Aug. 29, 1933. H. P. WICKERSHAM ET AL 1,924,425

BLOW-OUT PREVENTER

Original Filed May 28, 1931

Fig. 1.

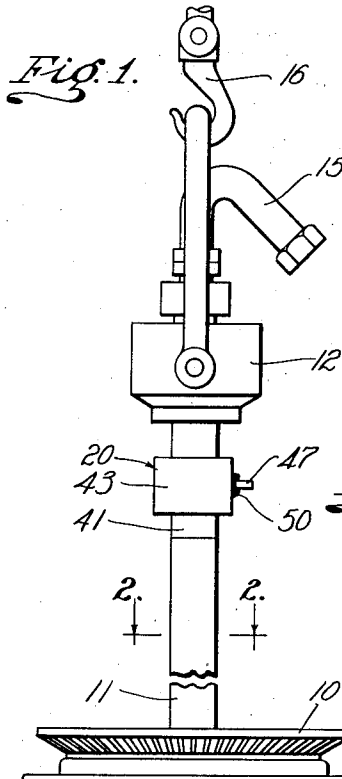


Fig. 4.

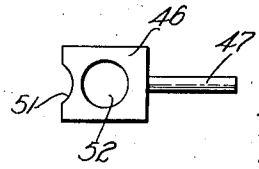


Fig. 3.

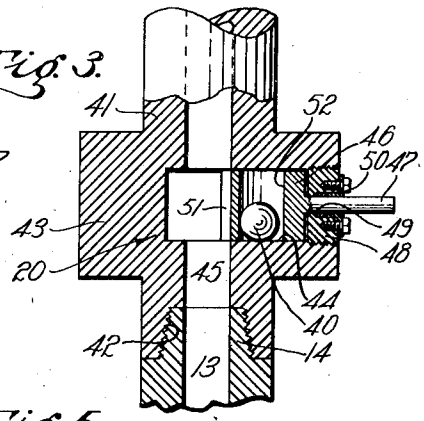


Fig. 2.

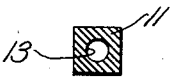


Fig. 5.

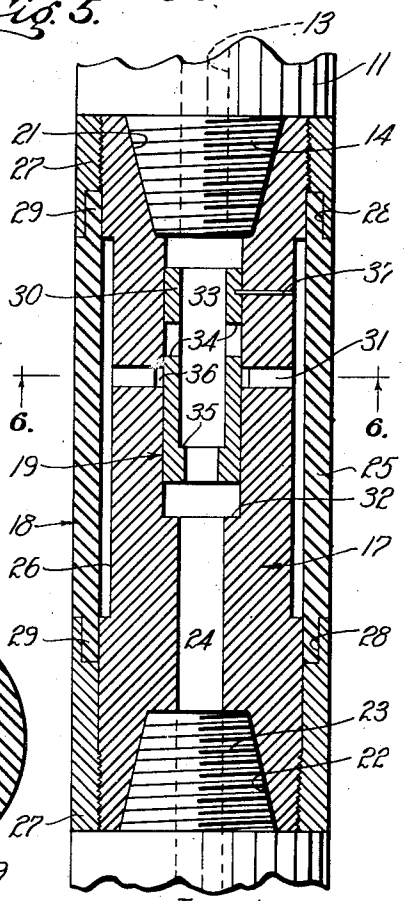
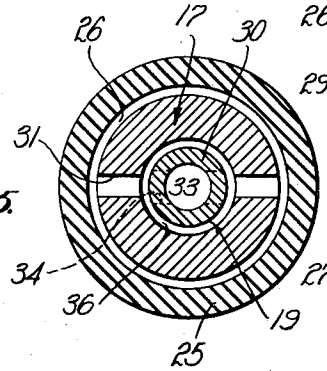


Fig. 6.



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Patented Aug. 29, 1933 1,924,425

UNITED STATES PATENT OFFICE

1,924,425

BLOW-OUT PREVENTER

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Application May 28, 1931, Serial No. 540,582
Renewed June 13, 1933

12 Claims. (Cl. 255—1)

This invention relates to a device for use in connection with well drilling apparatus, and relates more particularly to a blow-out preventer.

Blow-out preventers and casing heads of various characters have been introduced for preventing the discharge of fluid from oil and gas wells during drilling operations. The usual forms of blow-out preventers and like devices involve complicated and expensive structures to be applied to the upper end of the well casing and packing devices or closures for packing about the tools extending into the well or for closing off the upper end of the well casing. It requires considerable time to operate certain types of blow-out preventers and to arrange the various parts in operating position, and it sometimes occurs that the well gets out of control before the blow-out preventers can be made operative.

A general object of the present invention is to provide a practical and effective blow-out preventer that is particularly simple and inexpensive of manufacture and that is easily and quickly operated.

Another object of the invention is to provide a blow-out preventer that does not necessitate the provision of special parts or equipment on the well casing.

It is another object of the invention to provide a blow-out preventer that is adapted to be embodied or arranged in the drilling string and that is operable to pack directly with the well casing to seal off around the drilling string.

It is another object of the invention to provide a blow-out preventer of the character mentioned that is operable by fluid pressure. In accordance with the present invention, the packing element of the device is expansible by pressure on the circulation fluid in the drilling string.

It is another object of the invention to provide a blow-out preventer of the character mentioned that is adapted to be quickly operated in an emergency so as to be operable to close off a well casing when gas pressures suddenly develop in the well. As the device provided by this invention may be arranged in the drilling string, it is always available when the drilling string is within the well bore.

A further object of the invention is to provide a blow-out preventer of the character mentioned that does not materially weaken or complicate the drilling string and that does not normally interfere with the free circulation of fluid through the string.

Other objects and features of the invention will be best and more fully understood from the following detailed description of a typical form and application of the invention, throughout which description reference will be had to the accompanying drawing, in which:

Fig. 1 is a view illustrating the upper portion of a typical drilling string extending into a well casing and illustrating the device provided by the present invention embodied in the string. Fig. 2 is a transverse sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is an enlarged vertical detailed sectional view of the control means embodied in the invention. Fig. 4 is a top or plan view of the closure carrier included in the control means. Fig. 5 is an enlarged vertical detailed sectional view taken substantially as indicated by line 5—5 on Fig. 1. Fig. 6 is a transverse detailed sectional view taken as indicated by line 6—6 on Fig. 5.

The present invention is primarily intended for embodiment in a form for use in the usual or typical drilling string employed in connection with the rotary method of well drilling. It is to be understood, however, that the present invention may be constructed for use on special or varied equipment. Throughout the following detailed description, we will disclose a simple preferred form of the invention used in connection with the usual or common type of rotary well drilling equipment, it being understood that the invention is not to be construed as limited or restricted to the specific form or application of the invention about to be described.

The typical well drilling apparatus illustrated in the drawing includes a well casing C, a rotary table 10 for driving or rotating the drilling tools, a brief stem or kelly 11 extending through the table 10 to be operated thereby, drill pipe P connected with the lower end of the kelly 11, and a swivel 12 at the upper end of the kelly 11 for passing circulation fluid into the drilling string. The kelly 11 is polygonal or square in cross sectional configuration so as to be effectively driven by the rotary table 10 and has a central longitudinal fluid passage 13. The particular kelly illustrated in the drawing is provided at its opposite ends with tapered screw-threaded pins 14. The drill pipe P is connected with the lower end of the kelly 11 and extends downwardly through the well casing to carry the drilling tools at its lower end. The swivel 12 is provided to deliver the circulation fluid under pressure to the upper end of the kelly 11 to pass downwardly through the passage 13 into the drill pipe P. The swivel 12 is provided with a goose neck 15 for connection with the rotary hose (not shown) which delivers the circulation fluid

from the pumps. A hook 16 carried by a traveling block and suspension cables (not shown) suspends or carries the swivel 12. From the above, it is apparent that the rotary drilling string is formed of the drill pipe P and the kelly 11 and is supplied with circulation fluid by the swivel 12 at the upper end of the kelly.

The present invention includes, generally, a main part or body 17 adapted to be interposed in the drilling string at a point normally within the well casing C, expansible packing means 18 carried by the body 17 and operable to seal with the interior of the casing C, valve means 19 in the body 17 operable to divert or direct fluid pressure from the drilling string to the expansible packing means 18, and control means 20 in the drilling string at a point accessible at the surface for operating or closing the valve means 19 to provide for the expansion of the packing means 18.

In accordance with the broader principles of the invention, the body 17 may be arranged or interposed in the drilling string at any point that is within the casing C during drilling operation. In the particular case illustrated in the drawing, the body 17 is in the nature of a sub or connecting member interposed between the lower end of the kelly 11 and the uppermost length of drill pipe P. It is to be understood that the body 17 may be constructed for arrangement in a drilling string at various points, for example, for arrangement between two sections of a tool joint, or the like. The body 17 is an elongated member of round cross sectional configuration and is of suitable diameter and length. A tapered screw-threaded socket 21 is provided in the upper end of the body 17 to receive the lower pin 14 of the kelly or the pin of a suitable connecting member. A similar screw-threaded socket 22 may be provided in the lower end of the body 17 to receive a pin 23 of a connecting member or tool joint section on the upper end of the drill pipe P. A central longitudinal fluid passage 24 is provided in the body 17 and extends between the inner ends of the sockets 21 and 22.

The packing means 18 is carried by the body 17 and is operable by fluid pressure to seal with the interior of the well casing C. The sealing or packing means 18 includes a tubular member 25 surrounding the body 17. The sealing or packing member 25 may be formed of rubber or a suitable rubber composition and is of considerable length. An annular reduced portion or groove 26 is provided in the body 17 within the packing member 25. Means is provided for retaining or holding the packing member 25 on the body 17. Collars 27 are screw-threaded on the opposite ends of the body 17 and are provided at their inner ends with internal grooves 28. Tongues 29, or portions of reduced diameter, are provided on the opposite ends of the packing member 25 to fit in the grooves 28. When the packing member 25 is in its unexpanded or normal condition, it is of the same diameter as the collars 27 so as to be effectively protected by the collars. The packing member 25 is such that it is expansible to a position such as is indicated by the broken lines in Fig. 1 of the drawing to seal with the interior of the casing C.

The means 19 for directing or diverting the fluid pressures from the drilling string to expand the packing member 25 includes a valve 30 arranged in the opening 24 of the body to control the passage of fluid through radial ports 31 extending between the opening 24 and the groove 26. The upper end portion of the opening 24 is of enlarged diameter to carry the valve 30 and to provide an upwardly facing shoulder 32. The valve 30 is an elongated member having a sliding fit in the enlarged upper end part of the opening 24. The valve 30 is provided with a central longitudinal fluid passage 33 and lateral ports 34. An upwardly facing valve seat 35 is provided in the opening 33 below the lateral ports 34. The ports 34 are provided to communicate with the ports 31 when the valve member is in the down or actuated position. When the valve 30 is operated, as will be hereinafter described, it is supported on the shoulder 32 in a position where the ports 34 are in horizontal alignment with the ports 31. An annular groove 36 may be provided in the walls of the opening 24 at the inner ends of the ports 31 to ensure communication between the ports 34 and 31 when the valve is actuated.

The invention provides means for normally holding the valve 30 in an up position where its ports 34 are out of register with the groove 36 and are closed by the walls of the opening 24. A shear pin 37 is arranged in an opening in the body 17 and extends into an opening in the valve 30 to normally retain the valve in an up position where the ports 34 are out of register with the groove 36 and are closed. The valve 30 is normally in the up position illustrated throughout the drawing where the ports 34 are closed so that the packing member 25 is normally in the retracted or unexpanded state.

The control means 20 is provided at the upper end part of the drilling string and, preferably, above the rotary table 10 so as to be readily accessible at all times. The means 20 is manually operable to release a closure member or ball 40 into the fluid passage of the drilling string to come to rest on and seal with the seat 35 and close the circulation opening so that the pump pressure may be employed to actuate the valve 30 and expand the packing 25. In the preferred embodiment of the invention illustrated in the drawing, the control means 20 includes a body part 41 interposed between the upper end of the grief stem or kelly 11 and the swivel 12. A screw-threaded socket 42 is provided in the lower end of the body part 41 to receive the pin 14 on the upper end of the kelly 11. The upper end of the body part 41 may be connected with the swivel 12 in any suitable manner. A lateral enlargement 43 is provided on the body part 41 and has a horizontal opening 44 intersecting the fluid passage 45 of the body part. A carrier 46 is arranged in the opening 44 to carry or hold the ball 40. The carrier 46 is slidable in the opening 44 and has an outwardly projecting operating stem or push stem 47. A screw-threaded plug 48 closes the outer end of the opening 44 and has an opening 49 slidably passing the stem 47. A suitable packing gland 50 may be provided at the opening 49 to seal about the stem 47. The carrier 46 is normally within the outer portion of the opening 44 where it does not obstruct the fluid pasage 45. The plug 48 operates to limit the outward movement of the carrier 46 and the inner end of the carrier may be provided with a vertical groove 51 forming a wall of the passage 45 when the carrier is in the out position. A vertical opening 52 is provided in the carrier 46 to hold or contain the ball 40. The opening 52 is preferably of the same diameter as the fluid passage 45 and is located so as to come into direct register with the opening 45 when the carrier 46 is operated to an extreme "in" position. It will be apparent that, when the carrier 46 is

shifted to the "in" position where the opening 52 registers with the opening 45, the ball 40 passes into and through the passages 45, 13, and 33 to come to rest on the valve seat 35.

During normal operations, the carrier 46 is in the out position illustrated in Fig. 3 of the drawing where it does not interfere with the flow of fluid through the passage 45. The valve 30 is normally retained in the up position illustrated in Fig. 5 of the drawing by the shear pin 37. The valve member 30 is tubular, having the opening 33 so that it does not interfere with the free flow of fluid through the drilling string. When it is desired to operate the blow-out preventer to pack off around the drilling string, the carrier 46 is annually shifted inward so that the opening 52 is brought into direct register with the fluid passage 45. As the circulation fluid is pumped downwardly through the drilling string, the ball 40 is passed downwardly through the kelly 11 and the valve 30 upon actuation of the carrier 46. The ball 40 is proportioned so as to effectively co-operate with the seat 35 and close the lower end of the valve member 30. Upon the ball 40 engaging the seat 35, the pump pressure, that is, the pressure on the circulation fluid passing downwardly through the string, acts to shift the valve 30 downwardly and shear off the pin 37. Downward movement of the valve 30 is limited by the shoulder 32, which shoulder is adapted to support the valve in a position where the ports 34 are in register with the groove 36. The fluid pressure in the upper end of the drilling string, that is, in the fluid passage 24, is then diverted against the interior of the expansible packing member 25. The fluid pressure is adapted to expand the packing member 25 to effectively seal with the interior of the casing C. When the valve member 25 is in sealing engagement with the casing C, it effectively prevents the discharge of fluid upwardly through the casing and thus closes off the upper end of the well.

It is to be noted that the present invention provides a blow-out preventer that is particularly inexpensive of manufacture and particularly easy and quick to operate. As the device may be embodied in the usual drilling string, it is available at all times and may be employed to close off the upper end of the well casing in an emergency. The control means 20 is readily accessible to the operators, so that the blow-out preventer may be operated immediately upon indications of gas pressures in the well. The device does not necessitate large expensive devices for arrangement on the well casing, nor portable packing or closure devices for arrangement in the upper end of the casing. The device does not in any way interfere with the free handling of the drilling string or tools, and is such that it does not in any manner complicate the disconnection and assembling of the operating string.

Having described only a typical preferred form of our invention, we do not wish to limit ourselves to the specific details set forth, but wish to reserve to ourselves any and all changes and variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described our invention, we claim:

1. A device for use in connection with a drilling string having a fluid passage which includes, a body adapted to be interposed in the drilling string, packing means carried by the body and expansible by fluid pressure to pack with the well casing, shiftable valve in the body normally closing a port in the body for admitting fluid under pressure from the fluid passage to the packing means, the valve being tubular and normally adapted to pass fluid through the passage, and a control means for the valve on the upper end of the drilling string including a slide operable to move a closure member into the passage to close the opening in the valve.

2. In combination, a drilling string including, a string of pipe, and a grief stem at the upper end of the string of pipe, and a blow-out preventer associated with the drilling string including a body interposed between the grief stem and the string of pipe, packing means carried by the body operable by fluid pressure to seal with a well casing, valve means in the body operable to admit fluid under pressure from the drilling string to the packing, and a control for the valve at the upper end of the grief stem, the control including an object adapted to pass downwardly through the grief stem and pipe, and means for shifting the object into the grief stem to fall therethrough.

3. A device for use in connection with a drilling string having a fluid passage which includes, a body adapted to be interposed in the drilling string, packing means carried by the body and expansible by fluid pressure to pack with the well casing, valve means in the body for admitting fluid under pressure from the fluid passage to the packing means, the valve means including a shiftable valve normally closing a port on the body extending to the packing means, the valve having an opening normally passing the fluid flowing through the fluid passage, and a control for the valve means at the upper end of the drilling string, the control including a closure member, and a manually shiftable member operable to move the said closure member into the fluid passage to fall to the valve and close the opening in the valve.

4. A device for use in connection with a drilling string having a fluid passage which includes, a body adapted to be interposed in the drilling string, packing means carried by the body and expansible by fluid pressure to pack with the well casing, valve means in the body for admitting fluid under pressure from the fluid passage to the packing means, the valve means including a valve normally closing a port in the body extending to the packing means and operable downwardly to uncover the port, and means at the upper end of the drilling string for passing an object into the fluid passage to fall to the valve and close it whereby the valve may be operated downwardly by fluid pressure.

5. A device for use in connection with a drilling string having a fluid passage which includes, a body adapted to be interposed in the drilling string, packing means carried by the body and expansible by fluid pressure to pack with the well casing, valve means in the body for admitting fluid under pressure from the fluid passage to the packing means, the valve means including a valve normally closing a port in the body extending to the packing means and operable downwardly to uncover the port, a seat in the valve, a closure member for cooperating with the seat, and means for shifting the closure member from a position free of the fluid passage to a position where it falls into the drilling string to co-operate with the seat and close the fluid passage whereby the fluid pressure in the passage operates the valve downwardly.

6. A device for use in connection with a drill-

ing string having a fluid passage which includes, a body adapted to be interposed in the drilling string, packing means carried by the body and expansible by fluid pressure to pack with the well casing, valve means in the body for admitting fluid under pressure from the fluid passage to the packing means, the valve means including a valve normally closing a port in the body extending to the packing means and operable downwardly to uncover the port, a seat in the valve, frangible means for holding the valve in the position where the port is closed, a closure member adapted to fall through the fluid passage to co-operate with the seat to close the fluid passage whereby the fluid pressure may operate the valve downwardly to uncover the port, and means for shifting the closure member from a position clear of the passage to a position where it is free to pass down the passage.

7. A blow-out preventer for use on drilling string having a fluid passage including, a body adapted to be interposed in the drilling string, an expansible packing member surrounding the body, a valve in the body normally closing a port for admitting fluid under pressure under the packing member, the valve being shiftable to a position where the port is uncovered, and means controllable at the upper end of the string whereby fluid pressure in the string may be utilized to shift the valve including a closure member adapted to cooperate with the valve to close the fluid passage, and a slide operable to carry the closure member to the fluid passage to fall to the valve.

8. A blow-out preventer for use on drilling string having a fluid passage including, a body adapted to be interposed in the drilling string, an expansible packing member surrounding the body, a valve in the body normally closing a port for admitting fluid under pressure under the packing member, the valve being shiftable to a position where the port is uncovered, and means controllable at the upper end of the string whereby fluid pressure in the string may be utilized to shift the valve, the last mentioned means including a closure adapted to pass downwardly through the fluid passage to co-operate with the valve to close the fluid passage, and means normally holding the closure clear of the fluid passage and operable to shift the closure into the fluid passage to pass downwardly therethrough.

9. A blow-out preventer for use on drilling string having a fluid passage including, a body adapted to be interposed in the drilling string, an expansible packing member surrounding the body, a valve in the body normally closing a port for admitting fluid under pressure under the packing member, the valve being shiftable to a position where the port is uncovered, and means controllable at the upper end of the string whereby fluid pressure in the string may be utilized to shift the valve, the last mentioned means including a closure adapted to co-operate with the valve to close the fluid passage, and a carrier for the closure operable to pass the closure into the fluid passage.

10. A blow-out preventer for use on drilling string having a fluid passage including, a body adapted to be interposed in the drilling string, an expansible packing member surrounding the body, a valve in the body normally closing a port for admitting fluid under pressure under the packing member, the valve being shiftable to a position where the port is uncovered, and means controllable at the upper end of the string whereby fluid pressure in the string may be utilized to shift the valve, the last mentioned means including a closure adapted to co-operate with the valve to close the fluid passage, a member adapted to be mounted in the upper portion of the drilling string, and a carrier slidable in an opening in the said member to a position to pass the closure into the fluid passage.

11. In combination, a drilling string of pipe having a grief stem at its upper end, a tubular body interposed in the string below the grief stem, packing carried by the body and expansible by fluid pressure to pack with a well casing, there being a port in the body for admitting fluid pressure from the interior of the body to the packing means, a tubular valve shiftable in the body and normally closing said port, an element mounted in the string adjacent the grief stem and having a fluid passage registering with the fluid passage of the string and a lateral opening joining the fluid passage, an object adapted to pass through the string and cooperate with the valve to close its opening, and a carrier normally holding the object in said lateral opening and operable to shift the object into the fluid passage of the element.

12. In combination, a drilling string of pipe having a grief stem at its upper end, a tubular body interposed in the string below the grief stem, packing carried by the body and expansible by fluid pressure to pack with a well casing, there being a port in the body for admitting fluid pressure from the interior of the body to the packing means, a tubular valve shiftable in the body and normally closing said port, an element mounted in the string adjacent the grief stem and having a fluid passage registering with the fluid passage of the string, and a lateral opening joining the fluid passage, an object adapted to pass through the string and cooperate with the valve to close its opening, and a carrier having an opening normally holding the valve within the lateral opening, the carrier being shiftable to a position where its opening registers with the fluid passage so that the object may pass down the string.

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