Nov. 24, 1942. J. N. DOWNS 2,302,905

WELL PACKER

Filed May 24, 1940

Fig. 1.

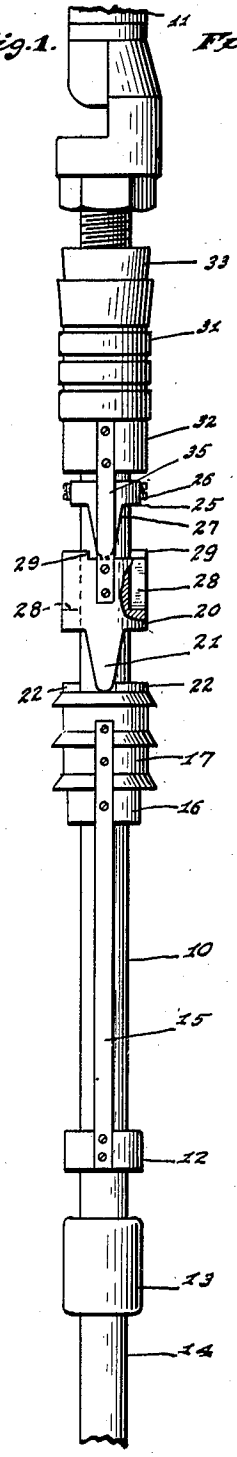


Fig. 2.

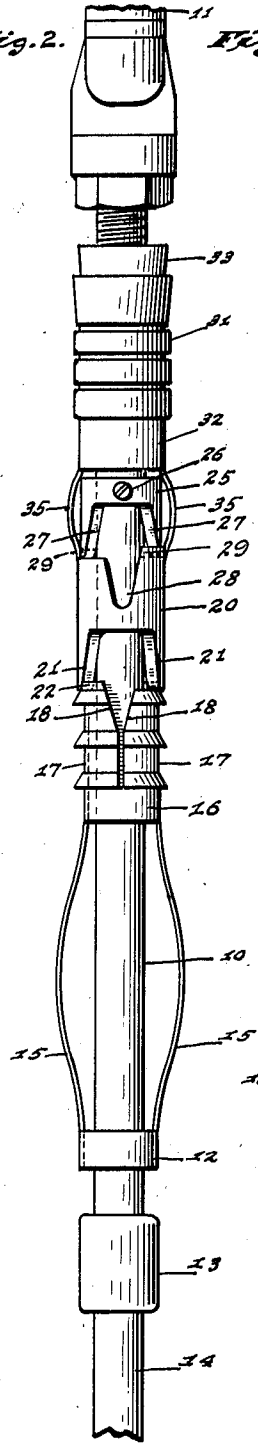


Fig. 3.

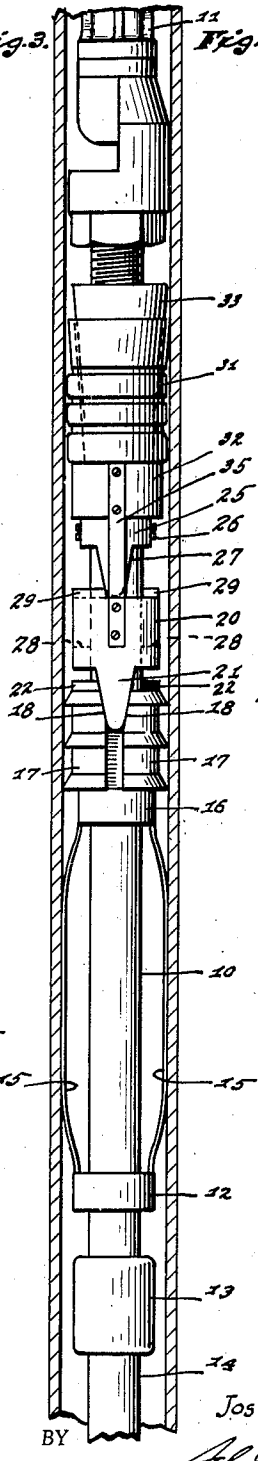
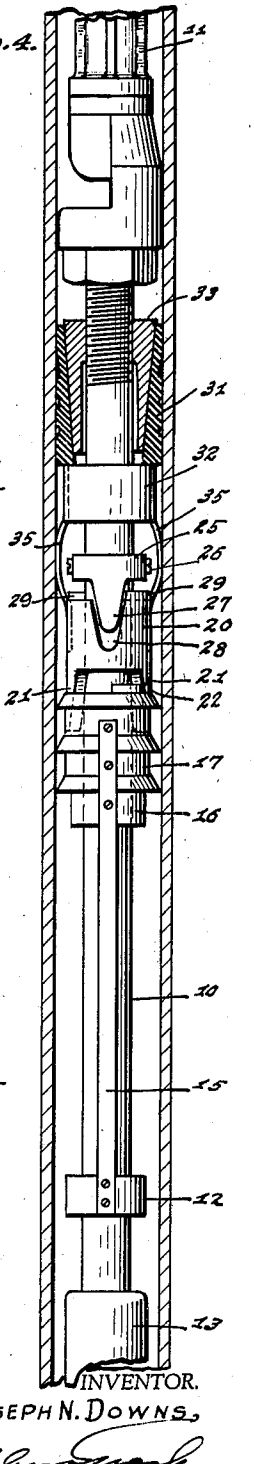


Fig. 4.



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WELL PACKER

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Application May 24, 1940, Serial No. 336,900

9 Claims. (Cl. 166—12)

My invention relates to well packers and has for its principal object the production of a well packer which can be set at any desired depth in the well casing, released, and reset at the same or any other elevation in the well casing without the necessity for the use of any special setting or releasing tools and solely by manipulation of the pipe upon which the packer is mounted. A further object of my invention is to provide a well packer especially suitable for use below a single-pipe ejector.

In carrying out my invention, I mount the various elements of the packer on a nipple forming part of the pipe-string in a well casing. The elements mounted upon the nipple include slips expansible into gripping engagement with the well casing and a packer comprising an expansible sleeve of yieldable material and a pair of members movable axially to expand such sleeve to form a seal in the well casing. The arrangement is such that the slips and the sleeve are expanded by downward movement of the nipple relatively to them. Means, releasable by an initial rotation of the pipe string and nipple, are provided for normally preventing downward movement of the nipple relatively to the slips; and an additional means, releasable by a subsequent rotation of the pipe string and nipple, normally prevent downward movement of the nipple relatively to the expansible sleeve.

The accompanying drawing illustrates my invention: Figs. 1 and 2 are front and side elevations respectively of the packer with the elements thereof in the position they occupy before the device is inserted into the casing; Fig. 3 is an elevation similar to Fig. 2, but showing the pipe-string rotated and lowered to expand the slips; and Fig. 4 is a view similar to Fig. 1 showing the packer completely set.

As previously mentioned, the elements of the packer are mounted on a nipple 10 forming part of the pipe-string to be used in the well casing. If the packer is to be used in connection with a single-pipe ejector 11, the upper end of the nipple 10 may be connected directly to the lower end of that ejector. Upon the nipple 10 I provide a slidable and rotatable coller 12, downward movement of which relative to the nipple is limited as by the coupling 13 through which the nipple 10 is connected to the next lower section 14 in the pipe-string. A pair of spring members 15 having their lower ends secured to the collar 12 extend upwardly of the nipple 10 and are secured adjacent their upper ends to a slip-collar 16 above which a pair of slips 17 are mounted. The slips 17 are substantially semi-circular in cross-section and, near the upper ends of the slips, their opposed edges diverge as indicated at 18 in Fig. 2. The spring members 15 are normally bowed outwardly of the nipple so as to engage frictionally the inner surface of the well casing in which the packer is to be used. Desirably, the upper ends of the springs extend upwardly beyond the slip collar 16 and are secured respectively to the slips 17, being so formed that they bias the slips inwardly to hold them normally out of engagement with the well casing. The slip-collar 16 and the slips 17, are rotatable and axially movable relative to the nipple 10.

Above the slips 17 there is disposed on the nipple 10 a rotatable and axially slidable slip-expanding sleeve 20 having diametrically opposite downwardly projecting fingers 21 tapered complementarily to the diverging edges 18 of the slips. As will be clear from Figs. 1 and 2, the fingers 21 normally engage the end surfaces of the respective slips, and are disposed at one side, preferably the clockwise side (as viewed from above), of diametrically opposite abutments 22 provided respectively on the slips. The counter-clockwise end of each of the abutments 22 is flush with the clockwise side of one of the tapered slots formed by the diverging slip-edges 18, as is clear from Fig. 2.

Above the sleeve 20 there is disposed on the nipple 10 a set-collar 25 held in fixed position on the nipple as by set screws 26. The set-collar 25 is provided with diametrically opposite, downwardly extending fingers 27 which normally rest on the upper end of the sleeve 20 but which, by rotation of the nipple and set-collar relative to the sleeve, may be brought into alignment with diametrically opposite recesses 28 in the upper end of the sleeve to permit the set-collar and nipple to move downwardly relative to the sleeve. Desirably, the sleeve 20 is provided on the counterclockwise side of each of the recesses 28 with an abutment 29, the purpose of which will be made apparent hereinafter.

The packer proper is located on the nipple 10 above the set collar 25 and includes an expansible sleeve 31 of yieldable material, such as rubber, having a collar 32 secured to its lower end and slidable with the sleeve relative to the nipple, and a sleeve-expander 33 fixed to the nipple.

The collar 32 is held in fixed axial position relative to the sleeve 20, conveniently through the use of two or more struts 35 which extend between the collar 32 and the sleeve 20 outside the set-collar 25. Desirably, these struts are bowed out-

wardly, so as to engage the inner wall of the well casing with a light frictional engagement, but the struts are sufficiently strong to transmit to the collar 32 the axial force which is necessary to expand the packing sleeve 31.

In the packer proper illustrated in the drawing, the interior of the expanding sleeve 31 is frusto-conical in shape, and the sleeve-expander 33 is also of frusto-conical shape, being tapered complementarily to the interior of the sleeve 31 so that as it moves downwardly therein it will expand the sleeve. While this particular type of packer is preferred, it is not essential.

In Figs. 1 and 2 I have illustrated the packer ready for introduction into the well casing. In this condition, the fingers 21 on the sleeve 20 are disposed at or adjacent the clockwise ends of the respective abutments 22 on the slips 17 and out of alignment with the tapered slots formed by the diverging side edges 18 of the slips; and the fingers 27 on the set collar 25 are disposed at or adjacent the counterclockwise ends of the respective abutments 29 on the sleeve 20. When the packer in this condition is introduced into the well casing and lowered therein, the springs 15 will engage the sides of the well casing and will tend, as a result of friction between them and the well casing, to elevate the slip collar 16 and the slips 17 relative to the downwardly moving nipple 10. Since the upper ends of the slips engage the fingers 21 on the sleeve 20 and since the upper end of that sleeve engages the fingers 27 on the set-collar 25, upward movement of the slip collar 16 will be limited, and the slips will be held in engagement with the fingers 21 and the sleeve 20 with the fingers 27. In this condition, the packer-expander 33 will be partly withdrawn from the sleeve 31, which will thus have a diameter less than that of the casing.

When the pipe-string carrying the nipple 10 and the packer-elements thereon have been lowered through the well casing, until the packer has obtained the desired depth, the pipe-string is rotated in a clockwise direction. Because of the frictional engagement of the springs 15 with the wall of the well-casing, those springs and the slips 17 to which they are connected do not follow the nipple 10 in its clockwise direction; and as a result, the fingers 21 are brought into alignment with the tapered slots formed by the diverging side edges 18 of the slips. Rotation of the fingers 21 past those slots is prevented by reason of the presence of the abutments 22. With the fingers 21 in alignment with the slots, the pipe-string is permitted to drop, the slips being held in fixed vertical position by the frictional engagement of the springs 15 with the well-casing; and as the fingers 21 thereupon enter the slots between the slips, they force the slips outwardly into gripping engagement with the wall of the well casing as illustrated in Fig. 3.

In the next operation of setting the packer, the pipe-string is rotated in a counter-clockwise direction. Since the fingers 21 are in engagement with the slots in the slips, the sleeve 20 cannot follow in this rotation, with the result that the fingers 27 will be brought into alignment with the recesses 28 in the sleeve 20. The abutments 29 prevent the nipple 10 from being rotated to carry the fingers 27 past the recesses 28. With the fingers 27 in alignment with the recesses 28, the pipe-string is permitted to drop again. In this second downward movement, the collar 32 cannot follow, because it is rigidly connected to the sleeve 20 by the struts 35. The sleeve-expander 33, however, moves downwardly with the nipple relatively to the sleeve 31 to expand that sleeve into sealing engagement with the wall of the well-casing.

It is to be noted that because of the engagement of the fingers 27 with the sleeve 20 and because of the rigid connection between that sleeve and the collar 32, the sleeve and sleeve-expander are held in fixed relative positions during the initial dropping of the pipe-string which sets the slip 17. As a result, the entire weight of the pipe-string is effective to expand the slips.

To release the packer it is only necessary to pull upwardly on the pipe-string. The frictional drag created by the outwardly bowed struts 35 prevents the sleeve 31 and collar 32 from following in the upward movement until the set-collar 25 strikes the collar 32, by which time the sleeve-expander 33 is withdrawn from the sleeve 31 to permit such sleeve to contract. After the collars 25 and 32 have come into engagement, continued upward movement of the pipe-string elevates the sleeve 20 with its fingers 21, and the slips 17 are moved out of engagement with the well casing by the springs 15.

If it is desired to re-set the packer without withdrawing it from the casing, the pipe-string is rotated in a counter-clockwise direction after the fingers 21 have been withdrawn from between the slips 17 as above set forth. In this rotation, the fingers 27 engage the abutments 29 to carry the sleeve 20 with the nipple 10; but owing to the frictional drag created by the springs 15, the slips do not follow in this rotation, with the result that the fingers 21 may be brought to their original positions at the clockwise ends of the abutments 22. Following this, the pipe-string is then rotated in a clockwise direction far enough to carry the fingers 27 out of alignment with the recesses 28 in the sleeve 20, the collar 20 being prevented from rotating by reason of the engagement between the struts 35 and the well-casing. The device is now restored to the condition existing before it was inserted in the well casing, and may be moved to any desired new elevation and re-set by the same sequence of operations as was employed in setting it originally.

I claim as my invention:

1. In a well-packer, a nipple adapted to form part of the pipe-string in a well-casing, slips slidably and rotatably mounted on said nipple and expansible into gripping engagement with the well casing, a slip-expander slidable and rotatable upon said nipple above said slips and acting on said slips to expand them upon downward movement relative to said slips, said slips and slip-expander being provided with means which when in one relative position prevent slip-expanding downward movement of said slip-expander relative to said slips, said means being movable to another relative position by relative rotation of said slip-expander and said slips in one direction to permit slip-expanding downward movement of the slip-expander, a packer sleeve of yieldable material on said nipple and rotatable and slidable relatively thereto, means on said nipple and acting on said packer sleeve to expand it into sealing engagement with the well-casing upon downward movement of said nipple relative to said slip-expander, said nipple and said slip-expander being provided with means which when in one relative position prevent such sleeve-expanding downward movement of said nipple, said means being movable to another relative position by relative rotation of said nipple and slip-ex-

pander in the opposite direction to permit such sleeve-expanding downward movement of the nipple, means connected with said slip-expander for creating a frictional drag between it and the well-casing, and means connected with said slips for creating a frictional drag between them and the well-casing, said nipple and said slip-expander having a lost-motion rotational interconnection for permitting the aforesaid two relative rotations.

2. In a well-packer, a nipple adapted to form part of the pipe-string in a well-casing, slips slidably and rotatably mounted on said nipple and expansible into gripping engagement with the well casing, a slip-expander slidable and rotatable upon said nipple above said slips and acting on said slips to expand them upon downward movement relative to said slips, said slips and slip-expander being provided with means which when in one relative position prevent slip-expanding downward movement of said slip-expander relative to said slips, said means being movable to another relative position by relative rotation of said slip-expander and said slips in one direction to permit slip-expanding downward movement of the slip-expander, a packer sleeve of yieldable material on said nipple and rotatable and slidable relatively thereto, means on said nipple and acting on said packer sleeve to expand it into sealing engagement with the well-casing upon downward movement of said nipple relative to said slip-expander, said nipple and said slip-expander being provided with means which when in one relative position prevent such sleeve-expanding downward movement of said nipple, said means being movable to another relative position by relative rotation of said nipple and slip-expander in the opposite direction to permit such sleeve-expanding downward movement of the nipple, and means connected with said slips for creating a frictional drag between them and the well-casing, said nipple and said slip-expander having a lost-motion rotational interconnection for permitting the aforesaid two relative rotations.

3. In a well-packer, a nipple adapted to form part of the pipe-string in a well-casing, slips mounted on said nipple and expansible into gripping engagement with the well-casing, a packing sleeve mounted on said nipple and expansible into sealing engagement with the well-casing, means rendered operative by rotation of said nipple in one direction for expanding said slips, and means rendered operative by a subsequent rotation of said nipple in the opposite direction for expanding said sleeve.

4. In a well-packer, a nipple adapted to form part of the pipe-string in a well-casing, slips mounted on said nipple and expansible into gripping engagement with the well-casing, a packing sleeve mounted on said nipple and expansible into sealing engagement with the well-casing, said nipple extending continuously through said sleeve and slips, a slip-expander on the nipple operative upon downward movement of said nipple relative to said slips for expanding the slips, a sleeve-expander on the nipple operative upon downward movement of said nipple relative to said sleeve for expanding the sleeve, the aforesaid parts being provided with means which when in one relative position prevent slip-expanding downward movement of said nipple and when in another rotative position permit that slip-expanding downward movement, and with means which when in one relative position prevent sleeve-expanding downward movement of said nipple and when in another relative position permit that sleeve-expanding downward movement, said first-named means being movable to its second relative position by an initial partial rotation of said nipple, and said second-named means being movable to its second relative position by a subsequent partial rotation of said nipple.

5. In a well-packer, a nipple adapted to form part of the pipe-string in a well-casing, slips mounted on said nipple and expansible into gripping engagement with the well-casing, a packing sleeve mounted on said nipple and expansible into sealing engagement with the well-casing, said nipple extending continuously through said sleeve and slips, a slip-expander on the nipple operative upon downward movement of said nipple relative to said slips for expanding the slips, a sleeve-expander on the nipple operative upon downward movement of said nipple relative to said sleeve for expanding the sleeve, the aforesaid parts being provided with means which when in one relative position prevent slip-expanding downward movement of said nipple and when in another relative position permit that slip-expanding downward movement, and with means which when in one relative position prevent sleeve-expanding downward movement of said nipple and when in another relative position permit that sleeve-expanding downward movement, said first-named means being movable to its second relative position by an initial partial rotation of said nipple, and said second-named means being movable to its second relative position by a subsequent partial rotation of said nipple in the opposite direction.

6. In a well-packer, a nipple adapted to form part of the pipe-string in a well-casing, slips mounted on said nipple between the ends thereof and expansible into gripping engagement with the well-casing, a packing sleeve mounted on said nipple and expansible into sealing engagement with the well-casing, and means operated by reverse rotations and by axial movements of said nipple as a whole for successively expanding first said slips and next said sleeve and including an element fixed on said nipple.

7. In a well-packer, a nipple adapted to form part of the pipe-string in a well-casing, a plurality of segmental slips mounted on said nipple and rotatable and axially slidable relative thereto, and a slip-expanding element mounted on said nipple and having a plurality of downwardly projecting fingers each insertable into the space between adjacent slips to expand them into gripping engagement with said well-casing, said slips being provided with upper end surfaces upon which the lower ends of said fingers are adapted to rest and with one or more abutments projecting upwardly from said end surfaces and disposed to limit rotation of said slip-expanding element in one direction to a position in which said fingers are respectively alined with spaces between adjacent slips and to limit rotation of said slip-expanding element in the opposite direction to an angle less than the circumferential extent of an individual segmental slip.

8. In a well-packer; a central support; slips, an expansible packing sleeve, and a slip-expander all carried by said support, and all movable both axially and rotatively relative to each other and to said support; a sleeve-expander fixed on said support; the aforesaid parts being provided with means which when in one position prevent slip-

expanding movement of said slip expander relative to said slips, said means being movable to another position by rotation of said central support relative to said slips in one direction to permit slip-expanding movement of said slip expander relative to said slips; and said parts also being provided with means which when in one position prevent sleeve-expanding movement of said sleeve-expander, said last named means being movable to another position by rotation of said central support relative to said sleeve in the opposite direction to permit slip-expanding movement of said slip-expander.

9. In a well packer; a central support; slips, an expansible packing sleeve, and a slip-expander all carried by said support, and all movable both axially and rotatively relative to each other and to said support; a sleeve-expander fixed on said support; the aforesaid parts being provided with means which when in one position prevent slip-expanding movement of said slip expander relative to said slips, said means being movable to another position by rotation of said central support relative to said slips to permit slip-expanding movement of said slip expander relative to said slips; said parts also being provided with means which when in one position prevent sleeve-expanding movement of said sleeve-expander, said last named means being movable to another position by rotation of said central support relative to said sleeve to permit slip-expanding movement of said slip-expander; resilient brake means carried by said sleeve; and a second resilient brake means carried by said slips; both said brake means being adapted to engage the wall of a well casing to create a frictional drag opposing movements of the sleeve and slips.

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