April 19, 1949. W. H. GRIFFIN ET AL 2,467,822

WELL PACKER

Filed April 26, 1946

Fig. 1.

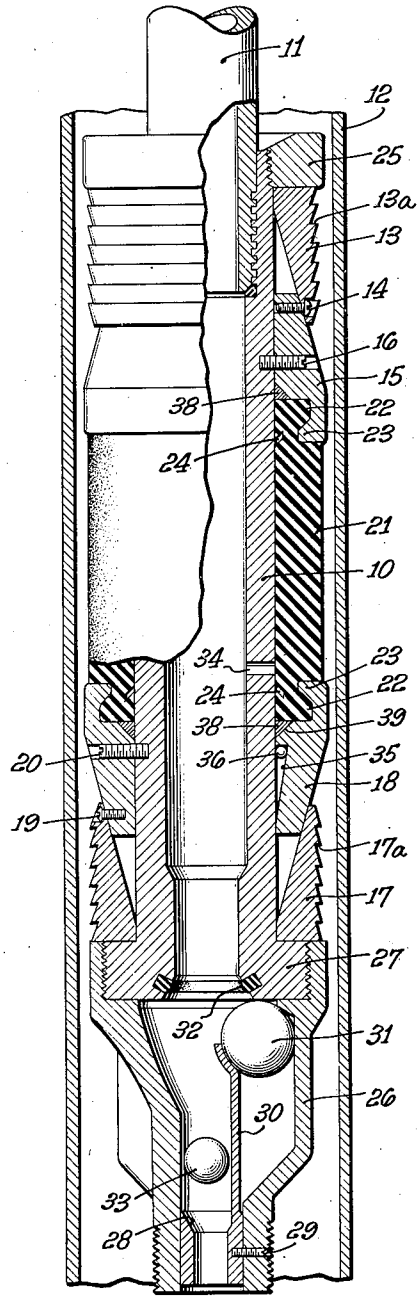


Fig. 2.

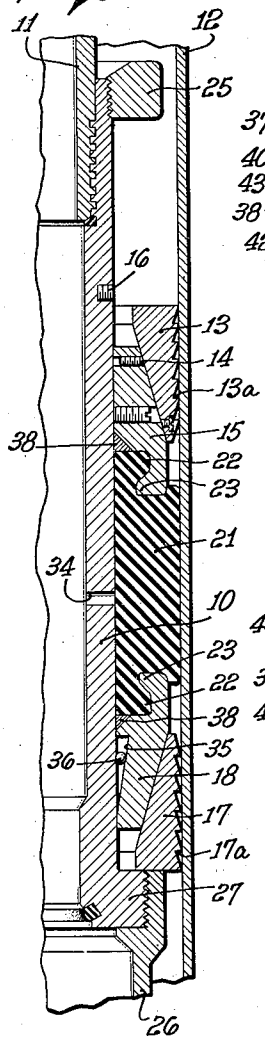


Fig. 3.

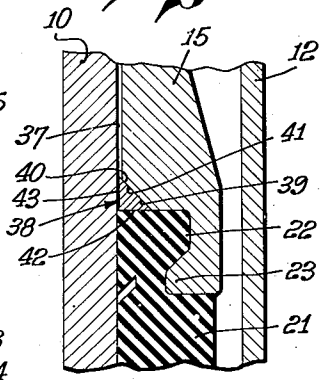
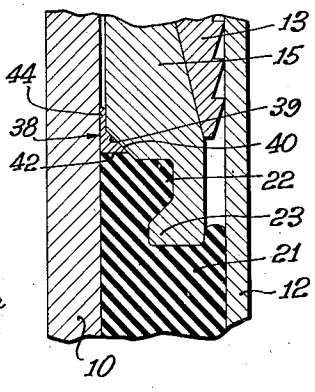


Fig. 4.



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WELL PACKER

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7 Claims. (Cl. 166—12)

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This invention relates to well devices, and more particularly to well packers designed to be lowered within well casings, liners and similar well conduits for the performance of desirable functions therein.

Well packers are provided with rubber or rubber-like packing members for effecting seals between the body members and the walls of well casings or liners in which the packers are to be used. A portion of the packing member is adjacent a retainer, which may have a loose or sliding fit on the packer body. Despite the provision of a relatively small operating clearance between the retaining member and the packer body, under many well operating conditions involving high pressures, high temperatures, or both, this clearance space affords a gap through which the packing material may flow. Under some circumstances such material has been almost completely dissipated through the gap and is unavailable for the continued performance of its function of sealing off the space between the packer body and wall of the well casing or liner.

It is, accordingly, an object of the present invention to prevent flowing of rubber and similar packing materials through the clearance space existing between a packer body, on which the packing member is mounted, and a packing retainer or abutment surrounding the body.

This invention has other objects that will become apparent from a consideration of the embodiment shown in the drawings accompanying and forming part of the present specification. This form will now be described in detail to illustrate the general principles of the invention, but it is to be understood that such detailed description is not to be taken in a limited sense, since the scope of the invention is best defined by the claims appended hereto.

Referring to the drawings:

Figure 1 is a longitudinal section and elevation of a well packer in a well casing, with its parts in retracted position;

Figure 2 is a partial longitudinal section of the well packer anchored in packed off condition within the casing;

Figure 3 is an enlarged fragmentary section of part of the packer shown in Figure 1; and

Figure 4 is a view similar to Figure 3 of part of the packer in packed off condition.

The invention is disclosed in the drawings as applied to a well packer of the general type shown in United States Patent No. 2,120,151. Essentially, it consists of a central tubular body 10 secured to a string of tubing or drill pipe 11,

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by means of which it is lowered through the well casing 12 to the desired setting point. The packer is anchored against movement in an upward direction by a set of upper segmental slips 13 initially held in retracted position by shear screws 14 threaded into a conical-like expander 15 slidable on the exterior of the body 10. This expander, whose outer surface tapers in an upward and inward direction to conform to the inner taper on the slips B, is also initially secured to the body by one or more shear screws 16.

Downward movement of the well packer is prevented by a plurality of segmental lower slips 17 having tapered surfaces inclined downwardly and inwardly and adapted to slide along a companion external tapered surface on the exterior of a lower conical expander 18, which is slidably mounted on the body 10. The lower slips are initially held in retracted position by shear screws 19 securing them to the lower cone 18, and the lower cone is also held in an initial upward position with respect to the lower slips by one or more shear screws 20 secured to the body 10. The lower screws 19, 20 have a greater shear value than the upper screws 14, 16, for reasons hereinafter set forth, and as also explained in the above patent.

A packing sleeve 21 is mounted on the body 10 between the two expanders 15, 18. In the specific example disclosed, this sleeve has external end flanges 22, 22 interlocking with inwardly extending flanges 23, 23 on the expander cones. The packing sleeve is also provided with internal lip seals 24, 24 near its ends, adapted to slidably seal with the external surface of the body.

The upper slips 13, when in retracted position, are contained within the circumferential confines of a trip ring 25 secured to the upper end of the body 10. Similarly, the lower slips 17 are contained initially within the peripheral confines of an abutment at the lower end of the body, defined by a valve housing and guide 26 threaded on a lower body flange 27. This valve guide depends from the body and has a trip ball seat 28 secured in its lower end by a shear screw 29. An arm 30 extends upwardly from the seat to hold a buoyant back pressure ball valve 31 in ineffective position to one side of the passage through the packer body 10, to prevent its engagement with a valve seat 32 at the lower end of the body while the tool is being lowered through the fluid in the well casing.

The tool is run in the well bore with its parts in retracted position, as shown in Figure 1. When the setting point is reached, a trip ball 33

is lowered or pumped down through the tubular string 11 until it engages the trip ball seat 28, closing the body passage against flow of fluid therethrough. Pressure can then be built up in the tubing string and body to force fluid under pressure through lateral ports 34 in the body into the elastic packing sleeve 21, inflating the latter against the casing and then elongating it in an upward direction to shear the screws 16, 14 holding the upper expander 15 to the body 10 and the upper set of slips 13 to this expander. Such upward movement of the conical expander 15 causes it to move within the slips 13 and force them radially outward along the abutting trip ring 25 into engagement with the casing (as explained in the aforesaid patent). The tubing string 11 is then elevated to move the body 10, lower slips 17 and lower cone 18 upwardly with respect to the upper expander and slips, foreshortening or compressing the packing unit 21 in a longitudinal direction and expanding it outwardly against the casing 12 to form a leakproof seal between the body 10 and casing 12.

After the packing has been thus engaged with the casing, a continuation of the upward strain and movement of the packer body 10 shears the screws 20, 19 holding the lower expander 18 to the body and the slips 17 to the expander, the lower abutment 26, 27 shifting the slips 17 longitudinally in an upward direction along the outer surface of the expander 18 and radially into anchoring engagement with the casing 12. Such action occurs because the upper expander 15 is prevented from moving upwardly by the casing engaging upper slips 13 and sealed off packing 21. Wickers 13*a* on the upper slips face in an upward direction and wickers 17*a* on the lower slips in a downward direction, preventing upward movement of the upper cone 15 and downward movement of the lower cone 18, and also precluding shifting of the intervening packing 21.

Upward movement of the packer body 10 is prevented by the anchoring engagement of the upper slips 13 in the wall of the casing 12. Downward movement of the packer body 10 is prevented by an expander locking device, consisting of a plurality of downwardly converging grooves 35 containing locking ball elements 36, in effect forming a one-way clutch. The lock device permits the body 10 to be moved upwardly with respect to the slips 13, 17, expanders 15, 18 and packing member 21, in order to effect complete anchoring in packed off condition of the well packed against the casing, but downward movement of the packing body 10 thereafter is prevented by the ball locking elements 36 wedging between the exterior of the body 10 and the tapered surfaces of the locking grooves 35. Downward strains imposed on the body are transmitted through the locking balls 36 to the conical expander 18, and through the lower set of slips 17 to the wall of the casing 12.

After the packer has been fully set, additional pressure imposed on the fluid in the tubing string and packer body shears the screw 29 holding the trip ball seat 28 to the guide 26 and blows it from the guide, releasing the back pressure ball valve 31 and permitting it to engage its seat 32, preventing return flow of fluid back into the packer body 10.

The need for a sliding action between the conical expanders 15, 18 and the body 10 to effect setting of the packer within the well casing requires that the inside diameter of the conical

expanders be made slightly greater than the outside diameter of the packer body. The difference in diameters is not very great. For example, well packers of the type described can be produced economically and operated efficiently if the difference in diameters is approximately 0.008 of in inch, which provides a radial clearance or gap of 0.004 of an inch.

In the use of well packers under high temperatures and pressure conditions, as when employed for performing high pressure squeeze cementing operations in hot wells, or as production packers high temperature and pressure well flowing conditions, it has been found that leakage sometimes develops around the packer body 10, apparently caused by flowing of the packing material through spaces or gaps existing between this body and wall of the casing. It has been found that some of the packing material flows, or tends to flow, into and through the relatively small annular clearance space 37 between the packer body 10 and abutment 15 adjacent the packing element 21. The present invention contemplates the prevention of such cold flowing of packing material.

To accomplish the stated objective, a ring 38 of pliant, inelastic or malleable material, such as ordinary lead, copper, Babbitt metal, etc., is disposed between each of the expander abutments 15, 18, and packing 21 to bridge the clearance space 37 between each abutment and the exterior of the body 10. Each abutment is chamfered adjacent the end of the packing to provide a generally triangular groove 39 in conjunction with the adjacent packing 21 in which a lead, or similar, packing flow preventing annulus or ring 38 is inserted. The outer inclined surface 40 of this ring engages the corresponding chamfered or tapered surface 41 of the abutment, the base 42 of the ring engages the packing 21, and its inner surface 43 is adapted to engage the exterior of the packer body 10.

The ring 38 may also have a working clearance with the packer body 10 to permit movement of the latter with respect to the conical expander and packing member, in order to effect anchoring of the packer within the well casing. This clearance may equal or be less than the clearance 37 existing between the expanders 15, 18 themselves and the exterior of the packer body 10.

The lead ring 38, under low pressure operating conditions, functions as an integral part of the expander abutments 15, 18. However, upon the subjection of the packing material to high pressure, high temperatures, or both, it will press the pliant, inelastic ring 38 upwardly along the tapered surface 41 of the abutment and radially inward into firm sealing engagement with the packer body 10, completely closing the small annular clearance space 37 between the abutment and body and precluding any flowing of packing material therethrough. If the pressures are sufficiently high, some of the material 44 from which the ring is made may even be forced into the small annulus 37 between the packer body 10 and abutment 15 (see Figure 4). Experience has shown, however, that even under very high pressure conditions, of the order of 7,000 p. s. i., the packing material is incapable of completely removing the lead ring from its bridging position across the clearance space.

The pliant, inelastic ring 38 has such characteristics that it will deform inwardly under the action of the rubber packing element 21 into sealing engagement with the body 10 before the

rubber element itself can commence squeezing through the small clearance space between the ring and the packer body. As stated above, under low pressure operating conditions the bridging ring 38 need not deform; but it will form a secure bridge across the clearance space under conditions that would otherwise cause the packing material to flow through the clearance space in the absence of the bridging ring.

It is, therefore, apparent that a determination has been made of a leakage difficulty with the prior art packers and that an effective remedy has been provided for overcoming this undesirable condition. The internal clearance bridging rings do not interfere with the normal setting operations of the well packer, allowing all of the parts to have the required relative sliding movement. It does, however, come into play when needed to close the clearance space between the packer body and the slidable elements therearound. The packing 21 itself produces the sealing and bridging action of the pliant, inelastic or malleable rings 38 between the packer body 10 and the packing abutments 15, 18.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. A well packer, including a packer body, a packing retainer slidable on said body, there being an annular clearance space between said retainer and body, a non-metallic packing around said body adjacent said retainer, and a pliant, inelastic annulus on said body engageable with both said retainer and packing and deformable inwardly by said packing upon its subjection to pressure across said clearance space between said body and retainer.

2. A well packer, including a body, a packer packing retainer slidable on said body, there being an annular clearance space between said retainer and body, a non-metallic packing around said body engaging said retainer, said packing and retainer defining an inner groove therebetween, and a pliant, inelastic annulus in said groove movable by said packing against said retainer and deformable inwardly into engagement with said body to bridge and close said clearance space between said body and retainer.

3. A well packer, including a packer body, a packing retainer slidable on said body, there being an annular clearance space between said retainer and body, a non-metallic packing around said body engaging said retainer, said retainer having an inner beveled surface defining an inner groove in conjunction with said packing, said surface being inclined inwardly in a direction leading away from said packing, and a pliant, inelastic annulus in said groove movable by said packing against the beveled surface of said retainer and deformable radially inwardly into sealing engagement with said body to close said clearance space between said body and retainer.

4. A well packer, including a packer body, a packing retainer movably mounted on said body, there being an annular clearance space between said retainer and body, a non-metallic packing around said body adjacent said retainer, the adjacent surface of said packing being substantially

at right angles to the axis of said body, said retainer having an inner beveled surface adjacent said retainer defining a generally triangular groove therebetween, and a pliant, malleable ring in said groove and adapted to be pressed by said packing against said beveled surface and deformed inwardly into sealing engagement with the exterior of said body to close said annular clearance space.

5. In a well packer having a packer body and a plurality of slips adapted to be engaged with the wall of a casing by an expander movably mounted with respect to said body, there being an annular clearance space between said expander and body; the combination therewith of a non-metallic packing adapted to seal said annular space between said body and wall of said casing and having a portion adjacent said expander, and a pliant, malleable ring in said expander adjacent said packing portion and adapted to be deformed inwardly by said packing against said body to bridge the annular space between said expander and body.

6. A well packer having a packer body, upper and lower expanders mounted on and movable with respect to said body, there being respective annular clearance spaces between said expanders and said body, upper and lower sets of slips cooperable with said upper and lower expanders, respectively, for anchoring said well packer to said casing against movement in both longitudinal directions, a non-metallic packing sleeve disposed on said body between said expanders, each of said expanders defining an inner groove in conjunction with said packing sleeve, and a pliant, inelastic ring in each of said grooves adapted to be engaged and deformed inwardly by said packing sleeve against said body to bridge the annular spaces between said expanders and said body.

7. A well packer, including a packer body having a portion with an uninterrupted cylindrical outer surface, a packing retainer slidable on said body, there being an annular clearance space between said retainer and body, a non-metallic packing around said body engaging said retainer, said packing and retainer defining an inner groove therebetween, and a pliant, inelastic annulus in said groove movable by said packing against said retainer and deformable into engagement with said uninterrupted surface of said body portion to bridge and close said annular clearance space between said body and retainer.

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