June 27, 1944. W. L. CHURCH 2,352,423

PACKER ASSEMBLY

Filed Dec. 2, 1940 3 Sheets-Sheet 1

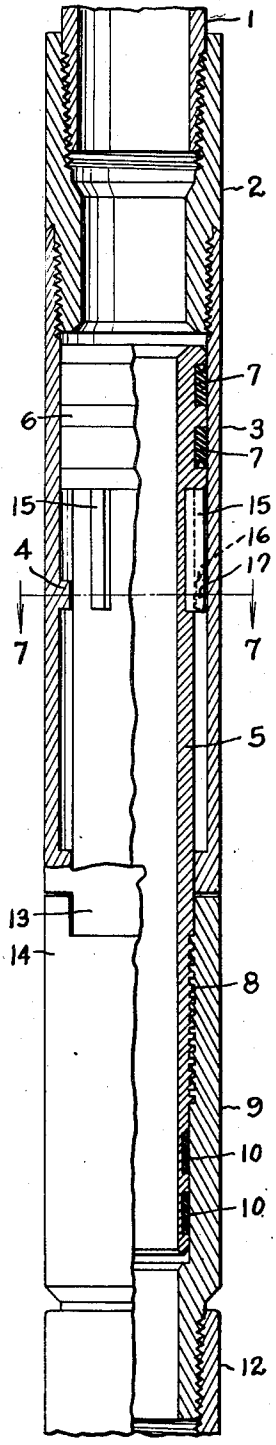


Fig. 1.

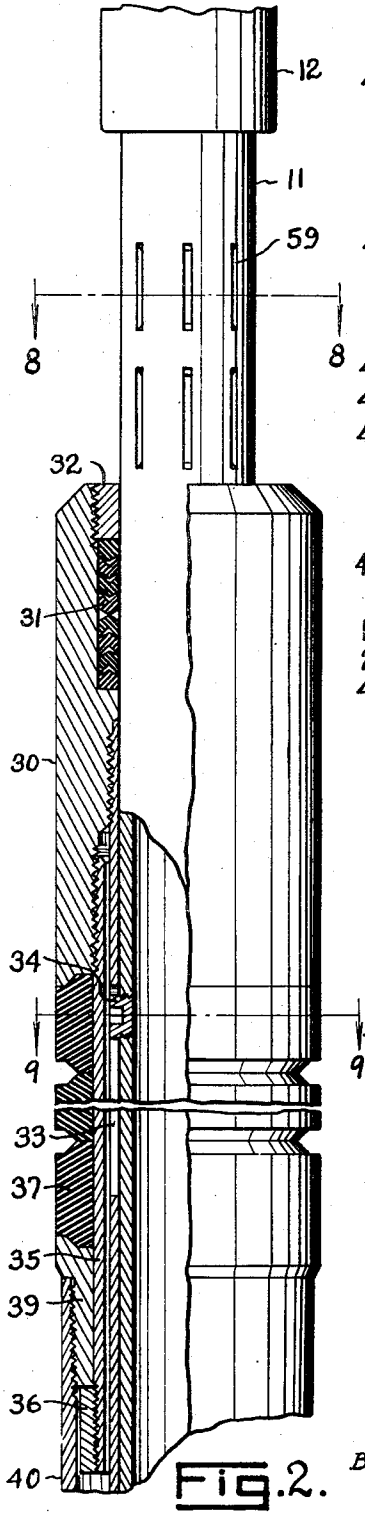


Fig. 2.

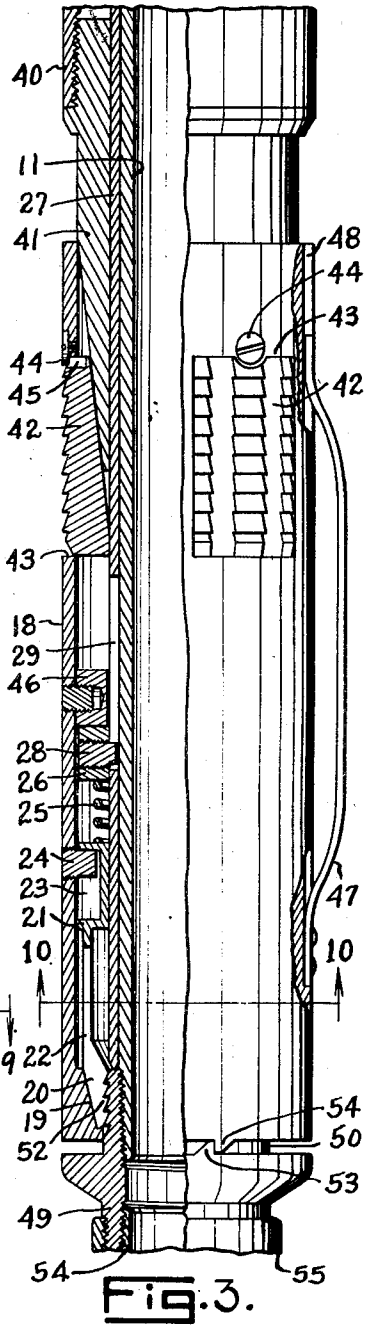


Fig. 3.

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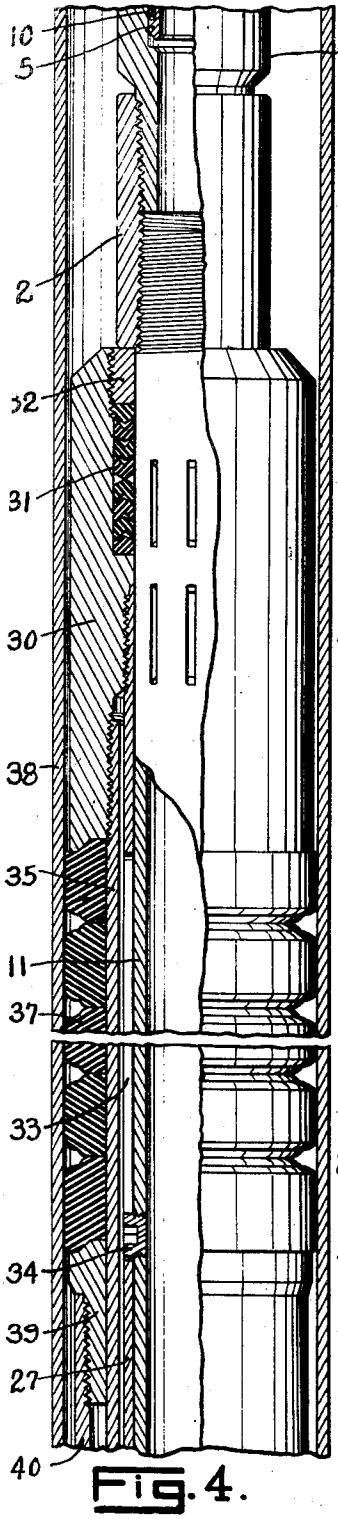


Fig. 4.

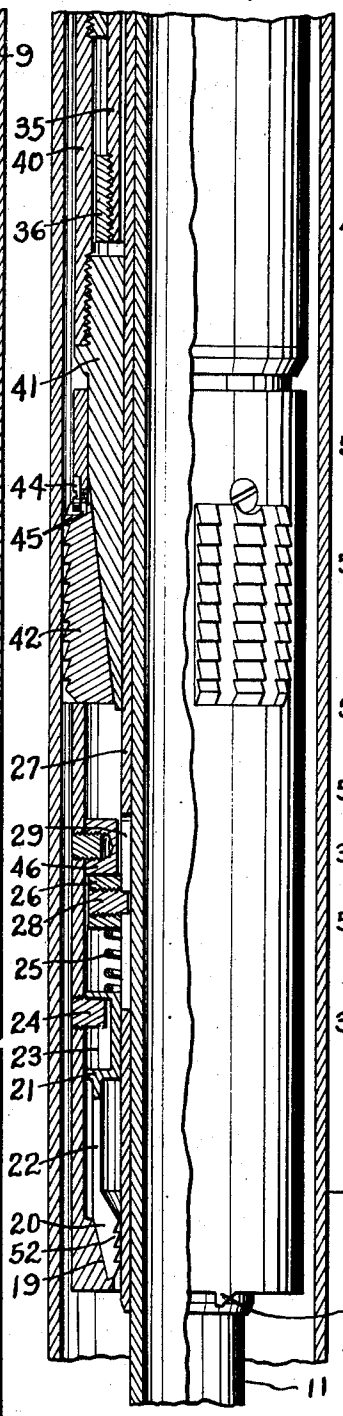


Fig. 5.

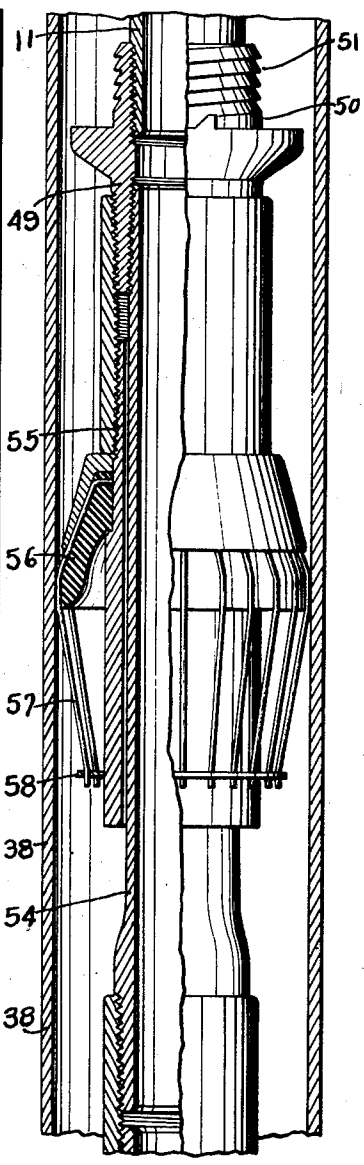


Fig. 6.

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PACKER ASSEMBLY

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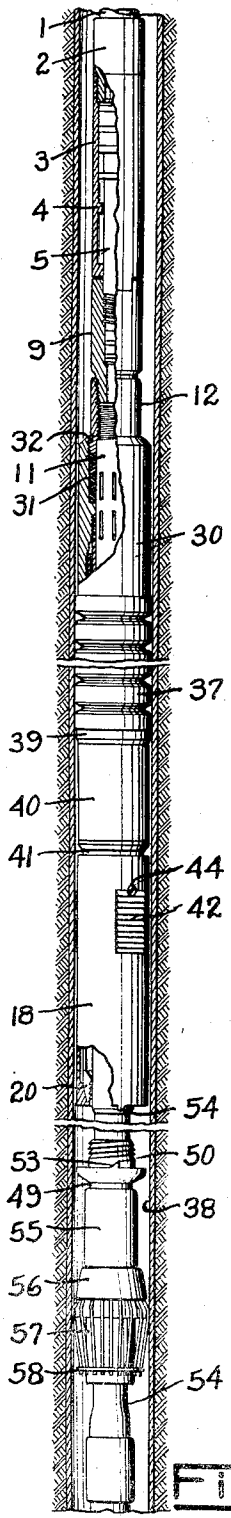


Fig. 11.

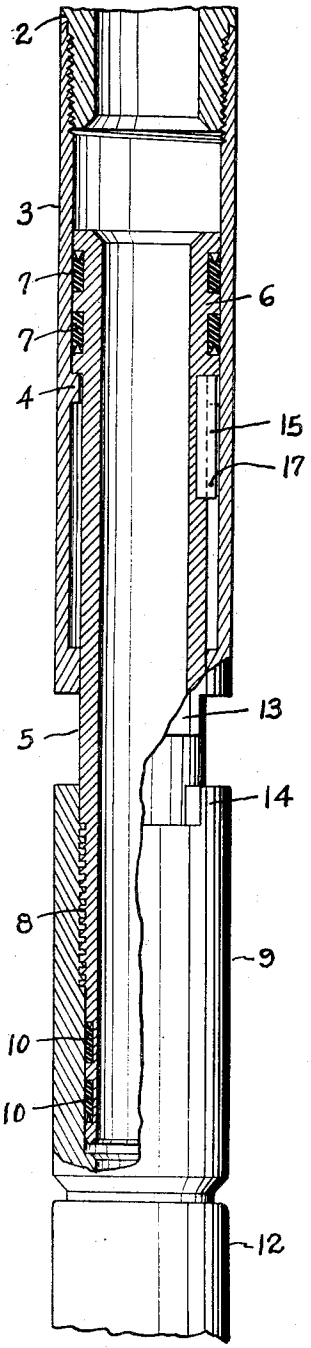


Fig. 12.

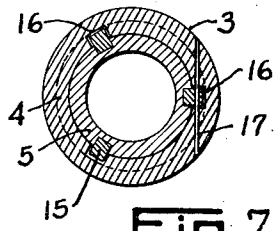


Fig. 7.

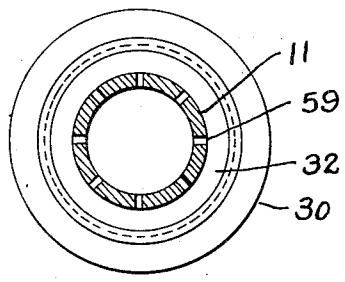


Fig. 8.

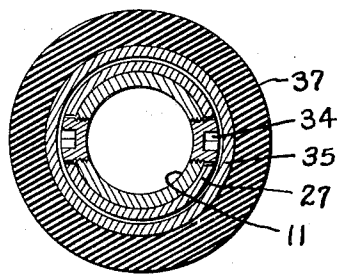


Fig. 9.

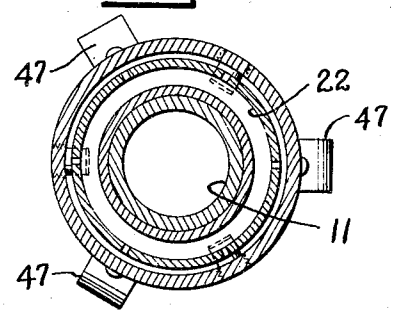


Fig. 10

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Patented June 27, 1944

2,352,423

UNITED STATES PATENT OFFICE

2,352,423

PACKER ASSEMBLY

Walter L. Church, Houston, Tex., assignor of one-half to Cecil Ware, Houston, Tex.

Application December 2, 1940, Serial No. 368,127

4 Claims. (Cl. 166—12)

This invention relates to a packer for wells and has particular relation to an expansible packer designed for forming a fluid tight seal between the well tubing and an outer well pipe or well casing.

An object of the invention is to provide a packer assembly that may be set at any selected elevation in the well and the packer, of the assembly, expanded to form a fluid tight seal so as to shield the well casing or well pipe above from the pressure of the fluid in the well.

It is another object of the invention to provide a packer assembly of the character described which may be set in a well and the packer expanded, and which may be thereafter readily released and withdrawn from the well or elevated or lowered and again set and the packer expanded.

The invention also embodies a novel construction whereby the tubing to which the assembly is attached may be detached from the assembly and withdrawn if for any reason the assembly itself becomes stuck in the well and cannot be withdrawn.

The invention herein disclosed embodies also novel means for setting the packer which constitute an improvement over that type of setting tool disclosed in United States Patent No. 1,912,823 issued to applicant on June 6, 1933, for Setting tool.

With the above and other objects in view the invention has particular relation to certain novel features of construction, arrangement of parts and use, an example of which is given in this specification and illustrated in the accompanying drawings, wherein:

Figure 1 shows a side view, partly in section, of the upper end of the assembly.

Figure 2 shows a side view, partly in section, of an intermediate portion of the assembly including the packer in collapsed position.

Figure 3 shows a side view, partly in section, of the intermediate portion of the assembly showing the casing engaging jaws retracted.

Figure 4 shows a side elevation, partly in section, of an intermediate portion of the assembly showing the packer expanded into sealing relationship with the well casing.

Figure 5 shows a side view, partly in section, of an intermediate portion of the assembly showing the casing engaging jaws in active position to engage the well casing.

Figure 6 shows a side elevation, partly in section, of the lower portion of the assembly in the position it will occupy when the packer is expanded.

Figure 7 shows a cross sectional view taken on the line 7—7 of Figure 1.

Figure 8 shows a cross sectional view taken on the line 8—8 of Figure 2.

Figure 9 shows a cross sectional view taken on the line 9—9 of Figure 2.

Figure 10 shows a cross sectional view taken on the line 10—10 of Figure 3.

Figure 11 shows an elevational view, partly in section, of the complete assembly showing the packer expanded or set, and

Figure 12 shows an elevational view, partly in section, illustrating the connection between the tubing and the packer assembly.

Referring now more particularly to the drawings wherein like numerals of reference designate the same parts in each of the figures the numeral 1 designates the string of well tubing to the lower end of which a coupling 2 is connected and depending from this coupling there is an elongated tubular nipple 3 having the inside stop 4 beneath its upper end. A tubular mandrel 5 is fitted downwardly through the nipple 3. The upper end of the mandrel 5 is formed with an enlarged head 6 which is surrounded by the countersunk packing rings 7, 7 which form a fluid tight joint with the nipple 3. The lower end of the mandrel 5 has external, coarse, left-hand threads 8 adapted to intermesh with corresponding internal threads in the coupling 9. Beneath these threads the lower end of the mandrel 5 has the external countersunk packing rings 10, 10 which form a seal with the coupling 9. The lower end of the coupling 9 is connected to the flow tube 11 by means of the collar 12.

The lower end of the nipple 3 is inwardly thickened and fits closely about the mandrel 5 and the adjacent ends of the nipple 3 and the coupling 9 are formed with the clutch jaws 13, 14 adapted to be engaged and disengaged. When the nipple 3 is moved downwardly relative to the mandrel 5 said clutch jaws will interengage as shown in Figures 1 and 11, whereby upon rotation of the tubing the coupling 9 and collar 12 will rotate with the tubing; but upon upward movement of the tubing the nipple 3 will be moved upwardly to disengage said clutch jaws as shown in Figure 12. The mandrel 5 has external keys 15 which extend into corresponding internal keyways in the stop 4 whereby the mandrel is caused to rotate with the tubing. The stop 4 is spaced a sufficient distance from the lower end of the coupling 2 to allow the relative longitudinal move-

ment of the nipple 3 and mandrel 5 so that the clutch may be engaged and disengaged. The clutch is normally maintained engaged by means of a frangible pin 17 whereby the nipple 3 and mandrel 5 are pinned together. In case the packer assembly should become stuck in the well so that it cannot be withdrawn the tubing 1 may be pulled upwardly to shear the pin 17 and to disengage the clutch and thereupon turned to the right to disengage the threads 8 from the coupling 9 and the tubing may then be withdrawn from the well.

The construction hereinabove specifically described for disconnecting the tubing from the assembly beneath is described and claimed in copending application Serial No. 525,731 filed March 9, 1944, for Safety joint.

The numeral 18 designates a tubular cage through which the tube 11 extends. The lower end of this cage has an inside downwardly tapering seat 19 on which the slips 20 are seated. The respective slips 20 are connected to a ring 21, above by means of the flexible arms 22 and the ring 21 has an external vertical keyway 23 into which a key 24, carried by the cage, projects. A coil spring 25 is interposed between a floating ring 26 and the slip ring 21. The floating ring 26 closely surrounds a release sleeve 27 and has an inwardly extended key 28 which projects into an elongated vertically extended slot 29 in said release sleeve. The upper end of the sleeve 27 is screwed into the enlarged set collar 30 which closely and slidably surrounds the tube 11 and whose upper end contains a suitable packing assembly 31 which is retained in place by the gland 32, screwed into the upper end of said collar 30. The packing 31 forms a fluid tight joint between the set collar 30 and the tube 11. The upper end of the release sleeve 27 has vertically elongated slots 33, and keys 34 are attached to the tube 11 and work in said slots 33 whereby the tube and release sleeve are caused to rotate together but are allowed a limited relative longitudinal movement.

Around the upper end of release sleeve 27 there is a tubular packer support 35 whose upper end is attached to the lower end of the set collar 30 and whose lower end is provided with an external annular stop 36. Surrounding the packer support there is a suitable expansible packer 37 which is sleeve-like in form and which is formed of rubber or other suitable expansible material so as to form, when expanded, a fluid tight seal with the outer well pipe or casing 38.

An annular abutment 39 surrounds the packer support 35 and is in abutting relation with the lower end of the packer 37. Attached to and depending from the abutment 39 there is a tubular expander sleeve 40 whose lower end is screwed onto the upper end of the downwardly tapering jaw expander 41 which fits closely around the release sleeve 27 and which fits closely within the upper end of the cage 18.

Mounted for radial movement in said cage there are the casing engaging jaws 42 whose inner sides converge downwardly and whose outer sides are formed with downwardly pitched teeth. The lower end of the jaw expander 41 fits snugly between the jaws 42 and said jaws work through lateral openings 43 in the cage 18. The jaws 42 are maintained against outward displacement from the cage by means of set screws 44 which are screwed into said cage and which have enlarged heads in the radially extended recesses 45 of said jaws.

The cage 18 has an inside stop 46 secured thereto which is located above, and is engageable with, the floating ring 26 to limit the downward movement of the cage relative to the release sleeve 27. The cage has a plurality of outwardly bowed wiper springs 47 whose lower ends are secured to the cage and whose upper ends are free and work in vertical external grooves 48 in the cage. These wiper springs 47 frictionally engage the outer pipe 38 while the assembly is in the well. Attached to the lower end of the tube 11 there is a special type of coupling 49 whose upper end is formed into a nipple 50 having coarse, external, downwardly pitched, right-hand threads 51 engageable with corresponding upwardly pitched inside teeth 52 carried by the slips 20. With the clutch members 13, 14 engaged, upon rotation of the tubing 1 to the right the tube 11 and coupling 49 will be correspondingly rotated and the nipple 50 will be unscrewed from the teeth of the slips 20 thus permitting the tube 11 to move downwardly relative to the cage 18. During this unscrewing operation the wiper springs 47 will hold the cage 18 against turning. The coupling 49 and the lower end of the cage 18 have interengaging stops 53 and 54 respectively to prevent the nipple 50 from becoming screwed too tightly into the slips 20 upon a relative reverse rotation of these parts.

Depending from the coupling 49 there is an inside extension tube 54 which forms, in effect, a continuation of the tube 11 and the tubing 1 and which may extend any selected distance down into the well; also attached to the lower end of the coupling 49 there is a tubular cup ring support 55 which, as shown is formed of two sections with an inverted cup ring 56 clamped between said sections and of a diameter to fit closely within the well casing 38. This cup ring is reenforced by the friction rods 57 which are spaced apart therearound, whose upper ends are embedded in the cup ring and whose lower ends are attached to an anchor ring 58. This cup ring is provided for the purpose of cleaning out the casing, and removing obstructions therefrom, in advance of the packer assembly as said assembly is lowered.

In use the apparatus is assembled as shown in Figures 1, 2 and 3 with the nipple 50 engaged and held by the slips 20 and with the nipple 3 and the mandrel 5 held against longitudinal movement by the frangible pin 17 connecting them. While being so lowered the expander 41 will be in its upper position and the sleeve 27 will be collapsed. When the selected lever has been reached to set the packer the tubing may be turned to the right, the cage 18 remaining stationary and the nipple 50 screwing out of the slips 20 as hereinabove explained. Thereupon the tubing may be lowered. Upon lowering of the tubing the keys 34 will move downwardly in the slots 33. The collar 12 will eventually land on the set collar 30 moving the latter downwardly relative to the cage 18 and to the jaws 42 and upon such downward movement the jaws will be immediately expanded by the expander 41 into engagement with the casing 38 thus anchoring the assembly against further downward movement, as a whole. The release sleeve 27 will also move downwardly with the set collar to the position shown in Figure 5. The downward movement of the annular abutment 39, however, will have been stopped and upon further downward movement of the tubing the set collar 30 will be caused

to move downwardly against the upper end of the packer 37 and said packer will be expanded into sealing relationship with the casing 38 as indicated in Figures 4 and 11 and the packer will be maintained so expanded by the required weight of tubing on it so that a fluid tight seal will be maintained between the packer assembly and the outer casing. Accordingly, the casing above and its couplings will be protected against high pressure fluid that may develop in the well and leaks in the casing couplings will not be liable to develop.

If it should be desired to re-locate the packer assembly, that is to elevate or lower it, the tubing may pulled upwardly pulling the nipple 50 up into the slips 20, the threads 51 of the nipple ratcheting past the teeth 52 of the slips so that said threads and teeth may be interengaged by a direct upward movement of the tubing. Upon such upward movement the upper end of the nipple 50 will also engage the lower end of the release sleeve 27 and move said sleeve upwardly thus moving the set collar 30 upwardly and upon such upward movement the annular stop 36 will engage the lower end of the abutment 39 and elevate said abutment and the expander sleeve 40 and expander 41 thus releasing the jaws 42 from the casing and such upward movement of the tubing will relieve the downward pressure of the set collar 30 against the upper end of the packer and the packer will be permitted to collapse so that the assembly may be relocated and again set as before.

With the packer set, as shown in Figures 4 and 11, production may be carried on through the tubing 1 to the ground surface. When it is desired to do so, the assembly may be, under normal conditions, removed from the well by releasing the jaws 42 and collapsing the packer as hereinabove explained. It sometimes happens, however, that the assembly may become stuck in the well so that it cannot be withdrawn. In such event an upward pull may be taken on the tubing 1 with sufficient force to shear the pin 17. Thereupon the nipple 3 will move upwardly relative to the mandrel 5 disengaging the clutch jaws 13, 14 and thereupon, upon rotation of the tubing 1 to the right, the mandrel will be disengaged from the coupling 9 and the entire string of tubing may then be withdrawn leaving the stuck packer assembly in the well.

The upper end of the tube 11 is provided with a plurality of slots 59 which will be located within the set collar 30, and be closed, when the packer is set and production is being carried on but which will be located above the set collar 30, as shown in Figure 2, when the assembly is being elevated or lowered in the well. It is to be understood that the well is filled with fluid and while lowering or withdrawing or adjusting the assembly in the well it is desirable that circulation be maintained from within the tubing to without the tubing and vice versa so that the pressure will be equalized thus relieving the packer assembly from a major portion of the weight of the liquid column above during these movements.

The drawings and descriptions are illustrative merely while the broad principle of the invention will be defined by the appended claims.

What I claim is:

1. A packer assembly for wells comprising a tubular packer support, an expansible sleeve-like packer around the support, a set collar connected to the upper end of the support and abutting the upper end of the packer, an external stop on the lower end of the support, an abutment abutting the lower end of the packer and located above the stop and through which the support is slidable, a release sleeve extended through the support and whose upper end is connected to the set collar, a downwardly tapering jaw expander around the release sleeve beneath the packer, means connecting said expander to the abutment, a cage around the release sleeve, casing engaging jaws around the expander and mounted to be moved radially in the cage by the expander upon downward movement of the expander, means for supporting the cage on the release sleeve, an inner tube adapted to be connected to an operating string and extended through the release sleeve, means for connecting said inner tube to the cage and which includes threads on the tube and expansible slips in the cage around and in engagement with the threads, said threads being pitched to be releasable from the slips upon rotation and downward movement of the tube and said threads being engageable with the slips upon a subsequent, non-rotative, upward movement of the tube, means carried by the cage and in frictional engagement with the well casing for holding the cage stationary upon such movements of the tube, means on the tube arranged to engage the set collar, when the tube is released from the cage and moved downwardly relative thereto, whereby the set collar, the packer and the expander will be moved downwardly to effect engagement of the jaws with the well casing and the expansion of the packer.

2. A packer assembly for wells comprising a tubular packer support, an expansible sleeve-like packer around the support, a set collar connected to the upper end of the support and abutting the upper end of the packer, an external stop on the lower end of the support, an abutment abutting the lower end of the packer and located above the stop and through which the support is slidable, a release sleeve extended through the support and whose upper end is connected to the set collar, a downwardly tapering jaw expander around the release sleeve beneath the packer, means connecting said expander to the abutment, a cage around the release sleeve, casing engaging jaws around the expander and mounted to be moved radially in the cage by the expander upon downward movement of the expander, means for supporting the cage on the release sleeve, an inner tube adapted to be connected to an operating string and extended through the release sleeve, means for connecting said inner tube to the cage and which includes threads on the tube and expansible slips in the cage around and in engagement with the threads, said threads being pitched to be releasable from the slips upon rotation and downward movement of the tube and said threads being engageable with the slips upon a subsequent, non-rotative, upward movement of the tube, means carried by the cage and in frictional engagement with the well casing for holding the cage stationary upon such movements of the tube, means on the tube arranged to engage the set collar, when the tube is released from the cage and moved downwardly relative thereto, whereby the set collar, the packer and the expander will be moved downwardly to effect engagement of the jaws with the well casing and the expansion of the packer and means on the tube arranged to engage the release

sleeve to move said release sleeve and set collar upwardly, relative to the cage and jaws, upon such upward movement of the tube, to release the packer.

3. A packer assembly for wells comprising a tubular packer support, an expansible sleeve-like packer around the support, a set collar connected to the upper end of the support and abutting the upper end of the packer, an abutment through which the support is slidable and abutting the lower end of the packer, a release sleeve connected to the set collar and extended through the support, a downwardly tapering jaw expander around the release sleeve beneath the packer and connected to said abutment, a cage around the release sleeve, casing engaging jaws mounted in the cage around the expander and movable radially outwardly by the expander upon downward movement of the expander, means supporting the cage on the release sleeve, an inner tube adapted to be connected to an operating string and extended through the release sleeve, means for connecting the inner tube to the cage and which includes threads on the tube and expansible slips mounted within the cage around the threads and having teeth which engage the threads, said threads being pitched so as to be released by the slip teeth upon rotation and downward movement of the tube and said threads being engageable with said teeth upon a subsequent non-rotative upward movement of the tube, means carried by the cage and in frictional engagement with the well casing for holding the cage stationary upon such movements of the tube, external means on the tube arranged to land on the set collar when the tube is released from the cage and moved downwardly relative thereto whereby the set collar, the packer and the expander will be moved downwardly to successively move said jaws outwardly into engagement with the well casing and expand the packer.

4. A packer assembly for wells comprising a tubular packer support, an expansible sleeve-like packer around the support, a set collar connected to the upper end of the support and abutting the upper end of the packer, an abutment abutting the lower end of the packer and through which the support is slidable, a release sleeve extended through the support and whose upper end is connected to the set collar, a downwardly tapering jaw expander around the release sleeve beneath the packer and connected to the abutment, a cage around the release sleeve, casing engaging jaws around the expander and mounted in the cage to be moved radially outwardly by the expander upon downward movement of the expander, means for supporting the cage on the release sleeve, an inner tube adapted to be connected to an operating string and extended through the release sleeve, means for limiting the range of movement of the tube relative to the release sleeve, means for connecting said inner tube to the cage and which includes threads on the tube and expansible slips in the cage around, and having teeth in engagement with, the threads, said threads being pitched to be releasable from the slip teeth upon rotation and downward movement of the tube and said threads being engageable with said teeth upon a subsequent, non-rotative, upward movement of the tube, means carried by the cage and in frictional engagement with the well casing for holding the cage stationary upon such movements of the tube, means on the tube arranged to engage the set collar, when the tube is released from the cage and moved downwardly relative thereto, whereby the set collar, the packer and the expander will be moved downwardly to effect engagement of the jaws with the well casing and the expansion of the packer, in succession, means on the tube arranged to engage the release sleeve to move said release sleeve and set collar upwardly, relative to the cage and jaws, upon such upward movement of the tube and means on the packer support engageable with said abutment to elevate the expander and release it from said jaws.

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