June 16, 1953 R. H. KOLB 2,642,141

COLLAPSIBLE PACKER FOR WELL INSTRUMENTS

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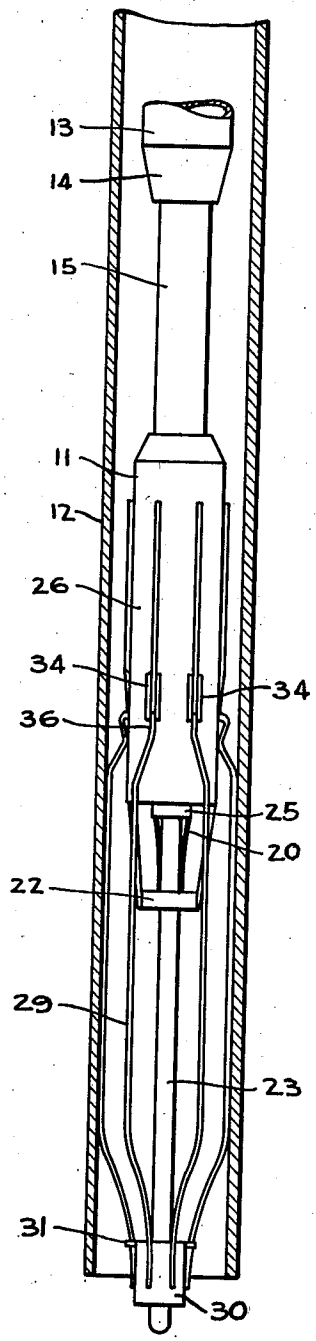


FIG. 1

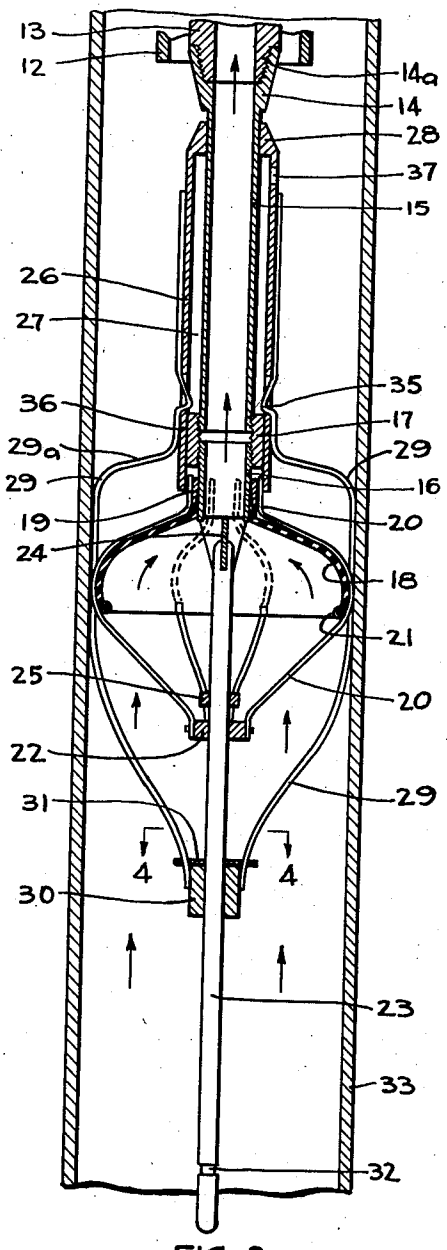


FIG. 2

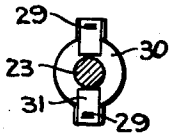


FIG. 4

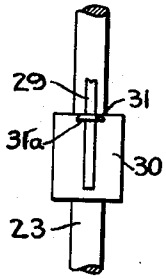


FIG. 3

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COLLAPSIBLE PACKER FOR WELL INSTRUMENTS

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4 Claims. (Cl. 166—10)

1

This invention relates to packers for use in well boreholes and pertains more particularly to collapsible packers for use with instruments employed in oil wells, for example, well instruments adapted to be lowered into a well borehole, casing or tubing on a wire line.

The packers presently used on wire line instruments have certain drawbacks and are considerably limited in their application, thus often decreasing the flexibility and usefulness of the instrument on which they are mounted. For example, the expansion of most packers is limited to about twice their collapsed diameter or the diameter of the mandrel on which they may be mounted. Thus, in order to employ a packer capable of sealing off a large-diameter borehole or well casing it is necessary to use a packer having a large diameter in its collapsed position. Most packers have an additional disadvantage in that they are capable of being actuated (or set in a fixed position in a well borehole) only once without removing the instrument and its packer from the well and resetting the packer. While a few packers are adapted to be moved and re-actuated several times when the instrument on which the packer is mounted is run into the well or withdrawn therefrom, there is at present no packer which may be actuated, retracted and then reset at several locations as it is moved both up and down in a cased or uncased well borehole.

It is therefore a primary object of this invention to provide an improved packer for use with a well instrument, which packer is capable of being reset at any desired number of locations in a cased or uncased well borehole as the instrument is run in and/or out of the well.

Another object of the present invention is to provide a collapsible packer adapted to be run through a small diameter production tubing in either direction while remaining in its retracted position.

A further object of this invention is to provide a collapsible packer contained within a housing adapted to be unhoused and expanded as it emerges from the lower end of a production tubing and capable of being automatically retracted within its housing as it again enters the tubing.

Another object of the present invention is to provide a readily collapsible packer for use on a wire line well instrument, said packer being capable of expanding to several times its collapsed diameter.

A further object of this invention is to provide a collapsible packer for well instruments of

2

small diameter capable of passing through a well production tubing, said packer being adapted to be automatically set upon emergence from the end of the tubing in a larger-diameter portion of a well.

These and other objects of this invention will be understood from the following description taken with reference to the attached drawing, wherein:

Figure 1 is a longitudinal view of the present well packer in its retracted or collapsed position when attached to the lower end of a well instrument and positioned within a well tubing;

Figure 2 is a longitudinal view, partly in cross section, of the present well packer in its operative or expanded position when located in a well bore or casing;

Figure 3 is a side view of the latching mechanisms 30 and 31 shown in Figure 2.

Figure 4 is a plan view of the latching mechanism of Figure 3 taken along line 4—4 of Figure 2.

Referring to Figure 1 of the drawing, the present well packer 11 is illustrated in its retracted position in a well tubing 12 together with a well instrument 13 removably secured in any suitable manner to the upper end of said packer.

The present packer comprises a tubular body member 15 having a coupling 14 at its upper end for attachment to a coupling 14a on the lower end of the well instrument 13, as shown in Figure 2. While the body member 15 may be a single tubular element, it is preferred for ease of assembling the present packer that the body member be made of two tubular pieces 15 and 16 joined together by a coupling 17.

Secured to the lower end of the tubular body member 16, in any suitable manner, is a cone-shaped element which will hereinafter be referred to as the parachute 18. The apex of the cone or the center of the parachute 18 is open allowing fluid to pass from the parachute up through the tubular body members 15 and 16 and up into the test instrument 13. The parachute is preferably made of any suitable thin flexible material such as rubber, synthetic rubber, rubberized canvas, canvas, plastic, metallic cloth or screen, etc. Additionally the parachute may comprise a plurality of relatively thin petal-like segments of metal or plastic material, the contiguous edges of said segments circumferentially overlapping when the packer is in its expanded or actuated position.

The apex of the parachute 18 is suitably secured in a fixed manner to the lower end of tubular body member 16, as by a ring clamp 19.

Fixedly secured to the outside of the tubular body member 16, or to the ring clamp 19, are a plurality of parachute ribs 20 which reinforce the parachute in its extended position, as shown in Figure 2, and aid in folding the parachute into its retracted position. The ribs 20 are preferably made of spring-steel wire or narrow metallic bands which may be provided with fixed rings 21 to which the lower edge of the parachute may be secured.

The lower ends of the ribs 20 are welded or otherwise fixedly attached to a ring 22 which is slidably mounted on a guide rod or extension shaft 23. The guide rod 23 in turn is affixed by one or more thin vanes 24 to the lower end of the tubular body member 16. The spaces between the vanes 24 allows fluid to pass around the end of the rod 23 and into the bore of tube 16. A stop member 25 affixed to the rod 23 limits the upward movement of the slidable ring 22.

Mounted for sliding coaxial movement on the tubular body member 15 is a parachute housing tube or sleeve 26. Preferably the sleeve 26 has an inside diameter greater than the outside diameter of the body member 15 whereby an annular space 27 is formed between the two elements. Formed or affixed on the top of the sleeve 26 is a bearing 28 in sliding contact with the outer wall of the body member 15. At least one port 37 is provided through the sleeve 26 near the top thereof to allow the escape of fluid which may become trapped within the sleeve. The outside diameter of the coupling 17 is preferably substantially equal to the inside diameter of the sleeve 26 whereby the outer face or wall of the coupling 17 acts as a bearing surface for the lower end of the sleeve 26. It is to be realized, however, that the tubular body member 15 may be constructed as a single element with its outer surface acting as the bearing surface for a close-fitting parachute housing sleeve 26.

The housing sleeve 26 is of a length such that the parachute is entirely covered when the packer is in its retracted position, as shown in Figure 1. The guide rod 23 extending for some distance below the body members 15 and 16 is of a diameter substantially smaller than the bore of the housing sleeve 26 whereby the parachute 18 may be folded and contained within the space between the rod 23 and the sleeve 26 when the packer is being moved within the production tubing 12.

A plurality of centralizer springs 29 and 29*a* are mounted on the packer assembly. The upper ends of the springs 29 are fixedly secured in any suitable manner, as by welding or clamping, to the housing sleeve 26 while the lower ends of the springs are affixed to a centralizer slide 30 mounted for movement along rod 23. The slide 30 is equipped with latch means 31 adapted to slide radially and seat in a groove 32 in the rod 23 near the lower end thereof. One form of latch means is illustrated in Figures 2 to 4 wherein the latch 31 comprises dovetailed bar members slidably mounted on either side of rod 23 in a dovetailed slot 31*a* (Figure 3) in the top of the slide 30. One spring 29 passes through each end of the latch means 31 and is anchored on slide 30. The springs 29 are secured to the latch means 31 so as to springload the latch means whereby said latch means disengages the groove 32 when the centralizer springs are allowed to expand outwardly against the walls of a well casing 33, as illustrated in Figure 2.

As shown in Figure 1, the wall of the housing sleeve 26 is provided with a series of longitudinal slots 34 equal in number to centralizer springs 29 and in alignment therewith. The slots 34 are wider than the springs 29 thus allowing offsets in the springs, as at numeral 35, to extend into said slots and seat against the shoulder formed by the top of the coupling 17. The operation of the centralizer springs 29 will be described hereinbelow. The springs 29 are of a length such as to extend from the coupling 17 to a point well below the parachute 18 and its ribs 20. Preferably, the centralizer springs are formed or designed so that a substantial length of each spring 29 is in fractional contact with the inner wall of the well casing 33 when the packer assembly is in its operative position.

In operation, the present packer assembly may be attached to the lower end of various types of well instruments for packing off a well casing and directing the production well fluid through the well instrument. For example, the present packer assembly may be attached to the lower end of a well flowmeter as described in U. S. Patent No. 2,593,285 to Fay et al.

Prior to insertion of the packer assembly and well instrument into a lubricator at the well head or into the top of the tubing string 12, the parachute ribs 20 are collapsed with the parachute 18 folded within them and the parachute housing sleeve 26 is lowered over the parachute 18 and ribs 20 so as to restrain them from opening. The centralizer springs 29 are then collapsed and manually held in a collapsed state. As the centralizer springs 29 are collapsed, the slide 30 and its latch 31 are forced down the rod 23 until the latch 31 engages the groove 32 in the lower end of the rod 23. As long as the centralizer springs 29 are maintained in a collapsed condition, either manually or by the walls of the tubing 12 as shown in Figure 1, the latch means 31 engages groove 32 and prevents the spring 29 and the housing sleeve 26 attached thereto from moving upwardly and unhousing the parachute 18. In this condition, the present packer assembly 11 may be lowered through the tubing without danger of the packer closing the bore of the tubing 12 and interfering with the production of oil therethrough. At the same time the parachute 18, being within the housing sleeve 26, is protected from damage by abrasion against the tubing wall while being lowered through the tubing 12.

When the packer assembly 11 passes out of the lower end of the tubing 12, as illustrated in Figure 2, the centralizer springs 29 expand and disengage the latch 31 from the groove 32 on rod 23. Frictional contact between the centralizer springs 29 and the well wall, or the wall of the casing 33, causes the housing sleeve 26, attached to the springs 29, to be moved upwardly along the tubular body member 15, thus unhousing the parachute 18.

Upon reaching the depth in the well at which an instrument reading is to be taken, the lowering of the instrument and packer assembly is stopped and the combined apparatus is raised or pulled upwardly a few feet. Reversed wall friction on the centralizer springs causes the housing sleeve 26 to be forced downwardly relative to the parachute 18. Downward movement of the housing sleeve 26 on body member 15 is limited by the latch means formed by the offsets 35 in the centralizer springs 29 which extend through slots 34 and come to bear on the

shoulder formed by the top of coupling 17. With the housing sleeve 26 in this position the largest diameter of the cage formed by the bowed centralizer springs 29 is located opposite the largest diameter of the parachute 18 which is at this time able to contact the inner wall of the well casing. Due to the flexibility of both the parachute 18 with its ribs 20 and the springs 29, they are also adapted to expand automatically and effectively close an uncased well borehole whatever its cross-sectional contour may be.

When the parachute packer has been set in the above-described manner and as illustrated in Figure 2, the parachute 18 is ballooned outwardly by the upward flow of the well fluid and all fluid is channeled by the parachute between the vanes 24, up the tubular body members 15 and 16, and up into the well instrument.

In testing a well, it is often desirable to move the well instrument up and down in the well borehole or well casing 33 and take readings at a plurality of stations. One of the great advantages of the present packer is that it is designed to be readily moved either upward or downward in a well borehole. To lower the instrument and its packer from one location to another, tension is released on the cable by which the instrument is suspended, and the weight of the instrument 13 moves the tubular body members 15 and 16 and the parachute 18 downwardly. At the same time wall friction on the centralizer springs 29 causes them to remain substantially stationary so that the parachute is wedged into the tapered lower section of the centralizer and is partially collapsed. This allows fluid to pass around the lower edges of the parachute and permits rapid lowering of the instrument, while the parachute is removed from abrasive contact with well wall.

When a new test location has been reached, the packer is again pulled upward a few feet so the centralizer springs 29 move downward with regard thereto until the offsets 35 in the springs stop in operating position once more against the collar 17. Readings may be taken at as many stations as desired with the instrument 13 and packer 11 traversing the well borehole any desired number of times in either or both directions. The operation of the packer is not adversely affected by the raising or the lowering of the combined instrument and packer. When the instrument is being raised in the well the parachute collapses partially due to the downward pressure of the well fluid on the top of the parachute, and a clearance is provided between the parachute 18 and the well casing 33 for any well fluid to be by-passed around the parachute packer. At the same time, the parachute is removed from abrasive contact with well walls.

When the instrument and packer is to be removed from the well through a tubing string, it is pulled upwardly until the open lower end of the tubing 12 contacts the nearly perpendicular upper portions of the centralizer springs 29 at 29*a*. A continued upward pull on the instrument causes the centralizer spring 29 to collapse. It will be seen from the drawings that the shape of the springs 29 is such that the bending to which they are subjected in collapsing causes them to pivot about a point 36 (Fig. 1) on the housing sleeve 26 a short distance below the slots 34. The collapsing centralizer springs 29 begin partially to collapse and to fold the parachute 18.

This pivoting action, upon continued raising of the springs 29 into the tubing 12, causes the offsets 35 to spring out of their respective slots 34, thus freeing the housing sleeve 26 which moves downwardly to collapse and surround the parachute 18 and its ribs 20. Further collapsing of the centralizer springs 29 causes them to extend axially downwards, thus moving the slide 30 down rod 23 until latch 31 again engages the groove 32. The parachute assembly remains latched as long as the centralizer springs are held in a retracted position by the tubing 12. The packer 11, in its retracted position shown in Fig. 1, can be withdrawn through the tubing 12 without interfering with the continuous production of fluid therethrough. The springs 29 space the retracted packer in the center of the tubing 12 allowing the flow of fluid past it and eliminating any swabbing action within the tubing by the packer. At the same time the parachute 18 is encased in the housing sleeve 26 and is thus protected from abrasion on the walls of the tubing.

I claim as my invention:

1. A well packer assembly adapted to be lowered through a well tubing, comprising a tubular body member, a rod co-axially secured to the lower end of said body member, said rod having a diameter substantially smaller than said body member, a radially expansible parachute packer axially mounted on said body member, said parachute packer in its retracted position being folded about said rod, a housing sleeve slidably mounted on said body member, said sleeve being adapted to surround said parachute packer and hold said packer in its retracted position during both the lowering and raising operation, and radially expansible centralizer spring means carried outwardly on said housing sleeve, said spring means developing a sufficient friction force against the well walls to free said parachute packer from said housing sleeve when the entire packer assembly is moved out of the lower end of the well tubing.

2. A well packer assembly adapted to be lowered through a well tubing, comprising a tubular body member, a rod co-axially secured to the lower end of said body member, said rod having a diameter substantially smaller than said body member, a radially expansible parachute packer axially mounted on said body member, said parachute packer in its retracted position being folded downwardly about said rod, a plurality of flexible metallic reinforcing ribs affixed at one end to the body member and extending radially and downwardly about the parachute packer, a housing sleeve slidably mounted on said body member, said sleeve being adapted to surround said parachute packer and ribs and hold said packer and ribs in their retracted position during the lowering operation, and radially expansible centralizer spring means carried outwardly on said housing sleeve, said spring means developing a sufficient friction force against the well walls to free said parachute packer from said housing sleeve when the entire packer assembly is moved out of the lower end of the well tubing.

3. A packer assembly adapted to be lowered through a well tubing suspended within a well casing, said packer assembly comprising an elongated tubular body member having open ends, a guide rod co-axially affixed to and extending from the lower end of said body member, fluid port means about the upper end of said rod and in communication with the bore of said body member, said rod being of smaller diameter than said body member, a radially expansible parachute packer of a thin impervious flexible material carried on said body member, the central portion of said parachute packer being secured to the lower

end of said body member, said parachute packer opening downwardly whereby the sides of the parachute engage the walls of the well casing when said packer is actuated, a plurality of flexible metallic reinforcing ribs affixed at one end to the lower end of the body member above said parachute packer, said ribs extending radially and downwardly along the top surface of the packer for reinforcing said parachute packer against the upward thrust of a well fluid, an elongated housing sleeve slidably mounted in a co-axial manner on said body member for alternately covering and uncovering the parachute packer and the reinforcing ribs when said packer is alternately in its inoperative and operative positions, and centralizer means comprising a plurality of bow springs affixed at their upper ends to the housing sleeve above the parachute packer and at their lower ends to a slidable member mounted on said guide rod below said parachute packer, said bow springs being radially expansible from said housing sleeve and guide rod for frictionally engaging the wall of the well casing whereby the housing sleeve is removed from the parachute packer on further lowering of the packer assembly.

4. A packer assembly adapted to be lowered through a well tubing suspended within a well casing, said packer assembly comprising an elongated tubular body member having open ends, a guide rod co-axially affixed to and extending from the lower end of said body member, fluid port means about the upper end of said rod and in communication with the bore of said body member, said rod being of smaller diameter than said body member, a radially expansible parachute packer of a thin impervious flexible material carried on said body member, the central portion of said parachute packer being secured to the lower end of said body member, said parachute packer opening downwardly whereby the sides of the parachute engage the walls of the well casing

when said packer is actuated, a plurality of flexible metallic reinforcing ribs affixed at one end to the lower end of the body member above said parachute packer, said ribs extending radially and downwardly along the top surface of the packer for reinforcing said parachute packer against the upward thrust of a well fluid, an elongated housing sleeve slidably mounted in a co-axial manner on said body member for alternately covering and uncovering the parachute packer and the reinforcing ribs when said packer is alternately in its inoperative and operative positions, centralizer means comprising a plurality of bow springs affixed at their upper ends to the housing sleeve above the parachute packer and at their lower ends to a slidable member mounted on said guide rod below said parachute packer, said bow springs being radially expansible from said housing sleeve and guide rod for frictionally engaging the wall of the well casing whereby the housing sleeve is removed from the parachute packer on further lowering of the packer assembly after the springs have engaged the casing wall, stop means carried by the housing sleeve for limiting the downward movement of said sleeve when the parachute packer is in its expanded position, and latch means caried by the slidable member for engaging the lower end of the guide rod to retain the centralizer springs in a retracted position as the packer assembly passes through a well tubing.

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