Aug. 4, 1925. 1,548,578

B. F. BLANCHARD

HYDRAULIC ROTARY UNDERREAMER

Filed June 9, 1922 2 Sheets-Sheet 1

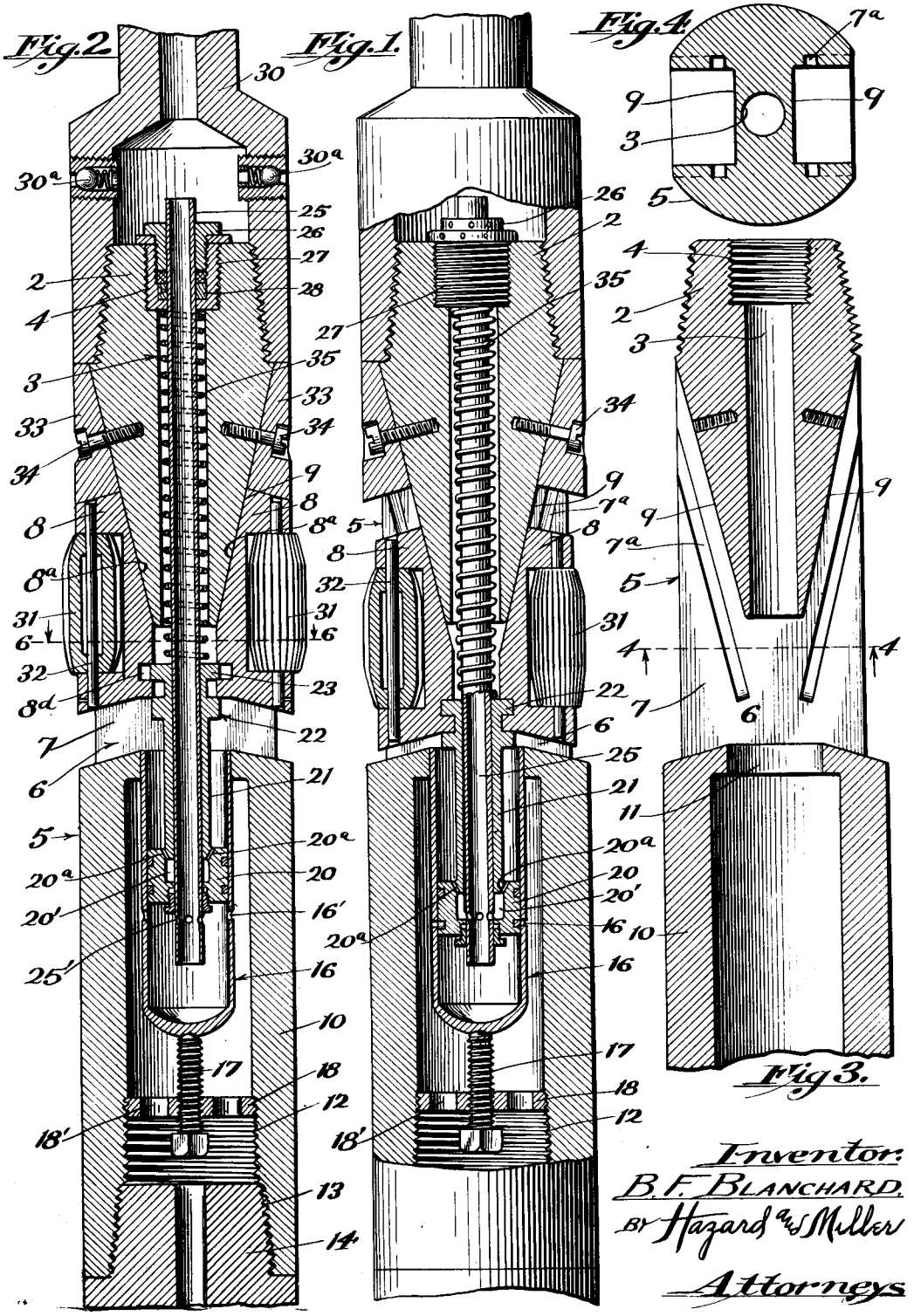

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Fig. 5.

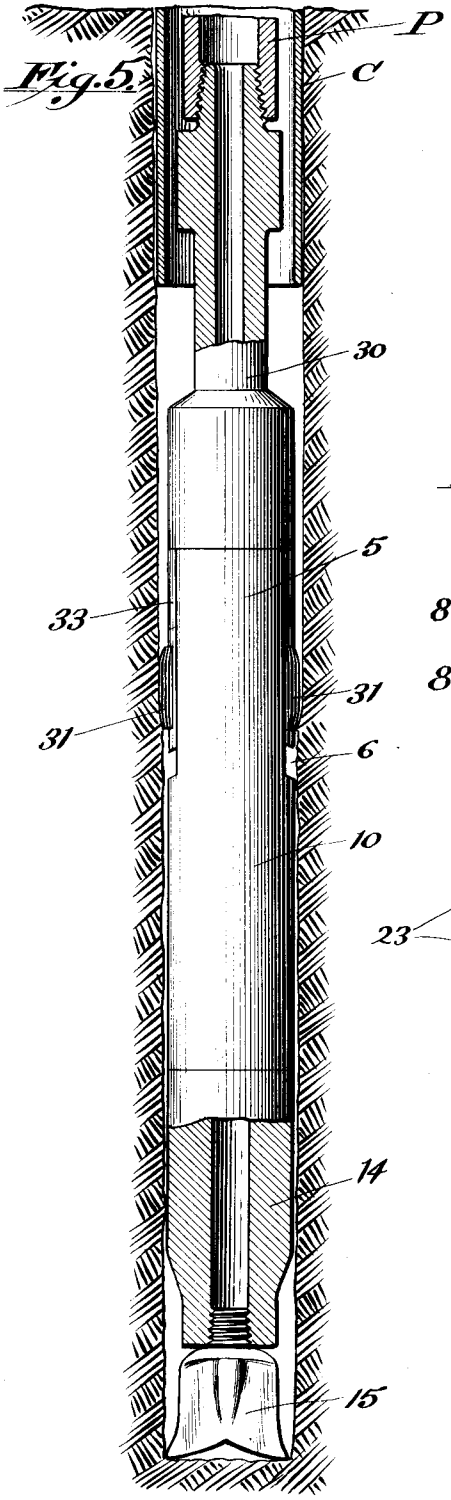


Fig. 6.

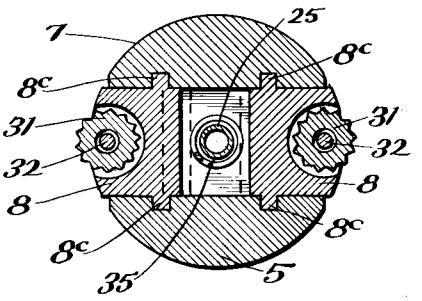


Fig. 7.

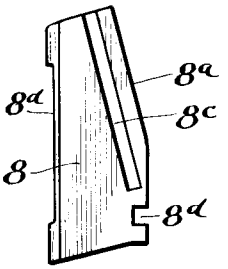


Fig. 8.

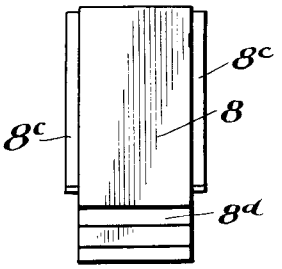


Fig. 9.

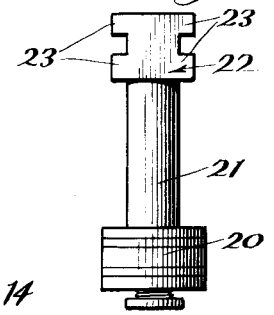
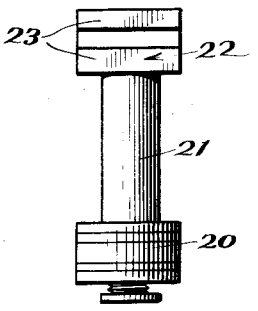


Fig. 10.



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Patented Aug. 4, 1925. 1,548,578

UNITED STATES PATENT OFFICE.

BENJAMIN F. BLANCHARD, OF BREA, CALIFORNIA.

HYDRAULIC ROTARY UNDERREAMER.

Application filed June 9, 1922. Serial No. 566,950.

To all whom it may concern:

Be it known that I, BENJAMIN F. BLANCHARD, a citizen of the United States, residing at Brea, in the county of Orange and State of California, have invented new and useful Improvements in Hydraulic Rotary Underreamers, of which the following is a specification.

This invention relates to deep well drilling tools and more particularly to underreamers.

It is an object of the present invention to provide a hydraulically set underreamer mechanism. Another object of the invention is to provide a hydraulically actuated set of underreaming tools which are of simple and substantial construction and which may be lowered into the well hole in a contracted position through the well casing and then expanded into operative reaming position.

Other objects will be made manifest in the following specification of an embodiment of the invention illustrated in the accompanying drawings, in which—

Figure 1 is a central longitudinal section of the underreaming tool in its retracted or collapsed position.

Fig. 2 is a longitudinal central section of the tool showing the underreamers in the expanded position.

Fig. 3 is a longitudinal section of the underreamer body.

Fig. 4 is a cross section on line 4—4 of Fig. 3 with the underreamer slides and cutters removed.

Fig. 5 is a side elevation and partial section of the tool as combined with a fish tail bit showing the installation in a well hole.

Fig. 6 is a transverse section on line 6—6 of Fig. 2.

Fig. 7 is an edge view of one of the detached cutter slides.

Fig. 8 is a side elevation of the inner face of a cutter slide.

Fig. 9 is a side elevation looking toward the end of the detached slide operating piston.

Fig. 10 is a broadside elevation of the piston.

In its preferred embodiment, the present invention consists of a body member comprising an upper taper threaded attaching neck 2 provided with an axial bore 3, the upper portion of which is enlarged and internally threaded as at 4. Below the neck 2 the body consists of a cylindrical shank 5 diametrically channeled from side to side to form a slide space 6 which has flat side walls 7 suitably spaced to receive slides 8. The shank portion 5 has downwardly and inwardly convergent outer faces 9 upon which the inner flat faces 8^a of the slides 8 bear. The outer faces 8^b of the slides may be curved on arcs concentric to the center of the shank 5, and the lateral faces of the slides 8 are provided with gibs or longitudinal flanges 8^c, and these incline with respect to the outer faces 8^b and are parallel to the inner faces 8^a of the slides, so that when the slides are respectively applied to the opposite inclined faces 9 of the body shank, the slides can be shifted along the inclined faces, and such action will result in the inward and outward movement of the slides.

The gibs 8^c of the slides are designed to enter the open upper ends of channels or guideways 7^a formed in the side faces 7 of the chamber 6. The convergent guide faces 9 of the shank body terminate somewhat above the bottom of the chamber 6 and thus provide for vertical movement in the chamber of means for actuating the slides 8.

Below the body portion having the convergent side faces 9—9, the body is provided with a tubular shell 10 having an open mouth 11 leading into the chamber 6 in the body shank. The lower end of the sleeve 10 is provided with internal threads 12, and below these are joint receiving tapered threads 13 to which may be attached any tool joint 14 which may carry a bit, for instance a fish tail bit 15, Fig. 5.

Fitting in the mouth 11 is an inverted thimble 16, the lower end of which is supported on an adjusting jack screw 17 mounted in a plate 18 resting in the threads 12 of the sleeve 10. The plate 18 is apertured as at 18′ to permit of the circulation of water in the usual manner. Slidably fitting the thimble 16 is a piston 20 having a tubular piston rod 21, on the upper end of which is fixed a coupling or cross head 22 having transverse lips 23 to enter transverse channels 8^d in the inner faces of the opposed slides 8. The slides interlock with the head 22 of the piston when this latter is exposed in the chamber 6 in the body shank 5 and when the slides are slipped down the convergent guideways 7^a to a position as is in-

dicated in Fig. 2, then downward movement of the slides contracts them more and they become thoroughly coupled with the adjacent head of the piston which becomes an actuating device for the slides.

The tubular piston rod 21 slidably fits upon a pipe or tube 25, the upper end of which projects above the neck 2 of the body, and is provided with a packing gland 26 entering a bushing 27 which is applied to the threads 4 in the body neck. The gland 26 serves to engage a collar 28 fixed on the upper portion of the pipe 25. The lower end of the pipe 25 extends below the piston 20 when the latter is in its lowermost position as is seen in Fig. 1, and adjacent the lower end of the pipe is a set of ports 25′ which, when the piston is in its lower position, provides for the escape of water entering through a fitting 30 attached to the neck of the reamer body (Fig. 2). The water passing from the ports 25′ enters a chamber 20′ in the piston and bleeds therefrom through upwardly directed bleed ports 20ª, and thence passes into the thimble from which it escapes at the mouth into the open chamber 6.

The slides 8 are each provided in their outer faces with pockets 8ᵉ of suitable proportions to receive reaming tools. In the present case these tools consist of substantially cylindrical cutters 31 having longitudinal cutting teeth on the periphery, and which teeth preferably converge or taper on the ends of the cutters, as shown clearly in Figs. 1 and 2. The cutters are mounted upon spindles 32, the ends of which are mounted in the contiguous walls at the ends of the pockets in the slides 8. The slides and cutters are of such proportions that they may be contracted to a position substantially within the side lines of the body sleeve 10, and this will enable the lowering of the tool into the well casing C, Fig. 5.

After the tool has thus been positioned below the well casing end, it is necessary to expand the slides 8 and to thrust the cutters 31 outwardly into effective position to ream the well hole. To that end, fluid under pressure is turned into the drilling pipe P, Fig. 5, and from thence it will pass into the fitting 30, and from this into the pipe 25, from which it will accumulate in the bottom of the thimble 21 and react against the piston 20. When sufficient pressure has accumulated against the piston, this will be forced upwardly, and by virtue of its connection with the slides 8, these will be forced outwardly to the position shown in Fig. 2 in which they have been forced up along the slide faces 9 of the underreamer body and outwardly at the same time. The upward movement of the cutters is limited and the strain of operation is taken by removable chock blocks 33 which are applied to the side faces 9 of the underreamer body and may be removably held as by screws 34 or other means.

The slides are normally subjected to the downward pressure of a substantial spring 35 surrounding the pressure supply pipe 25 and contained in the bore 3 of the cutter neck. Thus, when it is desired to lift the string of tools from the well, the hydraulic or other fluid pressure transmitted to the thimble 20 being removed, permits the spring 35 to function and press the piston 20 with the attached cutter bearing slides 8 down and, therefore, effect the retraction of the cutters.

In the expanded position of the cutters as shown in Fig. 2, the piston 20 occupies a position somewhat above a series of apertures 16′ provided in the thimble 16, and the excess and circulating water supplied by the pressure supply pipe 25 may then escape from the thimble piston chamber through the outlets 16′, and thence through the perforated plate 18 to the bottom of the well.

It is desirable to provide for the reception of water that may be encountered in the well as the tool is lowered, and to that end the fitting 30 is provided with inlet check valves 30ª above the neck 2 of the underreamer body, and, therefore, in the absence of pressure in the string of tool parts, the well water may enter through the check valves 30ª and accumulate in the chambers of the string. When hydraulic operating pressure is turned into the tool string, then the check valves 30 automatically seat and the operating pressure becomes effective upon the piston 20 to actuate and set the underreaming cutters 31.

When it becomes desirable to pull the tool from the well, the water in the column will be permitted to drain or bleed out into the well hole through the bleeding apertures 20ª. This prevents the drillers from being showered with water during the uncoupling of the sections as they are disconnected.

Various modifications and changes may be resorted to within the spirit of the invention as claimed.

What is claimed is:

1. An underreamer comprising, in combination, a set of retractive cutters, hydraulically operative means for projecting the cutters to active position, said means including a piston operatively connected to the cutters, said piston having a stem forming a motive fluid conduit, a piston chamber in which the piston operates and into which the conduit discharges, and spring means mounted on the stem for retracting the cutters.

2. An underreamer comprising, in combination a body having means for attachment to a string of tool parts in which

hydraulic pressure may be created, underreaming cutters mounted for retraction and expansion in the underreamer body, hydraulically operated means in the body for setting the cutters, and a fitting connecting the tool string and the underreamer body and having means for admitting well water to the chambers thereof.

3. An underreamer comprising, in combination a body having means for attachment to a string of tool parts in which hydraulic pressure may be created, underreaming cutters mounted for retraction and expansion in the underreamer body, hydraulically operated means in the body for setting the cutters, and a fitting connecting the tool string and the underreamer body and having means for admitting well water to the chambers thereof, said means comprising outwardly seating check valves for maintaining a hydraulic pressure in the tool string to effect the actuation of the underreaming cutters.

4. An underreamer comprising a body having means for attachment to a string of tool parts, the body being provided with opposite convergent faces, slides guidable along said faces to be moved inwardly concurrently and outwardly concurrently, cutters mounted on said slides to be operative in the outer position of the slides, and means within the underreamer body for shifting the slides to move the cutters to effective and ineffective positions, said means including a hydraulically operative hollow piston having operative connections with said slides, and a motive fluid conduit on which said piston is slidably mounted.

5. An underreamer comprising a body having means for attachment to a string of tool parts, the body being provided with opposite convergent faces, slides guidable along said faces to be moved inwardly concurrently and outwardly concurrently, cutters mounted on said slides to be operative in the outer position of the slides, means within the underreamer body for shifting the slides to move the cutters to effective and ineffective positions, said means including a hydraulically operative hollow piston having operative connections with said slides, and a pressure supply pipe extending through and on which said piston is slidably mounted and by which pressure fluid is conveyed to be operative upon the piston.

In testimony whereof I have signed my name to this specification.

B. F. BLANCHARD