open at its opposite ends and closed by cover plates **22**. One cover plate **22** is apertured for the passage of a valve stem **23**, carrying a control handle or wheel **24**. Suitable packing **25** is disposed between the valve stem **23** in the upper plate **22** to prevent escape of any fluid medium therefrom. Disposed within the housing **21** is an integrally formed valve core **26**, the valve core **26** is formed cylindrical and its central web portion **27** is sealed at **28** with respect to the housing **21**, to retard any leakage between the upper and lower halves of the valve. As will be seen in FIGURE 4, the valve structure above the web **26** is of a Y-shape, embodying a leg portion **29** and a Y-head **30**. The upper portion of the valve including the Y-shape constitutes a gas valve for the relief and control of pressurized gases that are generated upon the tops of the pistons **17** at predetermined times by explosive means to be described. The lower half of the valve core **26** constitutes a fluid valve and is operable simultaneously with the upper valve section **29**. The lower valve section below the web **27** embodies a vertical partition **31** and a pair of segments **32**. The lower valve controls the flow of pressurized medium from the closing cylinder, to the closing side of the blowout preventer and also, controls the flow of pressurized medium from

the opening tank to the opening side of the blowout preventer.

Connected to the opposite ends of the blowout preventer, are conduits 33 that are connected into a fluid closing line 34. The closing line 34 has communication with the lower chamber of the valve 26, as indicated at 35. The inner or opening ends of the blowout preventer has communication with a pressure conduit 36, connected with a conduit 37 that has communication with the lower valve section, as indicated at 38. The lower valve also has communication with the lower end of the cylinder 14, through the medium of a conduit 39. The lower valve also has communication with the lower end of the cylinder 15 through the medium of a conduit 40.

Threadedly connected to the upper ends of the cylinders 14 and 15 are pressure generating devices 41. The pressure generating devices, see particularly FIGURES 6–8 each embody an elongated pressure chamber 42 that is closed at one end by a threaded cap 43. The chamber intermediate its length communicates with an annular hollow ring 44. The hollow ring 44 communicates with the interior of the chamber 42 through the medium of relief ports 45. The ring 44 is provided with a threaded nipple 46 for securely attaching the pressure device into the head portion of the cylinders 14 and 15. The chamber 42 at its opposite end has been slightly enlarged to form an annular seat 47, that constitutes the limit means for the insertion of a pressure generating explosive cartridge 48. The cartridge 48 is substantially identical to the conventional blank shot-gun shells. The adjacent end of the chamber 42 is threaded to receive a combined clamping and sealing cap 49, that is axially chambered to receive a firing pin 50. The firing pin projects slightly beyond the face 49′ of the cap 49 where it may be struck by a suitable tool in order to fire the cartridge 48. When the cartridge 48 is fired by striking the pin 50, pressure is generated in the chamber 42, where it flows through the ports 45 and through the nipple 46 to impinge or pressurize against the pistons 17 or 18, driving the pistons downwardly for forcing the hydraulic medium from the cylinders and through the fluid lines to that side of the blowout preventer that is to be actuated. Each cylinder 14 at its upper end has communication with the upper or gas side of the valve by gas conduits 51, controlling the escape of gas from the upper side of the pistons 17 and 18 where it is caused to escape to the atmosphere. Each of the conduits 51 may be provided with any desirable pressure gauge 52′.

Operation

In assuming, that the blowout preventer is in the open position, illustrated in FIGURE 1, that the cylinder 14 is filled with suitable hydraulic fluid and that the piston 17 is in the uppermost position. Simultaneously, the cylinder 15 has been exhausted of its hydraulic fluid since it is now in the position where the blowout preventer has been actuated to the open position. The space between the piston 18 and the top of the cylinder 15 is obviously filled with air or other gaseous medium. The master valve 20 is now in the neutral position, illustrated in FIGURES 4 and 5. All of the conduits are freely communicative through the valve core. It will be understood of course that the blowout preventer and its operating pistons and cylinders and the conduits leading from the blowout preventer to the master valve and to the bottoms of the cylinders 14 and 15 are at all times filled with the hydraulic medium. Assume now that a situation has developed with respect to the oil well that requires the blocking off of the flow from the well, the operator then moves the control handle 24, shifting the valve core a relatively short movement, causing the leg 30′ of the Y-portion of the valve to close off the inlet from the conduit 51. This distance has also moved the partition 31 a distance toward the inlet from the conduit 39 but not sufficient to block the passage of fluid from the conduit through the valve and through the conduit 34. The cartridge 48 is then fired by striking upon the firing pin 50, generating a very powerful pressure that passes through the ports 45, nipple 46 to impinge upon the top of the piston 17, where it forces the oil downwardly from the cylinder 14, through the conduit 39, through the fluid valve portion and then through the conduit 34 to opposite ends of the blowout preventer where it will actuate the rams 11 to close off or seal the oil well against further discharge. Simultaneously with the actuation of the rams to the closing position, oil has been forced from the cylinders 7, through the bypass conduits 36, through the conduit 37, where it flows through the fluid valve portion of the device to pass through the conduit 40, traversing the conduit 40 and impinge upon the bottom side of the piston 18, forcing the piston 18 upwardly and expelling the air in the cylinder 15 through the conduit 51 where it is vented to the atmosphere through a vent 52. After the rams have been shifted to the closed position, the valve handle 24 is further rotated, uncovering the gas conduit 51 of the upper or gas side of the valve and covering or closing off communication from the conduit 39 to the conduit 34, thus maintaining the pressure upon the closing side of the blowout preventer. With the conduit 51 uncovered, pressurized gas will then escape from the cylinder 14 through the conduit 51 to bypass the valve flanges 30*a* and to escape to the atmosphere through a vent opening 53. The piston 17 is now at the bottom of the cylinder 14 while the piston 18 has been forced to the upper end of the cylinder 15 due to the reversal of the flow of the hydraulic medium.

When the blowout preventer is to be actuated to the open position, the valve mechanism having been initially moved to a neutral position, as illustrated, the valve is then rotated in an opposite direction and the flange member 30*a* will cover the inlet end of the conduit 51. Simultaneously, the fluid valve partition member 31 has moved adjacent to a covering position with respect to the conduit 40. The operator then explodes the cartridge in the adjacent pressure generating device 41, forcing the piston 18 downwardly, forcing the hydraulic fluid through the conduit 40, through the valve structure and to the conduit 37, where it is forced against the opposite sides of the pistons 8 to shift the rams into a release or outer position. The valve is further rotated as in the first operation explained, uncovering the gas conduit 51 from the tank 15, permitting such gas to escape through the vent 53 from the upper side of the piston 17. Simultaneously, the valve member 31 has covered the inlet end of the conduit 40, maintaining the pressure of the hydraulic medium upon the opening sides of the pistons 8. As before stated, the wing member 30′ and 30*a* first close the port or entrance end of the conduit 51 and then are movable to a further degree to permit the escape of the gaseous charge that has been exploded into the upper ends of the cylinders 14 and 15.

After the cartridge has been exploded, and the pressure generated thereby has been dissipated the cap 49 is removed for withdrawal of the cartridge 48 and to permit the installation of a new cartridge. The cap 49 is then screwed down tightly against a suitable gasket and to securely hold the cartridge in position both before and after firing. The passage of the gas through the ports 45 prevents any possibility of wads or other debris from the cartridge getting through the nipple 46 into the control cylinders 14 and 15. After a few actuations of the firing device, the end cap 43 may be removed and any accumulated wads may be easily removed.

It is therefore believed that a relatively simple but highly effective means has been provided to actuate the conventional oil well blowout preventer. The device has relatively few moving parts and presents a very novel form of pressure generating means not heretofore employed in connection with blowout preventers. The several conduits are few in number and may be connected to the blowout preventer with a minimum of effort and

with the conduits being extended away from the oil well a distance capable of constituting safety with respect to accidental damage and also to permit of an operator to safely approach the cylinders **14** and **15** for actuating the explosive charge generating device **41**. The structure is simple, strong, durable and highly effective as a means for controlling the well known blowout preventer.

While the cylinders **14** and **15** have been illustrated as having pistons **17** and **18** therein, that are actuatable against the hydraulic fluid under the influence of an explosive charge, it will be apparent that the pistons **17** and **18** could be omitted and the explosive charge pressurizing the column of hydraulic fluid in such cases where the hydraulic fluid is of a non-flammable type. Such an actuating means would be practicable and the system would function substantially identical to that illustrated.

It is to be understood that the invention is not limited to the precise construction shown, but that changes are contemplated as readily fall within the spirit of the invention as shall be determined by the scope of the subjoined claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Means for controlling the operation of a blowout preventer for oil wells of the type that comprises a pair of opposed rams that are movable in opposed relation to and from a position to interrupt the flow from the well and with the blowout preventer embodying a pair of cylinders that carry pistons having piston rods that control the movement of the rams, the means comprising a pair of hydraulic actuating cylinders and a master control valve, a conduit connected to the lower end of each hydraulic cylinder and to the master valve, conduits connected to the master valve and to the blowout preventer, one of the last-named conduits communicating with the blowout preventer to move the blow-out preventer to a closure position and the other of said last-named conduits communicating with the blowout preventer to actuate the preventer to an open position, an explosive pressurizing device connected to the tops of each of the actuating cylinders for pressurizing a hydraulic medium in the cylinders, the explosive devices being alternately actuated to close and open the blowout preventer and pressure relief conduits leading from the tops of the hydraulic cylinders to the master valve to exhaust the pressure from either of the hydraulic cylinders when a flow of pressurized hydraulic medium partakes of a reverse movement to actuate the blowout preventer to and from a closed position, the hydraulic cylinder, the hydraulic conduits and the cylinders and pistons of the blowout preventer being a closed circuit system.

2. The structure according to claim 1, wherein the hydraulic medium is oil.

3. The structure according to claim 1, wherein the hydraulic medium is a non-flammable fluid.

4. Means for controlling the movement of a blowout preventer for oil wells of the type that embodies a pair of ram devices to be movable to and from a closure position with respect to the oil well and with the blowout preventer embodying a pair of hydraulic cylinders having pistons therein and piston rods that are connected to the rams whereby to move the rams in opposed relation to the oil well pipe, the said control means for the blowout preventer embodying a pair of hydraulic cylinders and a common control master valve, one of said hydraulic cylinders constituting a closing cylinder for the rams and the other hydraulic cylinder constituting an opening cylinder for the rams, freely movable pistons operating in the hydraulic cylinders, an explosive pressure generating means disposed upon the top of each of the hydraulic cylinders to pressurize the pistons in the cylinders, a conduit leading from the bottom of the closing cylinder to the master control valve and a conduit leading from the master control valve to the closing side of the blowout preventer, a conduit leading from the bottom of the other hydraulic cylinder to the master valve and to the opening side of the blowout preventer, conduits leading from the tops of each of the hydraulic cylinders to the master control valve controlling the flow of a hydraulic medium from the closing hydraulic cylinder to the closing side of the blowout preventer back to the opening hydraulic cylinder and to simultaneously relieve pressure from the opening hydraulic cylinder to the atmosphere.

5. Means for controlling the closing and opening movement of a blowout preventer for oil wells, the means embodying a hydraulic cylinder for actuating the blow-out preventer to a closing position and a hydraulic cylinder for actuating the blow-out preventer to an opening position, a master control valve that communicates with both of the hydraulic cylinders, fluid conduits leading from the bottoms of each hydraulic cylinder to the control valve, a fluid conduit leading from the control valve to the closing side of the blowout preventer and a fluid conduit leading from the control valve to the opening side of the blowout preventer, the cylinders, the piston chambers and the conduits controlling a flow of a hydraulic medium in a closed circuit system, an explosive charge pressure generating device upon the tops of each of the hydraulic cylinders, pistons in each hydraulic cylinder that are movable upwardly by hydraulic pressure and movable downwardly by the explosive charge pressure to alternately control the flow of the hydraulic medium to the blowout preventer for a closing and opening movement, a gaseous pressure relief conduit leading from the top of the closing hydraulic cylinder to the control valve and to the atmosphere and a pressure relief conduit leading from the top of the opening hydraulic cylinder to the atmosphere, the control valve being chambered to control both the fluid pressure flow and the gaseous relief in a controlled cycle.

6. The structure according to claim 5, wherein the control valve comprises a cylindrical housing open at its opposite ends, closure caps for the opposite ends of the housing, a cylindrical valve core rotatable in the housing and with the core dividing the housing into a lower fluid chamber and an upper gas chamber, spaced apart ports in the housing upon one side that communicate with the lower chamber and the fluid conduits from the bottoms of hydraulic cylinders and ports upon the opposite side of the housing that communicate with the fluid conduits leading to the blowout preventer, the core having a lower abutment that controls the flow of pressurized hydraulic medium from the closing hydraulic cylinder to the closing side of the blowout preventer and to permit the flow of pressurized hydraulic medium from the opening side of the blowout preventer to the bottom of the opening hydraulic cylinder when the core is rotated a predetermined degree and to block and reverse flow of the hydraulic medium from the blowout preventer when the core is additionally rotated in the same direction, the core being reversible in an opposite direction to control a pressurized fluid medium from the opening hydraulic cylinder to the blowout preventer, the core having an upper abutment, the housing having spaced apart ports in its side walls that communicates with the upper chamber, one port being connected to the top of the opening hydraulic cylinder by a gas conduit and the other port being connected to the top of the closing hydraulic cylinder, other ports communicating with the upper chamber and the atmosphere, the last-named abutment functioning to interrupt the flow of gas from the tops of either hydraulic cylinder when the core is rotated a predetermined degree in either direction and a common operating handle whereby the core is rotated to control the flow through either chamber.

7. The structure according to claim 5, wherein the pistons in the hydraulic cylinders are alternately elevated under the influence of a reverse flow of the pressurized hydraulic medium in accordance with the closing and opening movement of the blowout preventer, the explosive charge pressure generating devices being alternately

actuatable to drive a piston in the closing hydraulic cylinder downwardly to force a column of the hydraulic medium through the system to close the blowout preventer or to drive a piston in the opening hydraulic cylinder downwardly to force a column of hydraulic medium through the system to open the blowout preventer, the explosive charge pressure upon the tops of the pistons being exhausted through the control valve as the pistons are elevated upon a reverse flow of the hydraulic medium, pressure relief valves disposed upon the tops of each hydraulic cylinder for relieving excessive pressure and pressure indicating gauges disposed in each gaseous relief conduit.

8. The structure according to claim 5, wherein the explosive charge pressuring devices for each hydraulic cylinder comprises an elongated firing chamber open at its opposite ends, a closure cap for one end of the chamber, the opposite end of the chamber having an enlarged bore to form a seat for a ferrule carried by an explosive cartridge and whereby the cartridge is disposed in the chamber, a closure cap for the opposite end of the chamber and that bears against the cartridge, a firing pin in the last named cap that projects outwardly of the cap and that is movable to fire the cartridge, the cylinder intermediate its length being provided with a circumferential hollow manifold that communicates with the cylinder, the manifold at one side being provided with a threaded nipple that has threaded engagement into a threaded aperture of the tops of the hydraulic cylinders.

9. Means for controlling the operation of a blowout preventer for oil wells and with the blowout being of the type that is movable to and from a position to interrupt the flow from the well, the blowout preventer being hydraulically actuated to a closing position and hydraulically actuated to an opening position with respect to the well thus embodying a closing side and an opening side,

a pair of hydraulic actuating cylinders and a master control valve, a conduit connected to the lower end of each hydraulic cylinder and communicating with the master valve, conduits connected to the master valve and to the blowout preventer, one of the last named conduits communicating with the closing side of the blowout preventer and the other of said last named conduits communicating with the opening side of the blowout preventer, an explosive pressurizing device connected to the tops of each of the actuating cylinders for pressurizing a hydraulic medium in the cylinders, the explosive devices being alternately actuated to close and open the blowout preventer and pressure relief conduits leading from the tops of the hydraulic cylinders to the master valve to exhaust the pressure from either of the hydraulic cylinders when a flow of pressurized hydraulic medium partakes of a reverse movement in their cycle of operation for controlling the blowout preventer, the master valve embodying both a gas chamber and a fluid chamber, the first named conduits leading from the bottoms of the actuating cylinders having communication through the fluid chamber and to the blowout preventer, the pressure relief conduits being connected to the master valve through the gas chamber and to the atmosphere, the hydraulic conduits, the actuating cylinders and the blowout preventer being a closed circuit system.

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