May 5, 1964 H. G. DYE 3,131,762

PACKER RETRIEVER

Filed Feb. 9, 1962

Fig. 1.

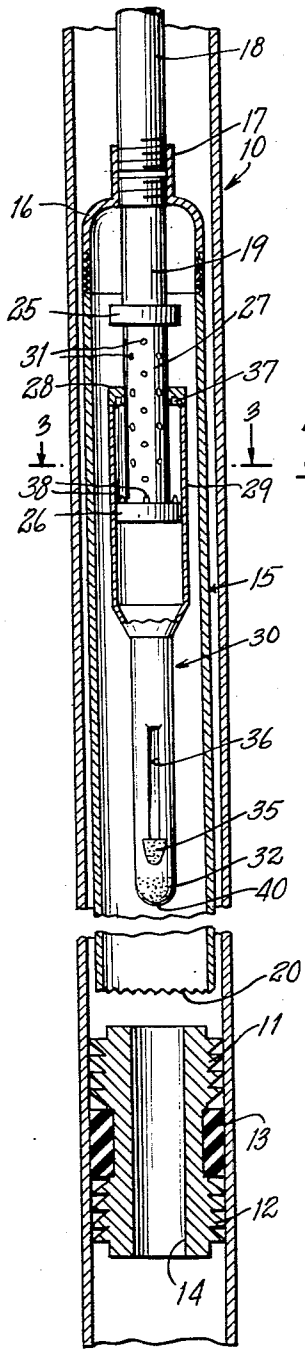


Fig. 2.

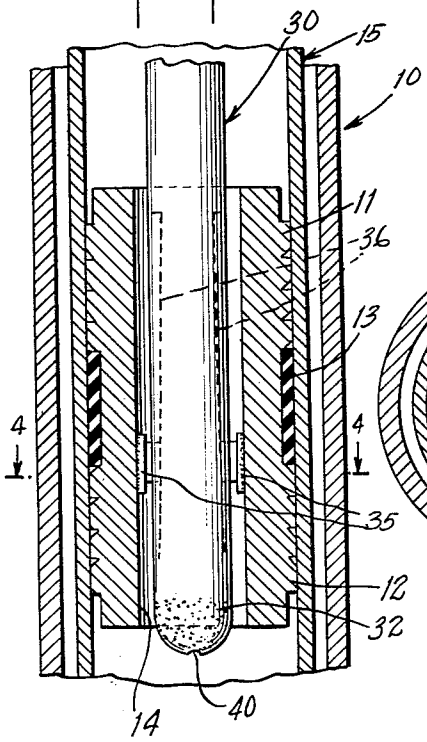


Fig. 3.

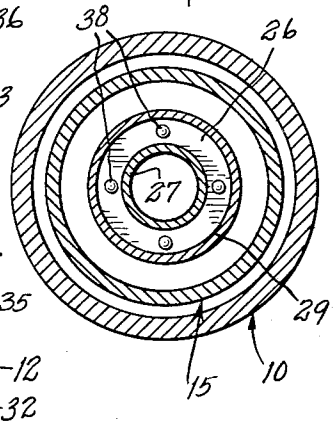
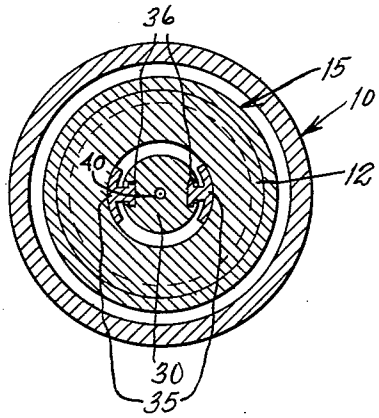


Fig. 4.



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PACKER RETRIEVER

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This invention relates to well equipment and more particularly to a tool for removing a packer from the bore of a well.

One conventional form of packer retriever comprises an annular cutter assciated with an elongated rotatable center spear that extends below the cutter and to the lower end of which, in advance of the cutter, is secured the retriever. Thus in the use of this type of tool, the rotating retriever and spear are threaded through the usual central opening in the packer to enable the cutter to come into engagement with the upper end of the packer for the milling operation. Such a threading operation with a rotating spear is a troublesome one even when conditions are right and frequently the results are so unsatisfactory that it becomes necessary to utilize some other means to accomplish the removal of the packer. A further disadvantage of this type of tool is that it is of relatively complicated design and therefore costly to produce.

The primary purpose of the instant invention is to provide an improved packer retriever having a normally non-rotary center spear and therefore none of the disadvantages usually associated with a rotating spear.

Another object of the invention is to provide an improved packer retriever which will be of relatively simple, sturdy design and less expensive to manufacture than conventional packer retrievers of the above indicated type.

Other objects of the invention as well as the novel features and advantages thereof will become apparent from the following description, when read in connection with the accompanying drawings, in which

FIG. 1 is a side elevational view, partly in vertical section, of a packer retriever constructed in accordance with the invention; said view additionally showing in cross-setcion a well casing and a packer secured to such casing and about to be engaged by the packer retriever;

FIG. 2 is an enlarged detailed view in vertical section showing the manner in which the tool removes the packer from the well casing;

FIG. 3 is a transverse sectional view taken along the line 3—3 of FIG. 1; and

FIG. 4 is a transverse sectional view taken along the line 4—4 of FIG. 2.

In the drawings, the numeral 10 indicates generally a well casing in which has been installed a conventional well bore packer composed of upper retaining slips 11, lower retaining slips 12 and a centrally located yieldable packing member 13. The slips 11 and 12 are serrated to provide teeth which securely engage the inner wall surface of the casing 10 to hold the packer in place; the upper slips 11 preventing upward movement of the packer and the lower slips 12 preventing downward movement of the packer. The packing member 13 firmly engages the inner wall surface of the casing 10 to prevent fluid flow between the casing and the packer. As is usual, the packer is provided with an axial passageway 14.

The packer removing tool of the invention comprises an elongated annularly shaped cutter sleeve or milling shoe 15 which has connected to its upper end a coupling member 16 provided with an internally threaded hub 17 to threadedly receive the lower end of a drill string 18 and the upper threaded end of a bronze bushing 19. It

will be noted that the axial passage through the bushing 19 communicates with the usual flushing fluid passageway through the drill string to form an extension of the latter. The lower end of the milling shoe 15 is formed with cutting teeth 20 or coated with a known cutting compound to provide an anular cutter capable of milling or cutting off the bore gripping and sealing parts of the packer. The milling shoe 15 is preferably made of a very thin cold rolled steel and of such diameter that the teeth only of the slips 11 and 12 of the packer are cut off, as is indicated in FIG. 2 of the drawings.

The bronze bushing 19 is provided with a pair of spaced external collars 25 and 26. The upper collar 25 is located on the upper end portion of such bushing, and the collar 26 is formed on the bottom end of such bushing. Slidably mounted on the portion 27 of the bushing 19 between the collars 25 and 26 is a collar 28 provided on the upper end of a center spear which is indicated generally by the reference numeral 30. The upper end portion 29 of the central spear has an interior diameter approximating the exterior diameter of the collar 26 which is slidably received therein. The upper end portion 29 is of sufficient length to enable the collar 28 on the upper end thereof to travel between the bushing collars 25 and 26 which function as stops to limit the vertical range of movement of collar 28 and consequently that of the center spear 30. The bushing portion 27 between the collars 25 and 26 is provided with a multiplicity of ports 31 which permit the flushing fluid to pass through the bushing and lubricate the sliding movements of the spear collar 28 on such bushing portion 27. It will thus be observed that the collars 25 and 26 and the lubricated portion 27 of the bushing perform the two fold functions of a guideway enabling the central spear to vertically reciprocate freely on the bushing, and of a bearing to enable the bushing to rotate with the drill string 18 and milling shoe 15 without imparting such rotational movement to the central spear. It will be further noted that the overall combined length of the bushing 19 and spear 30 is less than the length of the cutter sleeve 15 so that even when the spear 30 is in an advanced position with the collars 26 and 28 in engagement, it is wholly located within the confines of the sleeve 15. It will be observed, however, that when the central spear 30 is in its advanced position, the outer or bottom end 32 thereof will be spaced from the cutting teeth 20 on the sleeve 15 a distance substantially less than the axial length of the packer so that when gripping teeth on the lower packer slips 12 are cut away by the cutter sleeve 15, such bottom end of the central spear 30 will have advanced a substantial distance into the passageway 14 of the packer.

The central spear 30 is provided adjacent its lower end 32 with oppositely disposed slips 35 slidably mounted in raceways 36 extending longitudinally of such spear and provided with an inclined inner wall which permit the free downward movement of the spear through the packer, but which cause the slips 35 to move radially outwardly into gripping relation with the wall of the passageway 14 when the spear is moved upwardly relative to the packer.

The central spear is provided at its lower end 32 with a coating of suitable known cutting material enabling it to cut through any corrosion deposit that may tend to obstruct the insertion of the central spear into the passageway 14 of the packer. In order that such cutting action may be performed, the central spear can be temporarily locked to the bushing 19 to enable it to be rotated with the latter and the cutting sleeve 15. This locking action may be accomplished in any suitable way, as by providing on the bushing collar 26 lugs 38 adapted to interlock with locking recesses 37 formed on the inner wall of the collar 28 of the central spear. Thus, by turn-

ing the bushing 19 when the spear 30 is an extended position, the lugs 38 will enter and interlock with the recesses 37. This locking connection can be readily broken by rotating the drill string 18 to turn the bushing 19 in the opposite direction and lowering such string to lower the collar 26 and thereby to raise the bushing collar 28 above the lugs 38. The lower end of the hollow spear 30 is also provided with a port 40 which permits flushing fluid to flow to the coating material on such spear and to the cutting teeth 20 on the milling shoe 15.

It is believed it will be understood from the foregoing, that in the use of the tool of this invention, it will be lowered into a well casing 10 until the cutting teeth 20 on the cutting sleeve or milling shoe 15 thereof come into engagement with the upper end of the packer to be removed. The drill string 18, to the lower end of which is connected the tool herein, is then rotated to the right to make sure that the milling shoe 15 has properly started its milling operation which observation can be ascertained by noting the effect on the weight indicator. In this condition of the parts, the central spear 30 will be in its fully advanced position with the collar 28 thereof resting on the lower bushing collar 26, and flushing fluid will be traveling downwardly through the axial passages in the drill string 18 and in the bushing 19 and central spear 30, and will be discharging through the orifices 31 in the bushing portion 27 and the discharge port 40 at the lower end of the central spear 30.

Thereafter rotation of the drill string 18 will result in the teeth 20 of the milling shoe 15 progressively cutting away the teeth on the slip 11, the periphery of the packing member 13 and the teeth on the lower slips 12. The debris from such cutting operation will be carried by the flushing fluid upwardly between the milling shoe and the well casing 10 toward the surface. The downward cutting movement of the milling shoe 15 will result in a downward movement of the central spear 30 towards the packer. While the milling shoe 15 and the bushing 19 will partake of the rotational movement of the drill string 18 in this operation, the movement of the central spear 30 will be substantially a lengthwise movement with relatively little or no rotary movement especially as the spear is passing through the packer. This is in large part possible because the friction between the stationary and rotary engaging parts is reduced to a minimum by the flushing fluid discharging through the ports 31 in the bushing portion 27. If there are no obstructions in the path of the central non-rotating spear 30, it will move into the axial passageway 14 of the packer. Should the packer opening be obstructed, the downward movement of the central spear will be stopped. As the rotating bushing continues its downward movement with the rotating milling shoe, the bushing flange 25 will come into engagement with the collar 28 at the upper end of the halted central spear. It will be noted that the connection between the bushing 19 and spear 30 is a piston-like connection and that the chamber defined by the spear portion 29 will be filled with flushing fluid. Consequently, any longitudinal movements of the central spear 30 will be damped by such fluid. If such damping action or the weight of the string is unable to force the lower end of the spear 30 past the obstruction, the string may be raised and lowered to bump the collar 25 against the top of the spear until the obstruction is removed. If the obstruction can not be overcome in this manner, as in the case when the body of the packer is coated with a corrosion deposit, the milling shoe is turned in this condition of the parts until the dogs 38 interlock with locking recesses 37, whereupon the central spear 30 may be used as a drill to cause the cutting material on the lower end 32 thereof to mill away the deposit blocking the downward movement of such spear.

Upon the completion of the cutting operation by the teeth 20 on the milling shoe, the packer will be freed from the inner wall surface of the well casing 10 and will

move downwardly to cause the slips 35 which were moved upwardly on the spear 30 by the packer as the spear entered into passageway 14 during the drilling of the packer teeth 20, to move downwardly in the trackways 36. As the slips 35 move down in their associated tracks, the latter cause them to move radially outwardly into tighter engagement with the wall of the packer passageway 14. By then picking up the drilling string, the slips 35 will be set securely in the packer and cause the latter to come out of the hole with the tool.

It will be seen from the foregoing that the tool of this invention is of relatively simple sturdy construction, and that it can cut off the teeth of the packer, secure the loosened packer, and remove the same from the well, all in one operation. The central spear is non-rotating and follows the cutting tool through the packer. If there are obstructions to the operations of the tool, the latter can be utilized either as a bumping tool or as a drill to overcome such obstructions. These operations, as well as the drilling operations, are facilitated by the system of flushing ports provided in the tool.

While I have hereinabove described and illustrated in the drawings, a preferred embodiment of my invention, it will be apparent to those skilled in the art that various changes and modifications thereof may be made without departing from the spirit of the invention, or the scope of the appended claims.

I claim:

1. A tool for removing a well bore packer comprising an elongated milling shoe having annularly-shaped cutting means on the lower end thereof for milling away peripheral portions of the packer to disconnect such packer from a well casing, means for connecting the upper end of said milling shoe to the lower end of a drill string, a bushing rotatable with said milling shoe and located in coaxial relation within said milling shoe so that the passageway thereof will be in communication with and form an extension of the passageway through a drill string, a central spear located in coaxial relation with said milling shoe and supported in depending relation within the latter by said bushing, said spear having a lower portion adapted to move axially into the well bore packer as the latter is milled by said shoe, and means on said lower portion for securing the latter to the interior of the well bore packer to enable removal of the released packer from the well casing, means connecting said central spear to said bushing for longitudinal slidable movement relative to the latter while permitting said bushing to rotate relative to said central spear, and radial ports in said bushing enabling fluid flowing in said bushing passageway to lubricate the means connecting said central spear to said bushing so that said spear enters into the interior of the well bore packer with a lengthwise, substantially non-rotative movement, as said rotating milling shoe advances over the exterior of the packer.

2. A tool such as defined in claim 1, in which said means connecting said central spear and said bushing forms a fluid connection between said spear and bushing and includes means at the upper end of said central spear forming a piston like chamber in fluid communication with said bushing, and a collar provided on the lower end of said bushing and operating in the nature of a piston in said chamber, the lower end portion of said bushing functioning in the nature of a piston rod for such piston like connection.

3. A tool such as defined in claim 1, including a bumper member fixed on said bushing above said central spear and operable in the relative sliding movement of said bushing and spear wherein said bushing is moving axially downwardly relative to said spear, to bump the upper end of said central spear to force the advanced lower end of said central spear through an obstruction in its path.

4. A tool such as defined in claim 1, including interengageable means on said bushing and on said spear and coactable when interengaged to releashably lock said

central spear to said bushing so that said central spear may be rotatably driven by said bushing, and cutting means on the advanced lower end of said central spear enabling said spear to function as a drill during rotating movement thereof.

5. A tool such as defined in claim 1, in which the combined length of said bushing and said central spear when the latter is in fully advanced position on said bushing, is less than the length of said milling shoe, whereby said bushing and spear are wholly contained within said milling shoe, and in which the difference in the length of said milling shoe and the combined length of said bushing and spear in such fully advanced position of the latter is less than the length of the well bore packer to be removed, whereby said spear enters in following relation into the well bore packer as the milling shoe is milling the exterior of the packer.

6. A tool such as defined in claim 5, in which said securing means on the lower portion of said central spear

includes a pair of longitudinally extending raceways formed on opposite sides of the lower end portion of said central spear, and slips slidably mounted in said raceways and engageable with the interior of the well bore packer, the inner walls of said raceways being inclined outwardly downwardly to change the radial position of said slips in the movements of the latter along said raceways and to secure said slips to the well bore packer in the downward movement thereof in said raceways.

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