June 25, 1935. R. R. RENOUF 2,005,955

WELL PACKER

Filed Nov. 28, 1933

Fig. 1

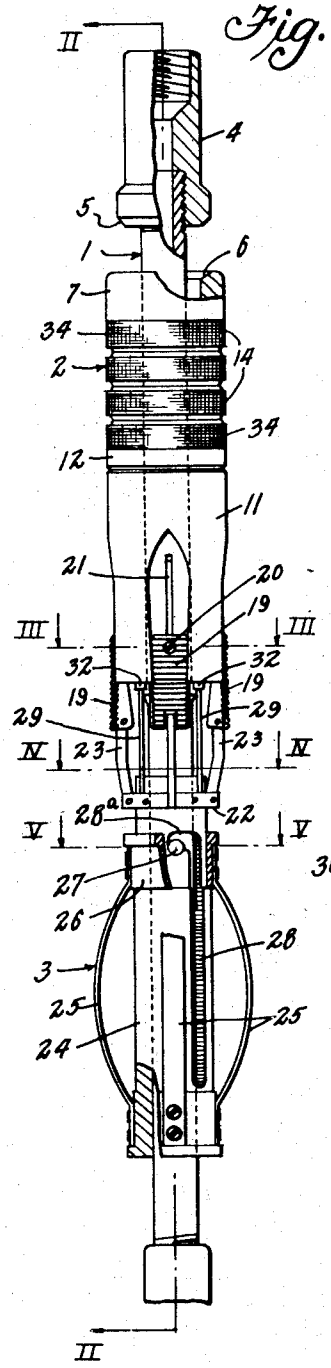
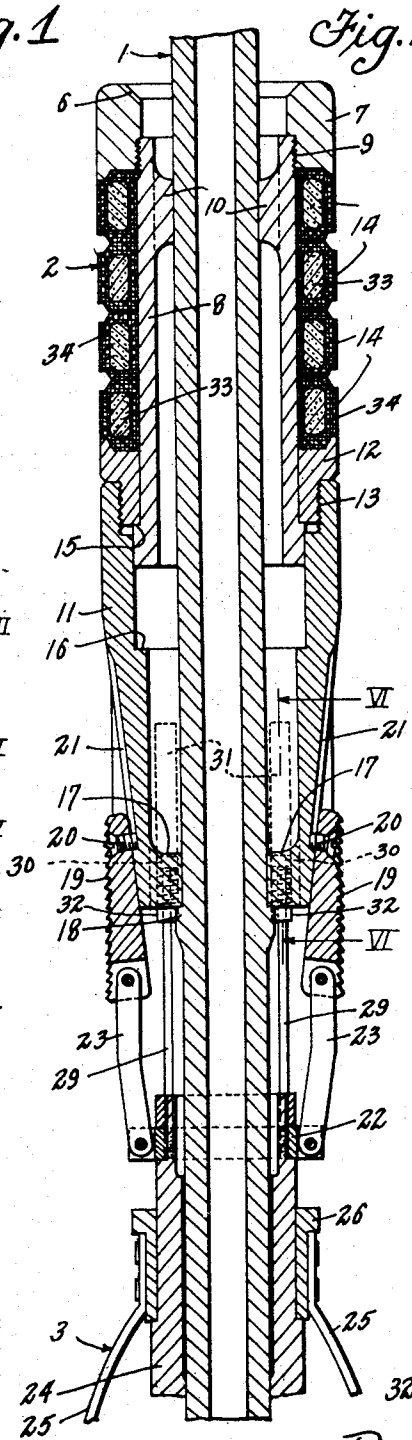


Fig. 2.



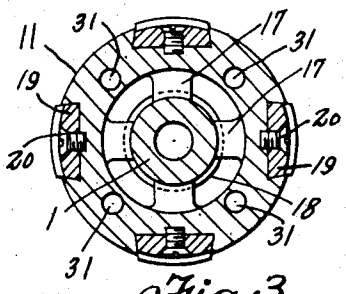
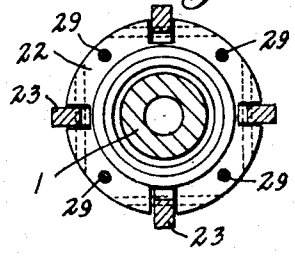


Fig. 3.

Fig. 4.



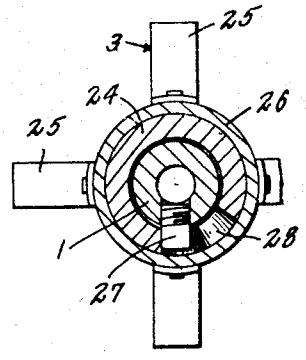


Fig. 5.

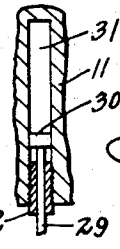


Fig. 6.

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2,005,955

WELL PACKER

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Application November 28, 1933, Serial No. 700,088

9 Claims. (Cl. 166—12)

This invention relates broadly to packing devices for oil wells, and particularly to what are known as by-pass packers, adapted to be set at any desired point within a well. Such packers are open to permit fluid to pass through the packer while the packer is being raised or lowered but completely seal the space between the oil tubing and casing when the packer is set.

An object of the invention is to provide a simple and practical structure for positively maintaining the by-pass valve of the packer open during raising or lowering of the packer.

Another object is to provide a packing structure that is positive in operation and cannot easily be damaged as the result of careless manipulation.

Another object is to provide a packer the parts of which can be manufactured and assembled at low cost.

Another object is to provide a packer having a slip mechanism that is particularly positive in operation and is not readily damaged or rendered inoperative in use.

Still another object is to provide a slip setting mechanism that is positive in operation and can be readily set or released within the well.

Other more specific objects and features of the invention will be apparent from the following detailed description which refers to the drawing.

In the drawing:

Fig. 1 is an elevation view of my packer in condition ready to be lowered into a well;

Fig. 2 is a detail vertical section showing the construction of the packer proper and the slip mechanism;

Fig. 3 is a cross section in the plane III—III of Fig. 1;

Fig. 4 is a cross section in the plane IV—IV of Fig. 1;

Fig. 5 is a cross section in the plane V—V of Fig. 1; and

Fig. 6 is a detail section view of one of the bolts and guides for retaining the by-pass valve in open position while the packer is being raised or lowered.

My packer comprises as its main component parts a hollow mandrel 1, which extends completely through the packer and slip assembly, a packer member 2 and the an anchor spring assembly 3, both the packer member and anchor spring assembly being slidably mounted upon the mandrel 1.

The mandrel 1 is connected at its upper end, as by screw threads, to a valve member 4 which in turn is adapted to be screwed onto the lower end of a string of tubing. The valve 4 is of solid construction except for a central passage therethrough, which connects the passage through the mandrel to the well tubing, and is provided with a beveled valve face 5 on its lower edge adapted to cooperate with a beveled valve seat 6 on the upper end of the packer member 2.

The packer member 2 comprises an upper collar 7 to which a hollow packer ring supporting sleeve 8 is attached, as by threads 9. The sleeve 8 is provided with a plurality of inwardly extending spacer lugs 10 which maintain the upper end of the packer member 2 in concentric relation with the mandrel 1.

A slip expander or cone 11 is positioned below the sleeve 8 and is extended up around and is in sliding engagement with the lower end of sleeve 8. A lower packer ring compression collar 12 is secured by screw threads 13 to the upper end of the cone 11. This collar 12 is in sliding engagement with the outer surface of the sleeve 8 to permit the sleeve 8 to telescope within the collar 12 when pressure is applied to expand the packer rings 14 which fit around the sleeve 8 and are retained in position thereon by the lower collar 12 and the upper collar 7. To limit upward movement of the sleeve 8 and the upper collar 7 with respect to the lower collar 12, a flange 15 is formed on the lower end of the sleeve 8, which flange engages the lower edge of the lower collar 12. Likewise, downward movement of the sleeve 8 and upper collar 7 is limited by a shoulder 16 formed in the cone 11, which shoulder is adapted to engage the lower end of the sleeve 8 in response to downward movement of the latter through a predetermined distance.

To maintain the lower end of the cone 11 in concentric relation with the mandrel 1, the cone is provided at its lower end with a plurality of inwardly projecting lugs 17 (Fig. 3), which lugs guide the cone 11 as it slides along the mandrel but permit free fluid flow from top to bottom through the sleeve 8 and cone 11 around the mandrel.

In operation, upward movement of the packer member 2 with respect to the mandrel 1 is limited by the engagement of the valve 5 with the valve seat 6 (Fig. 1). To limit downward movement of the packer member 2 with respect to the mandrel, a shoulder or collar 18 is provided on the mandrel which engages with the lower edges of the lugs 17 on cone 11 when the latter is in lowermost position with respect to the mandrel.

The packer is anchored to the casing at any desired elevation in the well by means of slips 19 which are mounted in dovetail slip guides on

the cone 11, as shown in Fig. 3, the slips being restrained from movement outwardly by the overhanging walls of the dovetail guides but being free to slide longitudinally along the slip seats. The vertical positions of the slips 19 with respect to the cone 11 is ordinarily determined by the setting mechanism which will be described later, but to prevent any possibility of the slips escaping from their guides each slip is provided with a screw 20 which projects into a longitudinal groove 21 in the bottom of its associated slip seat. Should a slip for any cause tend to move out of its slip seat, either at its upper or lower end, the inwardly projecting end of screw 20 engages with the end of the slot 21 in the slip seat associated with that slip and prevents further movement of the slip.

The slip setting mechanism comprises the anchor spring assembly 3, together with a slip collar 22 and slip reins 23. The anchor spring assembly 3 includes a sleeve 24 slidably mounted upon the mandrel 1 below the packer member 2, which supports bow springs 25 for frictionally engaging the well casing. The bow springs 25 are rigidly secured at their lower ends to the sleeve 24 but are secured at their upper ends to a ring or collar 26 which is slidable longitudinally on the sleeve 24 to permit contraction and expansion of the bow springs 25. The portion of the sleeve 24, upon which the collar 26 slides, is of slightly smaller exterior diameter than the main portion of the sleeve to limit downward movement of the collar 26.

The sleeve 24 is free to rotate upon the mandrel 1 except as limited by a lock pin 27 which projects outwardly from the mandrel and engages with a vertical slot 28 in sleeve 24, which slot is provided with a lateral recess 28a at its upper end.

The slips 23 are set and released in response to vertical movement of the sleeve 28 with respect to the cone 11. To this end, each slip 19 is connected by its associated rein 23 to the slip collar 22 which is rotatably mounted in an annular recess provided therefor on the upper end of sleeve 24. By virtue of the fact that the slip collar 22 is rotatably mounted on the sleeve 24, the reins 23 always remain in perfect alignment with the slips and ring regardless of the position of rotation of the sleeve 24 with respect to the packer member 2.

To maintain the valve 5 in open position with respect to the valve seat 6 in the upper end of the packer member 2, bolts 29 threaded into slip collar 22 are provided for connecting the slip body 11 to the slip collar 22, thereby positively holding the packer member 2 in its lower or open position while the slip collar 22 is in lower position as shown in the drawing. However, to permit the slip collar 22 to move upwardly with respect to the cone 11, which is necessary in order to set the slips 19, the bolts 29 are permitted to telescope into the cone 11. Thus, as shown in detail in Fig. 6, each bolt 29 is provided with a head 30 adapted to move vertically in a recess 31 in the slip body, which recess is closed at its lower end by a threaded bushing 32, which prevents the head 30 on the bolt from being withdrawn from the cone 11.

Although various types of packing rings may be employed with the assembly described, I have found that packer rings of the shape shown in Fig. 2 are particularly effective. Thus, referring to Fig. 2, each packing ring 14 comprises a rubber core 33 of rectangular cross section surrounded with a wrapping 34 of heavy canvas, the whole being compressed into the particular shape shown.

The device described functions as follows: When the packer is to be inserted into a well, the valve member 4 is screwed onto the lower end of the well tubing and the anchor spring cage or sleeve 24 is moved into lower position and turned to engage the pin 27 on the mandrel 1 in the recess 28a as shown in Fig. 1. This retains the sleeve 24 in lowermost position with respect to the mandrel, in which position the slips 19 are held in contracted position on the cone 11 and in which cone 11 is also held down, by the bolts 29, against the collar 18 on the mandrel. This maintains the valve seat 6 clear of the valve face 5 so that as the device is lowered into the well a free fluid passage is provided through the packer about the mandrel 1.

When the packer has been lowered to the level of the well at which it is to be set, the pin 27 is released from the recess 29 by rotating the tubing string to the left. This action takes place because of the fact that the sleeve 24 is restrained from turning by the friction of the bow springs 25 against the casing, whereas the mandrel rotates with the string of tubing to which it is solidly attached. After the pin 27 has been released from the recess 29, the tubing is again lowered, moving the mandrel down. The sleeve 24, however, now no longer moves downward with the mandrel since the pin 27 is free to move independently of the sleeve through the slot 28 and the sleeve 24 is maintained stationary by friction of the bow springs 27 against the casing. If the packer member 2 is perfectly free within the well casing, it will drop of its own weight with the mandrel 1, causing the slips 19 to ride upon their seats until they engage with the casing, which engagement positively locks the cone 11 to the casing and prevents any further downward movement thereof. Thereafter further downward movement of the mandrel continues until the valve face 5 rests against the valve seat 6 in the upper end of the packer member which seals the passage through the packer surrounding the mandrel. Further downward movement of the tubing string thereafter forces the upper packing collar 7 and sleeve 8 down with respect to the lower packing collar 12, squeezing the packer rings 14 and expanding them against the casing to form a seal therewith.

In case the packing member 2 is frictionally engaging the casing, it stops as soon as the pin 27 is disengaged from the recess 29, whereupon the mandrel moves down to engage the valve face 5 against the valve seat 6 and thereafter forces the cone 11 down until the slips 19 are set, after which the packing rings 14 are expanded as already described.

The shoulder 16 in the cone 11 is spaced a sufficient distance below the sleeve 8 to permit proper expansion of the packing rings 14 under normal conditions. However, should the casing be damaged or be of excessive diameter so that normal compression of the packing rings did not produce a solid seal, then the downward movement of the sleeve and upper packing collar 7 is limited by contact of the lower end of the sleeve 8 with the shoulder 16 to prevent damage to the packing rings.

The packer is released by merely lifting up on the tubing string. This carries the mandrel 1 upwardly, first disengaging the valve 5 from the valve seat 6 and thereafter lifting the slip cone 11 through the shoulder 18 engaging with the

lugs 17. Upward movement of the cone 11 releases the slips 19 into their normal position, as shown in the drawing, whereupon the entire packer may be withdrawn to the surface. It is possible, however, to reset the packer at another point in the well without withdrawing it. To do this, the tubing string, after being raised sufficiently to release the packer and bring the pin 27 into the upper end of the slot 28, is rotated to the right to return the pin 27 into the recess 29. Thereafter the packer may be again lowered or raised into any desired position in the well since the slips 23 are then locked in disengaged position.

It is to be understood that the embodiment of the invention described herein is only one of many possible variations and the invention is to be limited only as set forth in the appended claims.

I claim:

1. A well packer comprising in combination a mandrel adapted to be secured to the lower end of a string of tubing, a hollow packing member slidably mounted upon said mandrel and defining a fluid space between said packing member and mandrel, slip means including elements for frictionally engaging a casing slidably supported on said mandrel below said packing member for anchoring said packing member to a casing in response to downward movement of the packing member with respect to said slip means, means for normally locking said slip means in lowermost released position with respect to said mandrel, said locking means being releasable to permit downward movement of said mandrel with respect to said slip means, a valve seat in the upper end of the packing member, a valve on the mandrel adapted to engage with said seat when the mandrel is lowered with respect to the packing member to seal said fluid space and limit downward movement of the mandrel with respect to the packing member, and means for limiting upward movement of said packing member with respect to said slip means whereby when said slip means is in lowermost position on said mandrel said valve is disengaged from said seat, said means for limiting upward movement of said packing member with respect to said slip means comprising a plurality of rods extending upwardly from said slip means, said packing member being provided with passages to slidably receive said rods, the rods having enlarged heads on the upper ends thereof, and the orifices in the lower ends of said passages being provided with shoulders to engage said heads and limit downward movement of the rods with respect to the packing member.

2. A packer comprising in combination a mandrel adapted to be secured to the lower end of a string of tubing, a packing member surrounding said mandrel, said packing member comprising a sleeve and an upper packing collar rigidly secured together and a lower packing collar slidably mounted upon said sleeve, packing rings positioned about said sleeve between said packing collars, slip means for anchoring said lower packing collar to a casing, a valve seat on the upper end of said first packing collar, a valve on said mandrel normally positioned in spaced relation above said valve seat and adapted to engage said valve seat in response to downward movement of said mandrel with respect to said packing member, whereby downward movement of said mandrel with respect to said packing member first forces said valve against said valve seat and thereafter forces said upper collar and sleeve downward with respect to said lower collar to expand said packing rings.

3. A packer as described in claim 2 in which said sleeve is provided with a shoulder to limit downward movement of said lower packing collar with respect to said sleeve and upper packing collar.

4. A packer as described in claim 2 in which said packer comprises an element secured to said lower packing collar and having a shoulder in the path of movement of the lower end of said sleeve for limiting downward movement of the sleeve with respect to the lower packing collar.

5. In a packer, a member having a cylindrical surface, an upper packing collar secured to said member and constituting a shoulder thereon, a lower packing collar slidably mounted on said cylindrical member, and a plurality of packing rings surrounding said cylindrical member and stacked on top of each other and in direct contact with each other between said collars, each packing ring being of substantially rectangular cross-section with beveled upper and lower edges whereby the beveled edges of adjacent rings define an annular groove extending about said packer.

6. In a packer, a mandrel, a hollow packing member surrounding said mandrel comprising a sleeve, an upper packing retaining collar attached to said sleeve, a lower packing retaining collar slidably mounted upon said sleeve, a slip cone surrounding said mandrel and positioned below said packing member, said slip cone being recessed to receive the lower end of said sleeve, means for detachably securing said lower packing retaining collar to the upper end of said slip cone, and a shoulder on the lower end of said sleeve adapted to engage with the lower edge of said lower packing retaining collar to limit upward movement of said sleeve with respect to said slip cone, a shoulder at the lower edge of said recessed portion of said slip cone for engaging with and limiting downward movement of said sleeve, slips on said said slip cone and means attached to said slips for frictionally engaging the casing to force said slips upwardly and outwardly along said slip cone in response to downward movement of said slip cone, a valve seat on the upper end of said packing member and a valve on said mandrel for engaging with said seat in response to downward movement of the mandrel with respect to said packing member.

7. In a packer, a mandrel, a packing member and slip cone assembly slidably and rotatably mounted upon said mandrel, slips on said slip cone, a slip-anchoring sleeve slidably mounted on said mandrel below said slip cone, spring casing-engaging means on said slip anchoring sleeve, means comprising a pin on said mandrel and a bayonet slot on said slip-anchoring sleeve for limiting movement of said sleeve with respect to said mandrel, a slip collar rotatably mounted on said sleeve for longitudinal movement therewith, and means connecting said slip collar to said slips, cooperating stop means on said mandrel and packing member for limiting downward movement of said mandrel with respect to said packing member, and other means connecting said slip ring to said packing member for limiting upward movement of said packing member with respect to said slip ring.

8. A well packer comprising in combination a mandrel adapted to be secured to the lower end of a string of tubing, a first member slidably

mounted on said mandrel adjacent the upper end thereof and a second member slidably mounted on said mandrel below said first member, said first member defining with said mandrel a fluid passage surrounding said mandrel and including a packing member and a slip cone, slips slidably mounted on said cone, said second member including spring elements for frictionally engaging a casing, slip links connecting said second member to said slips for actuating the latter, means for normally locking said second member in a predetermined lowermost position on said mandrel, said locking means being releasable to permit downward movement of said mandrel with respect to said second member, a valve seat in the upper end of said first member, a valve on the mandrel adapted to engage with said seat when the mandrel is lowered with respect to said first member, to seal said fluid passage and limit downward movement of the mandrel with respect to said first member, and a link means independent of said slips and said slip links directly connecting said first and second members for limiting upward movement of said first member with respect to said second member whereby when said second member is locked in said lowermost position on said mandrel said valve is maintained clear of said seat.

9. A well packer, as described in claim 8, in which said link means for directly connecting said first and second members comprises a bolt threaded into one of said members at one end and having a head on its other end, said bolt being extended through an orifice provided therefor on said other member, which orifice is smaller than said bolt head.

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