Feb. 6, 1951 B. C. CHRISTENSEN 2,540,322

DEVICE FOR TESTING BLOWOUT PREVENTERS AND CASING

Filed Aug. 22, 1947 2 Sheets-Sheet 1

Fig. 1.

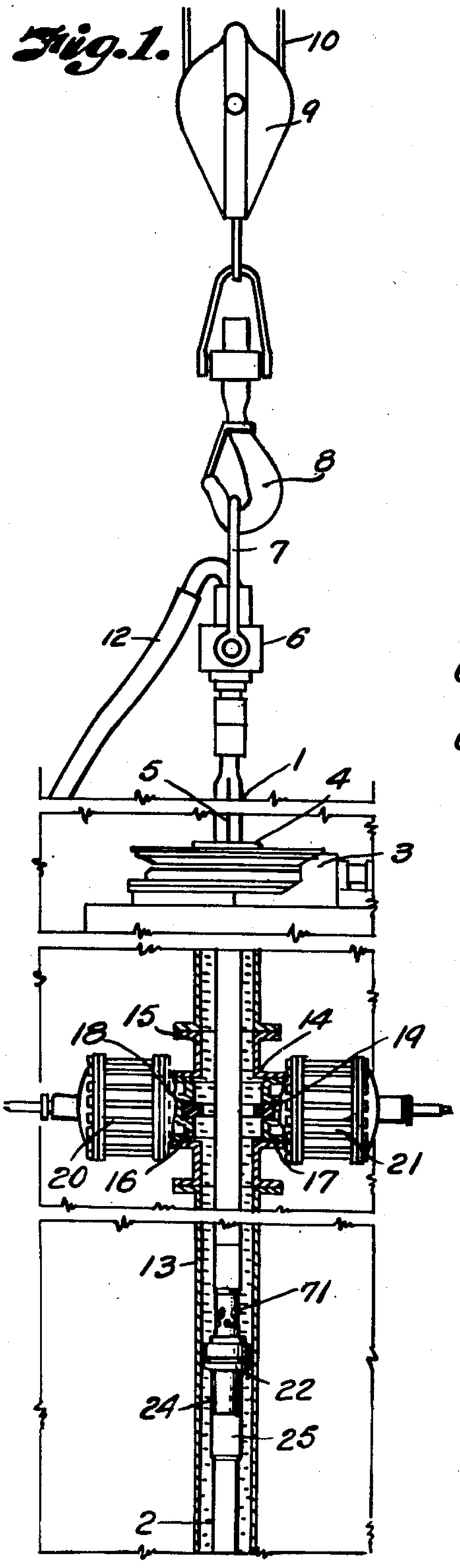
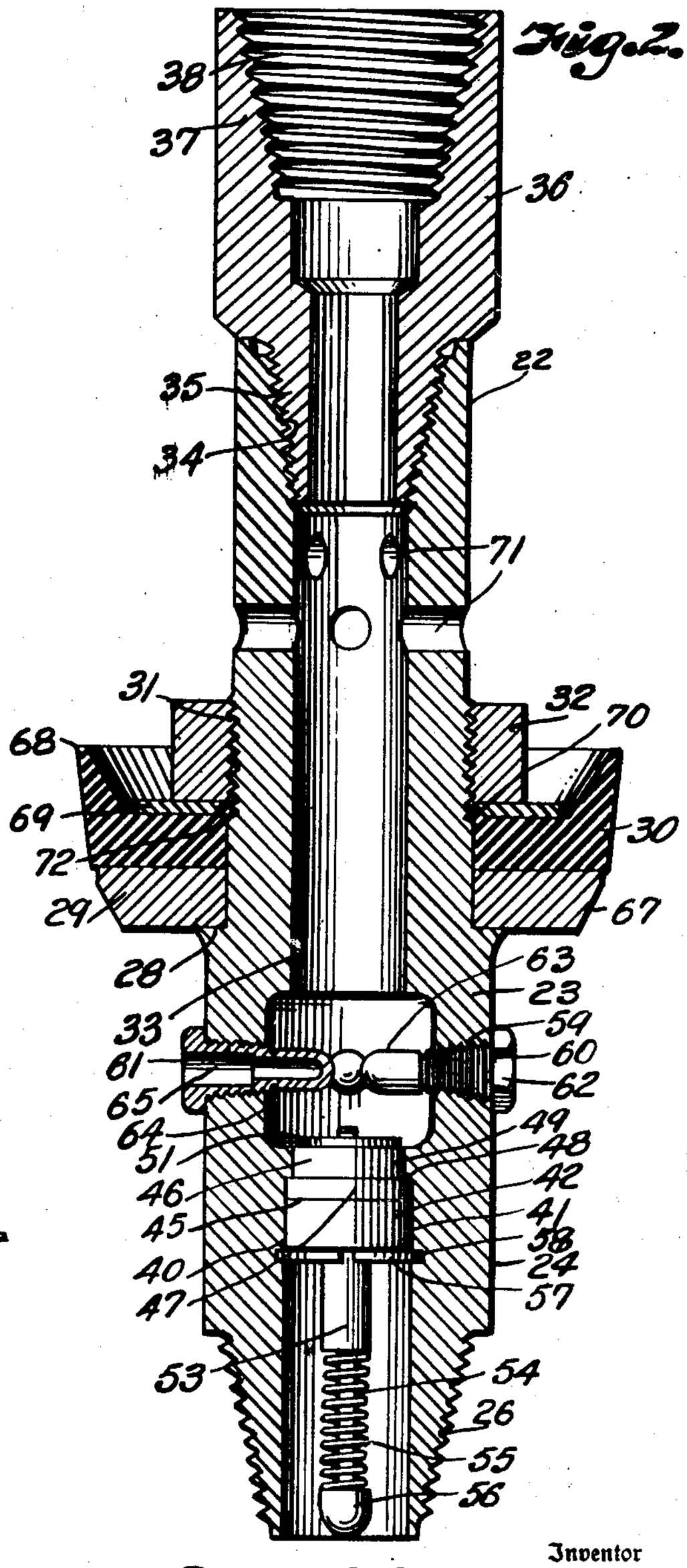


Fig. 2.



Inventor

Byron C. Christensen.

By Fishburn & Mullendore

Attorney

Feb. 6. 1951 B. C. CHRISTENSEN 2,540,322

DEVICE FOR TESTING BLOWOUT PREVENTERS AND CASING

Filed Aug. 22, 1947 2 Sheets-Sheet 2

Fig. 3.

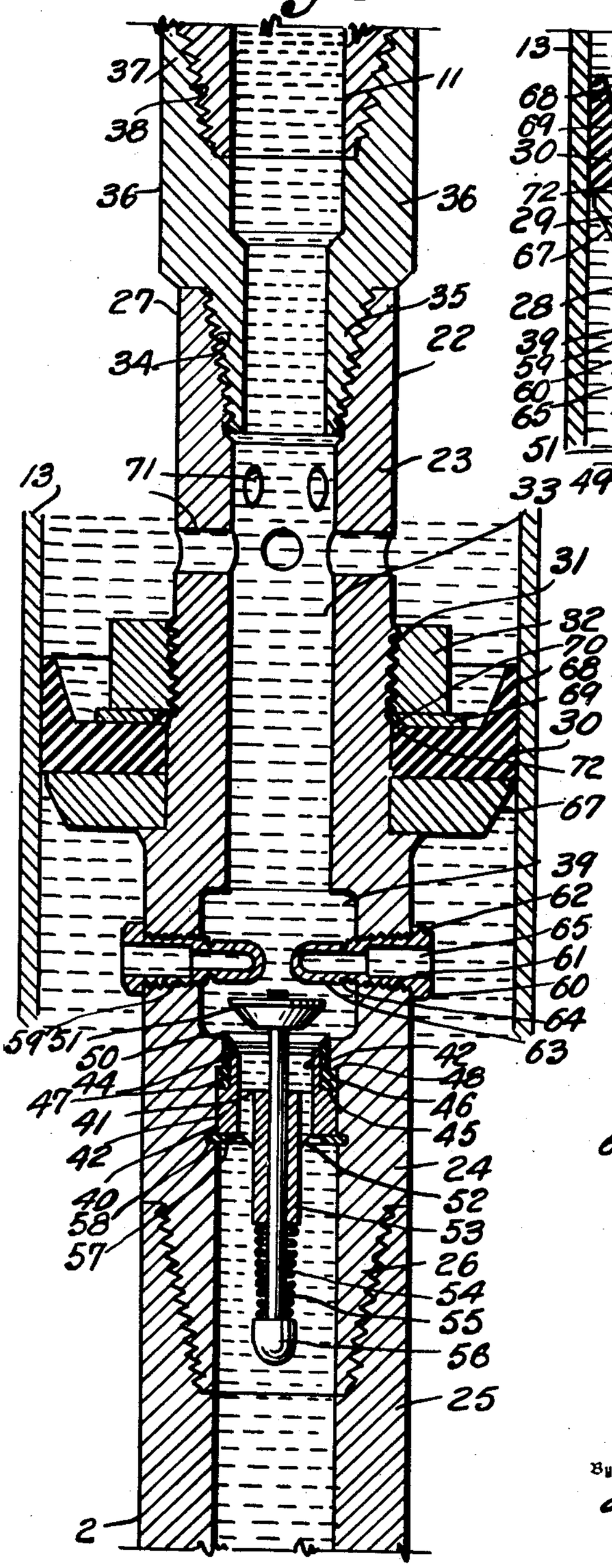


Fig. 4.

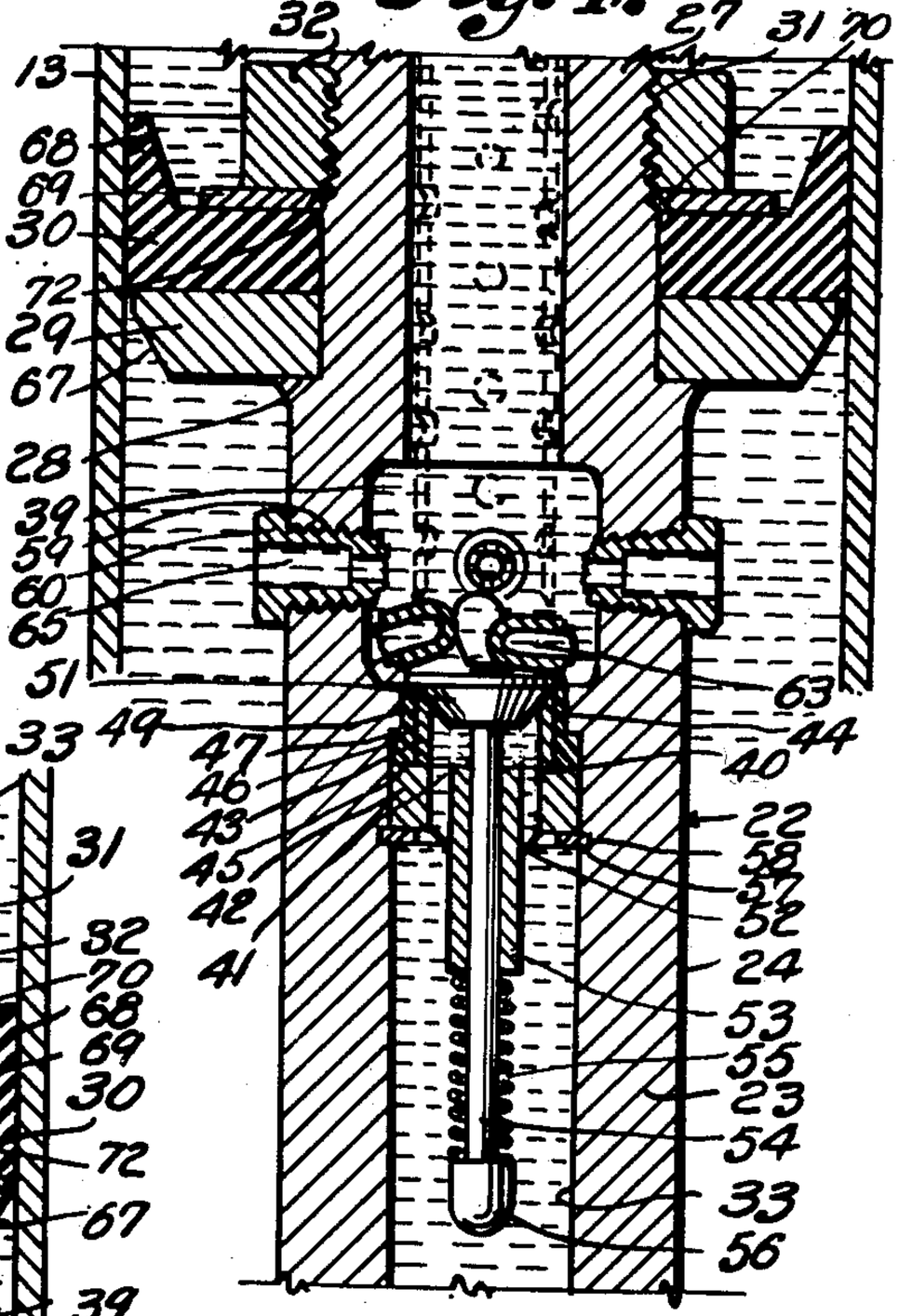
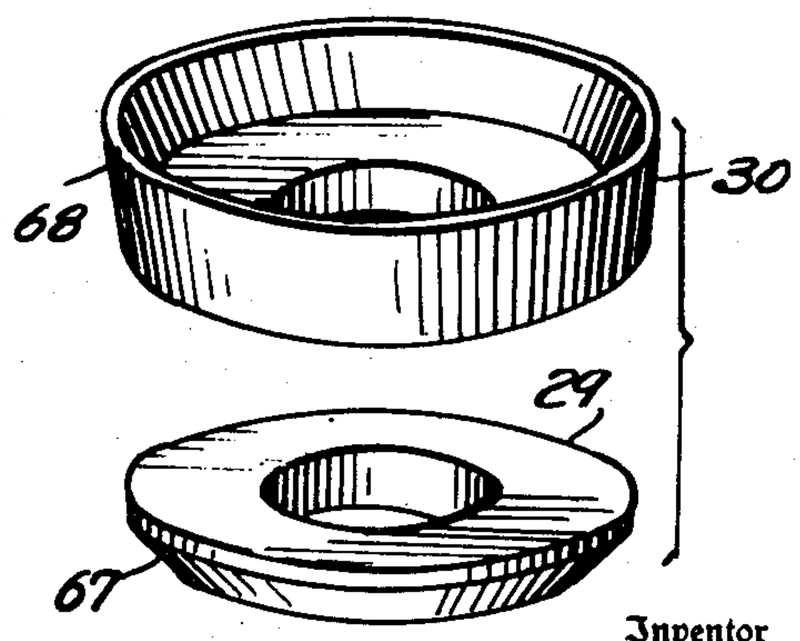


Fig. 5.



Inventor

Byron C. Christensen

By Fishburn & Mullendore

Attorney

Patented Feb. 6, 1951 2,540,322

UNITED STATES PATENT OFFICE

2,540,322

DEVICE FOR TESTING BLOWOUT PREVENTERS AND CASING

Byron C. Christensen, Oklahoma City, Okla., assignor to Drilling Equipment Mfg. Co., Oklahoma City, Okla., a corporation of Oklahoma

Application August 22, 1947, Serial No. 770,058

7 Claims. (Cl. 73—37)

1

This invention relates to a device for use in testing blowout preventers and/or casing during drilling operations through pressure producing formations. For example, in rotary drilling of wells, blowouts are apt to occur when an unknown formation pressure becomes greater than the head pressure of the drilling fluid. To guard against this difficulty the innermost string of well casing is equipped with a blowout preventer, one type of which comprises a valve-like body that is connected into the casing near the top of the well and usually at a point within the cellar below the platform of the drilling rig. Located in the valve-like body is a pair of rams having packing elements adapted to seal about the drill pipe and prevent the well pressure from blowing out through the casing. Such equipment is emergency equipment and may never be required during drilling of a well; however, most drilling companies require that such blowout preventers be tested periodically to assure that they remain in proper condition to meet emergencies.

In making the test, the rams are actuated to close the space between the drill pipe and casing, for example, once every twenty-four hours and the mud pumps are operated to apply pressure of the drilling fluid against the blowout preventers to give the desired test. Heretofore in making this test it has been necessary that the test pressure go to the bottom of the bore hole with the result that the high pressure acts on the formation and may cause it to break down and produce caving of the walls of the bore hole. Thus, the test required of the blowout preventer produces a hazard which may result in expensive operations or tools and perhaps loss of the well.

It is, therefore, the principal object of the present invention to provide a device which may be connected into the string of drill pipe and run into the casing to any point below the blowout preventer for preventing the test pressure from acting on the formation.

Other objects of the invention are to provide a device of this character that may be run into the casing without putting pressure on the formation incidental to the running in operation and when in position will stop any test pressure from reaching the formation. It is also an object of the invention to provide a structure which is adapted to be pulled with the drill pipe without swabbing or pulling a vacuum within the casing that might result in a reduction of the head of drilling fluid below the formation pressure.

Other objects of the invention are to provide a testing device that is of simple and inexpensive

2

construction; to provide a testing device having a removable sealing element and support therefor so that these parts may be removed and replaced with corresponding parts of different size when a different size string of casing is run into a bore hole.

In accomplishing these and other objects of the invention hereinafter pointed out, I have provided improved structure, the preferred form of which is illustrated in the accompanying drawing wherein:

Fig. 1 is a diagrammatic elevational view of a well drilling apparatus including a casing and a blowout preventer connected therein and showing the present invention attached to a string of drill pipe.

Fig. 2 is a vertical section through the testing device before it is connected into a drilling string.

Fig. 3 is a similar section through the device showing it connected into a drilling string and being lowered through the casing of a well, the pressure holding valve being held in unseated position by the drilling fluid to prevent building up of pressure on the formation.

Fig. 4 is a similar fragmentary view of the structure illustrated in Figure 3 but showing the valve in seated position and the shear plugs broken off to effect flow of drilling fluid during removal of the drill pipe without pulling a vacuum on the formation or causing swabbing out of the casing.

Fig. 5 is a perspective view of a sealing ring and its supporting plate removed from the body of the testing device.

Referring more in detail to the drawings:

1 designates a drilling apparatus including a string of drill pipe 2 to which the drill bit (not shown) is connected and which is adapted to be rotated by a turntable 3 usually located on the derrick floor and which is equipped with slips 4 for driving the kelly rod 5 that is connected to the upper end of the drill pipe. Connected with the kelly rod is a swivel 6 supported by a bale 7 from the hook 8 of a traveling block 9, the traveling block being supported from the crown block of the derrick by a tackle cable 10 as in usual practice.

The drill pipe usually comprises a plurality of pipe sections that are interconnected by pin and box tool joints to form a continuous duct 11 (Fig. 3) leading from the swivel 6 to the bit at the bottom of the well for the flow of a drilling fluid, the drilling fluid being supplied under high pressure from the mud pumps (not shown) through a duct 12 that is connected with the

swivel 6. The drilling fluid on flowing through the bit washes the cuttings upwardly within the bore hole exteriorly of the drill pipe and through a casing 13 that has been set into the bore hole. The drilling fluid also performs the important function of maintaining a static head on the formation to prevent infiltration of formation pressures.

It is well known that careful rotary drilling and maintenance of a drilling fluid of proper consistency and weight will prevent blowouts into the bore hole; however, blowouts may occur through loss of drilling fluid in underground cavitives, and such blowouts are controlled by equipping the casing 13 with a blowout preventer 14 which includes a valve-like body 15 adapted to be connected into the casing and which is provided with diametrically opposed rams 16 and 17 having packing elements 18 and 19 that are adapted to seal off the space between the casing and drill pipe when the rams are actuated by steam or water pressure cylinders 20 and 21 that are connected therewith.

As above stated, blowout preventers are emergency equipment and may not be required during the drilling of a well; however, most companies require that the blowout preventers be tested from time to time to determine the serviceability thereof and this is effected by actuating the rams to effect a seal with the drill pipe and by actuating the pumps to materially increase the pressure of the drilling fluid being circulated upwardly between the casing and drill pipe. The increase in pressure on the drilling fluid, therefore, acts throughout the depth of the bore hole with the result that excessive pressures are applied to the formation which in many cases may weaken the formation to the point where cavings occur and it is the purpose of the present invention to prevent this hazard by equipping the drill pipe at a point below the blowout preventer and above the lower end of the casing with a shutoff or testing device 22 now to be described.

The testing device is best illustrated in Fig. 2 and includes a substantially cylindrical body 23 having a lower portion 24 substantially conforming to the outer diameter of the box end 25 of a tool joint on one of the drill pipe sections and which is provided with an externally threaded pin 26 for engaging the internal threads of the box. The upper portion 27 of the cylindrical body is of smaller diameter to provide an annular shoulder 28 on which a ring-shaped plate 29 is adapted to be mounted for supporting a packing ring 30 as later described. The portion 27 is provided in upwardly spaced relation from the shoulder 28 with external threads 31 for mounting a nut 32 to retain the packing ring against the supporting plate 29 as later described. The body thus formed has an axial bore 33 that forms a continuation of the bore 11 through the drill pipe and has an internally threaded counterbore 34 to receive the threaded pin end 35 of an adapter 36 which is provided with a box 37 having internal threads 38 conforming to the threads of a conventional pin or a tool joint to secure the next upper section of drill pipe. Formed in the bore 33 at a point preferably below the level of the shoulder 28 is an enlarged recess of compartment 39 which connects with the lower portion of the bore through a shutoff valve assembly 40.

The valve assembly 40 includes a spider-like cage 41 having a head portion 42 corresponding to the diameter of the bore to snugly fit therein.

The cage also includes a collar portion 43 of reduced diameter and which has an inwardly bevelled end providing a valve seat 44. Seated on the shoulder 45 that is provided on the cage is a packing ring 46 having a flange portion 47 that is clamped between the shoulder and an internal annular shoulder 48 in the bore 30. The ring also includes an upwardly etxending sleeve portion 49 in encircling relation with the collar 43 and which projects slightly above the seat 44 as indicated at 50 (Fig. 3) to cooperate with the seat in effecting a positive seal of the valving member 51 when the valving member engages the seat as shown in Figs. 2 and 4. The cage also includes a spider 52 supporting a tubular axial guide 53 in which is slidably mounted the stem 54 of the valve 49 for guiding the valve to and from its seat under control of a coil spring 55 that is sleeved over the valve stem and has one end bearing against the guide and the other end against a head 56 attached to the depending end of the valve stem. The cage is retained in position with the flange of the packing ring in sealing contact with the shoulder 48 by means of a split expanding ring 57 which has its peripherial edge seated in an annular groove 58 formed within the interior of the bore 30 as shown in Fig. 2, 3 and 4. Formed in the wall of the cylindrical body in registry with the chamber 39 are a plurality of internally threaded openings 59 for mounting shear plugs 60. Each plug includes an externally threaded nipple-like body 61 having a polygonal-shaped head 62 adapted to be engaged by a suitable wrench with which the plugs may be turned into and out of the internally threaded openings 59. The inner ends of the nipples have hollow snap lugs 63 which have annular grooves 64 adjacent their juncture with the nipple-like bodies of the plug to provide lines of shear on which the plugs snap off for a purpose later described. The hollow interior of the snap off lugs connect with bores 65 opening outwardly through the nipple-like bodies of the lugs as shown in Fig. 3. When the snap off lugs are intact, bores 65 of the nipple-like bodies are closed to flow of drilling fluid therethrough, however, when the snap lugs are broken off by a section of tubing (Fig. 4) dropped through the drill pipe, the liquid in the drill pipe drains therethrough into the casing. The supporting plate 29 includes a ring-like body having downwardly beveled periphery 67 to facilitate passage into the upper end of the casing and the plate is of a diameter to provide support for the packing ring. The packing ring is sleeved over the reduced end of the tubular body of the device and has an upwardly extending and outwardly flaring flange 68 which sealingly engages the inner face of the casing under pressure applied to the drilling fluid. The packing ring is retained in position by a washer 69 having a downwardly beveled inner periphery 70 into which a portion of the packing ring is extruded to effect tight seal about the body of the device upon application of the nut 32. Formed in the body of the device about the threads which mount the nut 32 is a plurality of radially extending ports 71 through which pressure of the drilling fluid is exerted onto the drilling fluid carried above the sealing ring to test the packing elements of the blowout preventer as later described.

In assembling the device for insertion within a casing of a given diameter, a proper diameter supporting plate 29 and sealing ring 30 is selected. The plate and sealing ring are sleeved

over the reduced end 27 of the tubular body 23 of the device so that the supporting plate 29 seats on the shoulder 28. The washer 69 is then applied to be followed by the nut 32 which is turned onto the threads 31 until the sealing ring is adequately clamped between the washer 69 and supporting ring 29 and to extrude a portion 72 thereof into the space provided by the inner beveled periphery 70 of the washer 69. A set of shear plugs 60 are then threaded into the openings 59 to close the openings. The valve assembly 41 is then inserted through the lower end of the bore 33 in the tubular body and the cage 41 retained in position by the snap ring 57.

The device thus assembled is then connected with the tool joint 25 of a section of drill pipe tubing in the bore hole and an adapter fitting 36 is mounted on the upper end of the device to connect the tool joint of the next upper section of drill pipe as shown in Fig. 3. A string of drill pipe is then lowered into the well to position the testing device at the desired distance below the blowout preventer. The rams are then actuated to close the sealing elements 16 and 17 onto the drill pipe and the mud pumps are operated to increase the pressure of the drilling fluid being admitted to the drill pipe through the swivel 6. During lowering of the drill pipe within the casing, the pressure underneath the packing ring 30 is relieved through the drill pipe upon automatic opening of the valve 51 against action of the spring 55 (as shown in Fig. 3). When the device has reached a desired position the pressures above and below the valve 51 equalize so that the spring 55 is effective in closing the valve. Then when the pressure is increased the pressure in the drill pipe is transmitted through the openings 71 to act on the fluid trapped between the sealing element 30 and the packing elements 18 and 19 of the blowout preventer 14. Pressures may be established up to the capacity of the pumps, which pressures are noted on the usual gauges (not shown). If the blowout preventer prevents leakage of the liquid at pressures up to the capacity of the pumps, the blowout preventer is considered in serviceable condition to hold pressures at least as high as the test pressure. If it is desired to provide a higher pressure than is possible with the mud pumps, the tackle 10 may be actuated to provide an upward lift on the drill pipe which applied additional pressure to the liquid trapped between the sealing ring 30 and the blowout preventer.

After the test has been completed and it is desired to remove the test device, a section of tubing, illustrated by the dotted lines (Fig. 4), is dropped through the upper end of the drill pipe to shear off the snap plugs which snap plugs drop into the chamber above the shutoff valves and are trapped therein so that they cannot be lost in the bore hole. Then when the drill pipe is raised the fluid in the drill pipe will flow out through the bores of the plugs to avoid creation of a vacuum and swabbing action of the sealing ring when the device is being drawn upwardly through the casing, thereby preventing loss of head in the drilling fluid and maintaining the desired pressure of the drilling fluid on the formation being drilled.

From the foregoing it is obvious that I have provided a test device which is of simple and inexpensive construction and which operates to prevent the hazards caused by the usual testing of blowout preventers. It is also obvious that devices may be lowered to any point within a casing so as to pressure test any portion of the casing.

What I claim and desire to secure by Letters Patent is:

1. A device of the character described including a tubular body having upper and lower ends adapted to be connected between the tool joint connections of a drill pipe and provided with a lateral fluid outlet, packing means carried on and encircling the tubular body below said outlet for sealing contact with a casing through which the drill pipe is extended, a check valve in the tubular body below the fluid outlet and having a valving member adapted to open against pressure incidental to running of the drill pipe into the casing and adapted to close under pressure of drilling fluid admitted through the upper end of the drill pipe for diverting the drilling fluid through said outlet into the casing.

2. A device of the character described including a tubular body having upper and lower ends adapted to be connected between the tool joint connections of a drill pipe and provided with a lateral fluid outlet, packing means carried on and encircling the tubular body below said outlet for sealing contact with a casing through which the drill pipe is extended, a check valve in the tubular body below the fluid outlet and having a valving member adapted to open against pressure incidental to running of the drill pipe into the casing and to close under pressure of drilling fluid admitted through the upper end of the drill pipe for diverting the drilling fluid through said outlet into the casing, and means carried by the tubular body for substantially equalizing pressure above and below the packing means.

3. A device of the character described including a tubular body having ends adapted to be connected between the tool joint connections of a drill pipe and provided with vertically spaced outlet openings, packing means carried on and encircling the tubular body between said outlet openings for sealing contact with the casing through which the drill pipe is extended, a check valve in the tubular body and adapted to open against pressure when the drill pipe is run into the casing and to close under pressure of drilling fluid admitted through the upper end of the drill pipe for diverting the drilling fluid through said outlet above the packing means, a hollow plug closing the outlet below said packing means and having a snap off lug adapted to effect drainage of the drilling fluid through the hollow plug for equalizing the pressure above and below the packing means upon withdrawal of the drill pipe from the casing.

4. A device of the character described including a tubular body having ends adapted to be connected between the tool joint connections of a drill pipe and provided with upper and lower outlet openings and having an annular shoulder intermediate said openings, a packing supporting ring carried on said shoulder, a packing member supported on said ring and adapted to sealingly engage a casing in which the drill pipe is extended, means for removably retaining the packing member in clamping contact with said supporting ring, a check valve in the tubular body and adapted to open against pressure when the drill pipe is run into the casing and to close under pressure of drilling fluid admitted through the upper end of the drill pipe for diverting the drilling fluid through the upper outlet opening, a hollow shear plug closing the lower outlet opening and having a snap lug adapted to be disengaged from the hollow shear plug for draining

drilling fluid from the drill pipe to equalize pressure above and below the packing ring upon withdrawal of te drill pipe from the casing.

5. A device of the character described including a tubular body having ends adapted to be connected between the tool joint connections of a drill pipe and provided with vertically spaced outlet openings, said tubular body having a chamber registering with the lower outlet opening, packing means carried on and encircling the tubular body between said outlet openings for sealing contact with the casing through which the drill pipe is extended, a check valve in the tubular body and adapted to open against pressure when the drill pipe is run into the casing and to close the bottom of said chamber under pressure of drilling fluid admitted through the upper end of the drill pipe for diverting the drilling fluid through said outlet above the packing means, a hollow plug closing the outlet to said chamber and having a snap off lug projecting into the chamber and adapted to break off when an object is dropped through the drill pipe to effect drainage of the drilling fluid through the hollow plug for equalizing the pressure above and below the packing means upon withdrawal of the drill pipe from the casing.

6. A device of the character described including a tubular body having differentially sized upper and lower ends to provide an intermediate shoulder and having outlet openings above said shoulder, annular packing and packing supporting members sleeved over the smaller of said ends and seated on said shoulder, a nut threaded onto said smaller end for retaining the packing member against the supporting member and the supporting member against said shoulder, an upwardly opening check valve closing the larger end of the

tubular body, a threaded pin on the larger end for engaging the box end of a tool joint, and an adapter threaded into the smaller end and having an internally threaded box to receive the pin end of a tool joint.

7. A device of the character described including a tubular body forming a passageway and having differentially sized upper and lower ends to provide an exterior annular shoulder, said tubular body having outlet openings located above and below said shoulder, annular packing and packing supporting members sleeved over the smaller end for support on said shoulder, clamping means engaged with said tubular body and cooperating with said shoulder for retaining the packing and its supporting members, an upwardly opening check valve closing the larger end of the tubular body and located below said outlet openings, and frangible means closing the outlet openings below said shoulder to provide bypass of fluid through the tubular body when the check valve is closed and the frangible means is broken for flow of fluid through said outlet opening below said shoulder.

BYRON C. CHRISTENSEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,067,499	Millmine	Jan. 12, 1937
2,109,745	Hayward	Mar. 1, 1938
2,113,856	Parks	Apr. 12, 1938
2,164,195	Waltermire	June 27, 1939
2,216,268	Fritsche	Oct. 1, 1940
2,334,303	Allen	Nov. 16, 1943