Dec. 12, 1933 J. GRANT 1,938,960

HYDRAULIC EXPANSION OF UNDERREAMERS

Filed Aug. 10, 1932

Fig. 3.

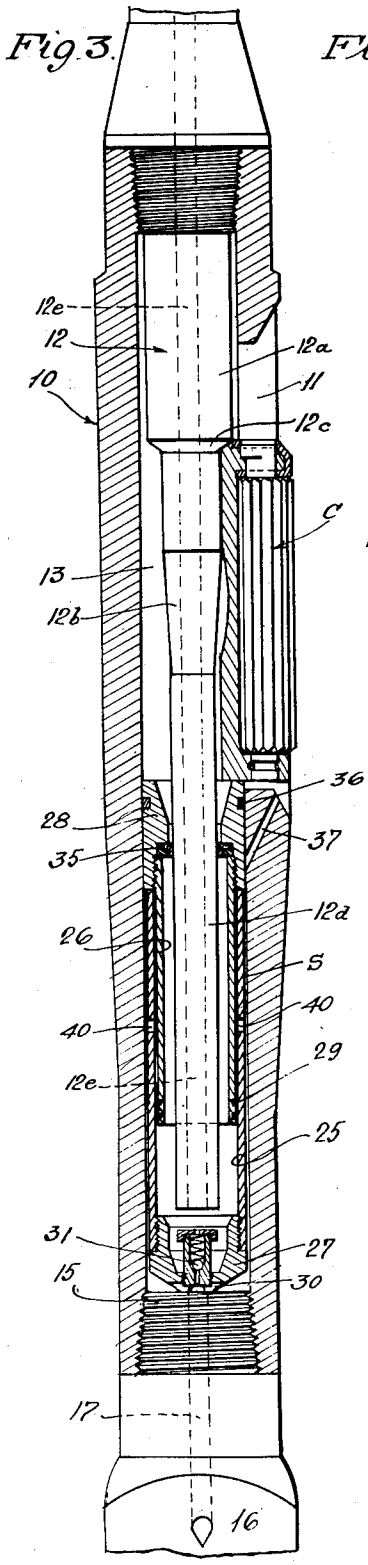


Fig. 2.

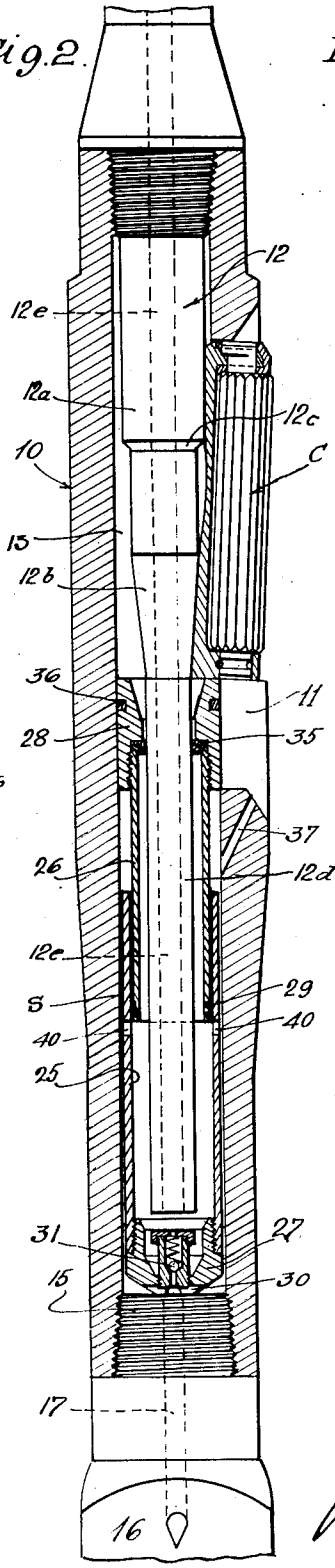
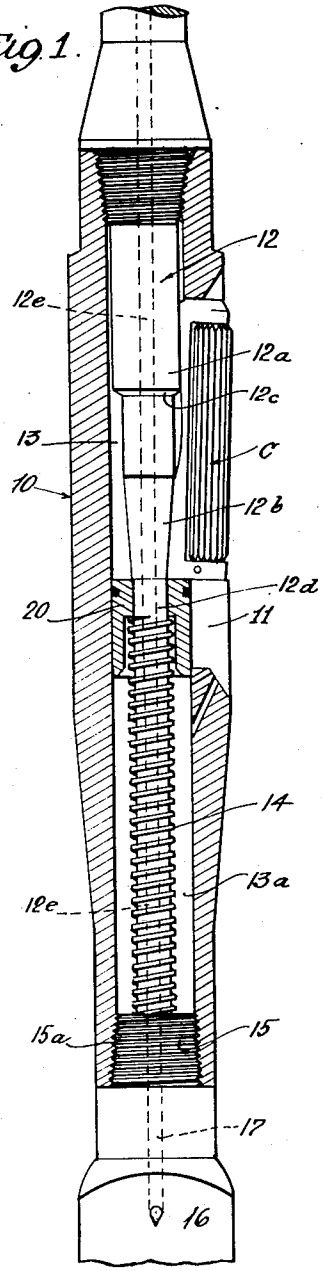


Fig. 1.



Inventor.
John Grant.

James T. Buckley

Attorney.

Patented Dec. 12, 1933 1,938,960

UNITED STATES PATENT OFFICE

1,938,960

HYDRAULIC EXPANSION OF UNDER-REAMERS

John Grant, Los Angeles, Calif.

Application August 10, 1932. Serial No. 628,119

3 Claims. (Cl. 255—75)

This invention has to do with expansible reamers such as are used in well reaming; and the invention comprises particularly the provision of hydraulic expansion means that, in itself, is efficient, reliable and simple, and that is capable of substitution in standard forms of reamers for the usual actuating spring devices thus making the reamers interchangeable as between spring and hydraulic actuation.

For explanation of the invention I choose a typical instance of application, not however implying thereby a limitation to such instance. In such a typical expansive reamer as is shown in the Grant Patent No. 1,819,367, dated August 18, 1931, the body is tubular, a central cutter-abutment mandrel and actuating spring, etc., occupying the central bore, and the cutters being mounted in wall slots to be moved vertically with reference to the mandrel by the spring.

In applying the present invention to such a reamer, a self contained hydraulic actuator is provided that, as a unit, may be slipped into place after the spring and the spring device has been removed. The substitution is simple and easily effected, and the action of the hydraulic actuator is simple and positive.

Several features of the hydraulic actuator to be here specifically described are aimed at adapting the actuator to the type of reamer here exampled, and will be described later. The main features of the actuator in its preferred form are that it is unitary and that, when in place, it takes hydraulic pressure from the fluid circulating passages of the reamer and, expanding under that pressure, moves the cutters to expanded position.

Further and best understanding of the invention itself will be had from consideration of the specific and illustrative embodiment and application which I now proceed to describe in detail but without inferences of limitation of the invention except as defined in the then following claims.

In the drawing:

Fig. 1 is a longitudinal central section of the typical form of reamer here chosen as an application of the invention, this figure showing the reamer with its usual expanding spring.

Fig. 2 is a somewhat enlarged similar section showing the hydraulic actuator in place and the cutters expanded.

Fig. 3 is a similar section showing the cutters contracted.

The illustrative expansive reamer has a tubular body 10 whose wall has a number (usually three) of cutter slots 11, only one of which is here shown. The cutters, designated generally by C, are movable both vertically and radially in those slots. Inside the body is a longitudinally extending cutter expanding end abutment mandrel 12, with its abutment portions 12*a* and 12*b*, its diagonal expanding shoulder 12*c*, and its extension 12*d* that serves to carry the circulating fluid, through the mandrel bore 12*e*, down past the cutters and into the chamber 13 where the spring 14 is ordinarily housed. Spring chamber 13*a* forms the lower part of the longitudinal body bore 13. The spring may rest at its lower end on the joint pin 15 of the bit 16 that usually is attached to the lower end of the reamer, circulating passages 17 of the bit passing a portion of the circulation to ejection points below the reamer and to the bit.

Although there are many other features of practical importance in such a reamer as here described, including such things as cutter make-up, coaction of cutters with mandrel and body, etc., I have now described sufficient of the structure to explain the application of the present invention.

In the form illustrated the spring may be removed downwardly by first removing the bit; that however is broadly immaterial as the whole reamer may be disassembled by removing the mandrel upwardly, moving the cutters inwardly into the bore and then up, and then removing the cutter propeller 20 and the spring upwardly. The cutter propeller slidably fits bore 13 and mandrel extension 12*d*. If it be desired to remove the cutter propeller downwardly without the necessity of disassembling the reamer for upward removal of the parts, it is only necessary that the screw-threaded box 15*a* at the lower end of the body be as large as bore 13; and I show such proportioning as that enables the spring and propeller to be removed, and the hydraulic actuator to be inserted, without disassembling the reamer and merely by removing the lower bit.

The hydraulic actuator unit is made up principally of two telescoping tubes 25 and 26 carrying the lower and upper heads 27 and 28. The two tubes may be made to have a fluid tight fit in their telescopic action by suitable fitting or by means such as packing indicated at 29. Lower head, being designed here to rest directly on bit pin 15, has slots 30 across its lower surface to allow the liquid circulation to reach bit passage 17. The lower head also contains an upwardly opening valve 31 which allows the fluid that

stands in the well to enter the actuator, and thus to enter and fill the passage in the drill pipe that connects with the upper end of the mandrel, as the reamer is lowered in the hole.

Upper head 28, on the upper end of tube 26 either fits snugly about mandrel extension 12*d* or, preferably, has packing 35 to prevent upward leakage around the mandrel. The exterior of this head may fit body bore 13 fairly snugly to prevent or minimize leakage around the head, as is the case with cutter propeller 30 in Fig. 1, or it may be also provided with packing 36. In any case, however, it is desirable that the fit, or the packing, be not so tight as to make difficult the insertion of the hydraulic unit. The tubes 25 and 26, however, and also lower head 27, are of such external sizes that a clearance space is left within the body bore for the circulating fluid to reach bit passage 17 and discharge passages 37 that show a portion of the circulation upwardly under the reaming cutters. The circulation reaches that space S only through the ports 40 in tube 25 when they are uncovered by the lower end of tube 26 in the expanded position of Fig. 2.

Insertion and removal of the hydraulic device, as well as its action is now apparent from what has been said. It may be inserted and removed preferably through the lower end of the body, merely by removing the bit. In action, when circulation pressure is applied to the mandrel passage from the drill pipe, that pressure is communicated to the interior of the expansible hydraulic unit through the mandrel extension and causes the actuator to expand. In expanding, its upper head 28 pushes upon the cutters in the same manner that the spring actuated propeller pushes up on the cutters, moving the cutters relatively upward on the mandrel until they are expanded and bear inwardly against the abutment portions of the mandrel. With the cutters in that position, inward pressure on them does not to any appreciable degree tend to force them down; furthermore the upward drag on the cutters due to contact with the hole wall tends to keep them up. Consequently, in the expanded position little or no upward force need be exerted by the hydraulic actuator.

In the expanded position the ports 40 are open allowing free exit of the circulating fluid into space S. Due to the circumstances just stated, ports 40 may allow such free exit, it only being necessary that sufficient pressure be kept in the actuator to hold up the upper tube and head and thus keep the ports open; although it may be desirable to make the ports a little smaller in order to keep a little more back pressure in the actuator for the purpose of keeping the cutters up, or instantly moving them up, in case they should for any reason tend to fall.

The circulation, thus reaching space S, passes both to discharge passages 37 and to bit passage 17 where it performs the usual offices.

I claim:

1. In combination with an expansive reamer having a hollow longitudinally bored body, a cutter longitudinally movable and laterally expansively and contractively movable in the body, a downwardly extending longitudinal water course tube discharging at a point in the body bore, a member removably secured in the lower end of the body bore, and the reamer having a fluid discharge opening leading from the bore; a unitary removable expansion actuator in the body bore comprising upper and lower telescopic tubular parts, the upper part having an upper head slidably fitting the body bore and engaging the cutter to give it longitudinal movement, and said head having a packed aperture passing the water course tube into the space enclosed by the telescopic parts, the lower telescopic part having a lower head resting on the removable member at the lower end of the body bore, and the two telescopic parts having valvular means opening a passage from their interior into the body bore when expanded.

2. In combination with an expansive reamer having a hollow longitudinally bored body, a cutter longitudinally movable and laterally expansively and contractively movable in the body, a downwardly extending longitudinal central water course tube that discharges at a point within the body bore, and having attachment means at the lower end of the body bore for attaching a drill bit with a passage communicating with the body bore; a unitary removable expansion actuator in the body bore comprising upper and lower telescopic tubular parts, the outer one of said telescopic parts fitting the body bore with fluid passage clearance, the upper telescopic part having an upper head slidably fitting the body bore, said head having a packed aperture passing the water course tube into the space enclosed by the telescopic parts and said head bearing against the cutter to give it longitudinal movement, the lower one of said telescopic tubes having a head adapted to rest upon the upper end of a drill bit in the lower part of the body bore, and said lower head having water course passages in its under face to reach the drill bit passage, and one of said telescopic parts having openings through its wall uncovered by the relative movement of the other telescopic part when moved in expansion by fluid pressure.

3. In combination with an expansive reamer having a hollow longitudinally bored body, a cutter longitudinally movable and laterally expansively and contractively movable in the body, a downwardly extending longitudinal central water course tube that discharges at a point within the body bore, and having attachment means at the lower end of the body bore for attaching a drill bit with a passage communicating with the body bore; a unitary removable expansion actuator in the body bore comprising upper and lower telescopic tubular parts, the outer one of said telescopic parts fitting the body bore with fluid passage clearance, the upper telescopic part having an upper head slidably fitting the body bore, said head having a packed aperture passing the water course tube into the space enclosed by the telescopic parts and said head bearing against the cutter to give it longitudinal movement, the lower one of said telescopic tubes having a head adapted to rest upon the upper end of a drill bit in the lower part of the body bore, and said lower head having water course passages in its under face to reach the drill bit passage, a check valve in said lower head opening inwardly into the space within the telescopic parts, and one of said telescopic parts having openings through its wall uncovered by the relative movement of the other telescopic part when moved in expansion by fluid pressure.

JOHN GRANT.