This invention relates to new and useful improvements in a packer.

It is an object of this invention to provide a packer having positive means for engaging the packer with the setting tool in well drilling, in combination with yieldable means for holding the engaging means in position, providing means for setting the packer and testing the well in one operation.

In present day practices, when it is desired to pack off at a selected position in a bore, the packing tool is lowered into the well and the packer set, and the tubing then withdrawn and the well washed, or acidized, by lowering suitable washing tools therein, and the washing tool is then withdrawn and the tubing reentered into the casing and again engaged with the packer and the well placed into production. It is an object of this invention to provide a packer that will accomplish all of these desired tasks in one continuous operation.

When considerable depths are reached, tubing is stretched until it reaches the maximum of its elasticity and attempts to set a packer under such conditions endangers the tubing and may cause distortion or other damage to the well. It is another object of this invention to provide a packer for wells which may be set by downward pressure rather than the customary lifting action of the tubing or working string.

With the above and other objects in view, the invention has relation to certain novel features of construction and operation of parts more particularly described in the following specification and illustrated in the accompanying drawings, wherein:

Figure 1 is an elevational view of the packer in packing position.

Figure 2A is an enlarged elevational view, in section, showing the device preparatory to packing, and being a partial view of the device, and

Figure 2B is a continuation of the view shown in Figure 2A, and

Figure 3 is an elevational sectional view, showing the device in packed position and ready for production,

Figure 4 is an end view, taken on the line 4—4 of Figure 3, in cross section, and

Figure 5 is an enlarged view of the lower slip setting mechanism.

Referring now more particularly to the drawings, the numeral 1 designates a well casing to be packed. A setting tool 2 is provided with the hold down 3, which consists of a plurality of toothed members mounted in the side wall of the tool 2 having means for limiting their outward movement such as the shoulders 4, 4 and having means for constantly urging the toothed members outwardly, such as the springs 5, 5. A mandrel 6, having the internally toothed portion 7, which meshes with the toothed members of the tool 3, has internal threads below the toothed portion 7 and the setting tool 2 is externally threaded at 9 to mesh with the threads 8 of the mandrel. A dovetailed ring packer 10 is provided in the setting tool 2 beneath the threads 9.

When the tool is lowered into the well at the desired position, the valve 39 will be opened and the ball 38 is dropped into the sub 32, and stopped by the restriction 33. The drilling fluid is then pumped into the tubing 29 under pressure and flows through the ports 28 into the chamber 30, through the ports 27 and against the piston 25 and the pressure is built up until the piston 25 bears against and shears the pins 26 and 21, moving the piston upwardly and which in turn moves the lower slips 36 outwardly against the lower expander ring 20 and sets the lower slips 36. The entire string is then lowered a predetermined distance based on the known weight of the string, applying pressure to the upper expander ring 16 and expanding the packer against the casing until the shear pin 17 is sheared and the upper slips 15 moved outwardly and downwardly on the expander ring 16, setting the upper slips 15. The pressure of the drilling fluid is then increased until the ball 35 is forced through the restriction 33 and into the cage 34. The packer is then tested by continuing the pressure on the drilling fluid. Then the tubing is rotated to the left, disenabling the setting tool 2 from the mandrel 6, the threads 8, 9 being left hand threads, and the setting tool lifted out of the mandrel and the tubing raised until the tail pipe clears the upper end of the mandrel and the washing of the well, or acidizing, or similar operation,
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then carried out, as desired. When such action is completed, the tubing again is lowered until the hold down members engage the internal teeth of the mandrel, again connecting the tubing to the packer to guard against damage from excessive pressures, and the production of the well, or other well activity, carried on.

The method of setting a packer tool applied with this device is to lower the tool on the end of a string of tubing until the packer is in the desired position, then anchoring the lower end of a packer by means of the fluid operated piston bearing against the lower slips, and then permitting the weight of the string of tubing to bear against the upper end of the packer a predetermined degree, thus expanding the packer and providing means for locking the packer in expanded position as by means of the upper slips heretofore referred to. The method consists of three steps; first lowering a packer into a well bore; second setting the lower end of the packer by fluid pressure and third, by completing the setting of the packer by lowering the string of tubing a predetermined distance against the partially set packer, and locking the packer in set position.

While the foregoing is considered a preferred form of the invention, it is by way of illustration only, the broad principle of the invention being defined by the appended claims.

What I claim is:

1. In a packer, a setting tool, a mandrel releasably secured to said setting tool, an expandable packer on said mandrel, fluid pressure operated means for setting said packer means for disengaging said setting tool and packer and yieldable means on said setting tool for re-engaging said setting tool with said mandrel by longitudinal movement after the packer has been set and the setting tool disengaged.

2. In a packer, a setting tool, a mandrel releasably mounted on said setting tool, an expandable packer on said mandrel, means for retaining said packer in expanded position comprising upper and lower slips, and means for retaining said packer in position while the upper slips are set by drill stem pressure.

3. In a packer, a setting tool, an expandable packer on said mandrel, means for retaining said packer in expanded position comprising upper and lower slips, drilling fluid operated means for raising and setting said lower slips and means for retaining said packer in position while the upper slips are set by drill stem pressure.

4. In a packer, a mandrel, and a tubing through said mandrel, an expandable packer mounted on said mandrel, slips on said packer, means for setting said slips, comprising a piston mounted in said mandrel and having aligned passageways for the admission of drilling fluid to flow against said piston and having means for rotatably disengaging said mandrel and tubing and for reengaging said mandrel and tubing by longitudinal movement of said tubing.

5. In the method of packing a well bore and of setting a packer lowering a packer into a well bore on a setting tool attached to a string of tubing through which drilling mud may be pumped, anchoring the lower end of the packer in the bore by upwardly directed fluid pressure against the packer, then releasing the weight of the drill stem on the upper end of the packer until the packer is expanded and anchoring the upper end of the packer in position disengaging the setting tool by rotation for release of the drilling mud in the tubing and reengaging said setting tool with said packer by longitudinal movement.

6. In a packer, a setting tool, a mandrel releasably secured to the setting tool by means of left hand threads, means for engaging the mandrel with the setting tool after disengagement by longitudinal movement comprising setting tool members movably mounted in the outer wall of said setting tool, the outer surface of said members being toothed, means for limiting the outward movement of said members and intermeshing teeth on said mandrel positioned to become engaged with the teeth of said inwardly yieldable members when the setting tool is lowered into the mandrel.

7. In a packer, a mandrel, and a tubing engaged with and extending through said mandrel, an expandable packer mounted on said mandrel, slips on said packer, means for setting said slips by fluid pressure, comprising a piston mounted in said mandrel bearing against said slips, a chamber between said mandrel and tubing and said tubing having passageways into said chamber and said mandrel having passageways from said chamber to said piston, and a valve controlling the flow of fluid through said passageways, means for disengaging said tubing from said mandrel to raise the discharge end of said tubing above said packer and means for reengaging said tubing and mandrel by longitudinal movement of said tubing.

8. In a well bore packing device, a string of tubing having drilling fluid under pressure therein, a mandrel engaged with the bottom of said string of tubing, an expandable packer on said mandrel, a ball cage on the bottom of said mandrel having a passageway on the lower end thereof and a ball yieldably mounted in said passageway, means for directing a predetermined degree of drilling fluid pressure against said ball and packer for setting said packer, and for increasing said pressure to move said ball through said passageway for the free flow of fluid through said cage beneath said packer, rotation means for disengaging said tubing from said mandrel to permit the discharge of the drilling fluid above said packer and means for reengaging said tubing with said mandrel by longitudinal upward movement of said tubing.

9. The method of packing a well bore comprising washing the bore beneath a packer therein, setting the packer by drilling mud pressure in the tubing, disengaging the tubing from the packer and raising the lower end of the tubing above the packer and discharging the drilling mud therefrom, reengaging the tubing with the packer and to washing or sealing the formation beneath the packer.

10. In a means for preparing a well bore for production comprising an expandable packer tool, means for lowering said tool on a string of tubing into a well bore to the desired formation, means for washing the bore through the tubing and packing tool, means for closing the lower end of the packer tool against the flow of drilling mud, means for expanding and setting the packer tool, means for disengaging the tubing from the packer and raising the lower end of the tubing to a position above the packer and discharging the drilling mud in the tubing into the bore, means for reengaging the tubing with the packer by means of longitudinal pressure and means for opening the lower end of the packer tool to permit the flow of fluid into and out of the formation beneath the packer.

11. In a well bore packing device, a string of tubing through which drilling mud under pressure may flow, a mandrel engaged with the lower end of said string of tubing, an expandable packer on said mandrel having upper and lower slips, a tail pipe extending from said string of tubing through said mandrel, a chamber beneath said packer, an annular piston formed in said chamber, passageways through said tail pipe and through said mandrel into said chamber, a valve in the passageway in said tail pipe, said valve having means constantly urging same towards closed position and means on said mandrel for holding said valve in open position to permit fluid under pressure to flow through said passageways and
bear against said piston and to set said lower slips of said packer, and after having set said lower slips of said packer, said tail pipe being elevated to move said valve out of contact with said mandrel and into closed position and means for lowering said string of tubing a predetermined distance to set said upper slips of said packer.

1. In a means for setting a packer in a well bore, a yieldable packer, upper and lower slips adjacent said packer, a piston housing and an annular piston mounted in said housing beneath the lower slips of said packer, a tubing extending through said packer having a lateral passageway therein, a valve in said passageway having means for constantly urging said valve into closed position, a mandrel extending through said packer and into said housing between said tubing and housing, said mandrel being reduced internally forming a shoulder, a passageway through said mandrel into said housing, said valve bearing against said shoulder and being maintained in open position for the free flow of fluid under pressure through the passageways and against said piston to set the lower slips of said packer and being movable off of said shoulder and into closed position to block the flow of fluid through said passageways, and means for setting said upper slips by downward movement of said tubing after said lower slips have been set.

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