

July 16, 1963

W. H. STATES

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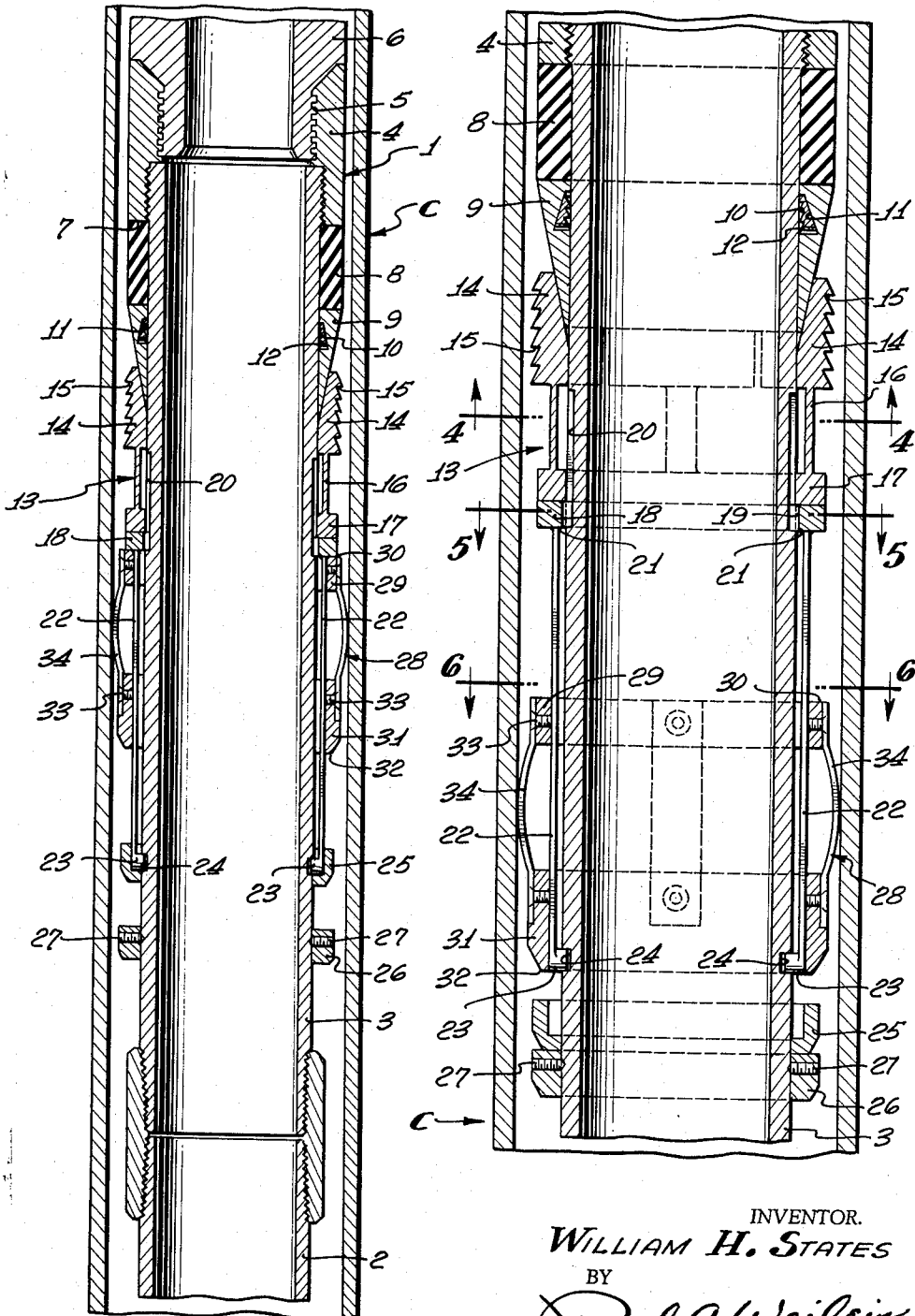
LINER HANGER

Filed April 7, 1958

2 Sheets-Sheet 1

FIG. 1.

FIG. 2.



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FIG. 3.

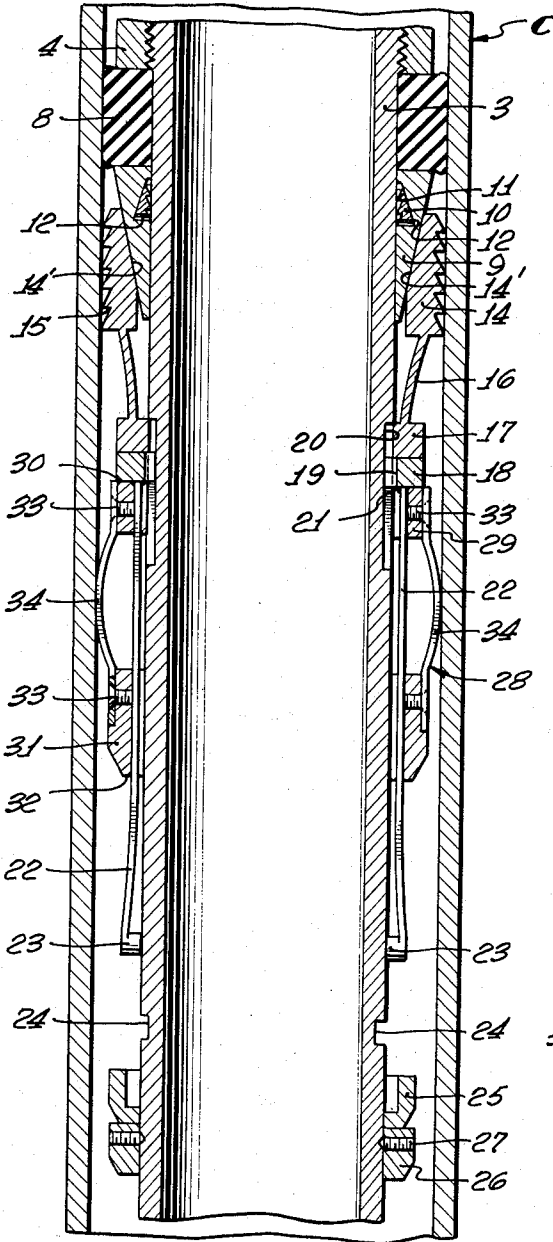


FIG. 4.

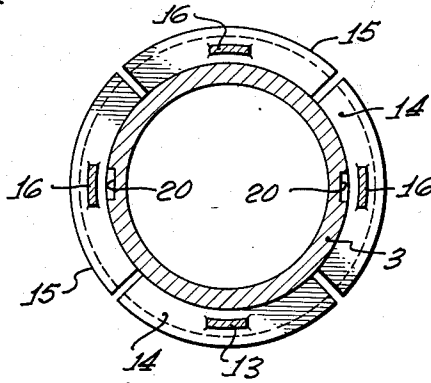


FIG. 5.

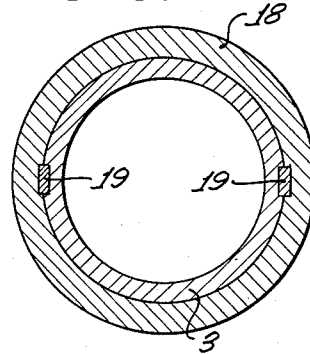
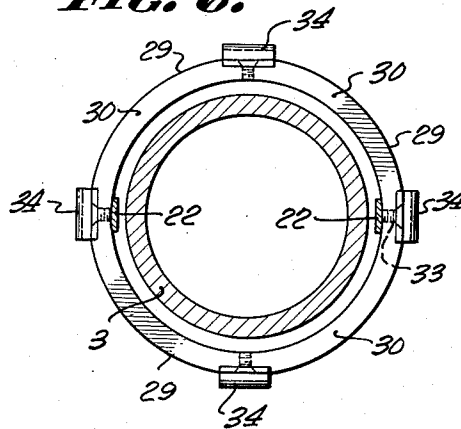


FIG. 6.



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LINER HANGER

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Filed Apr. 7, 1958, Ser. No. 726,834
8 Claims. (Cl. 166—138)

The present invention relates to well devices, and more particularly to improved means for anchoring and supporting a member within well casing or other pipe.

It is common practice in oil well drilling and production procedures to hang a liner in a well casing by what is called a liner hanger. This practice ordinarily includes the use of wickered slips mounted on the hanger for manipulation, when the hanger is at the proper level in the casing, so as to expand the slips into biting engagement with the casing whereby the weight of the liner suspended on the hanger is transferred to the casing. Setting tools are provided for attachment to the lower end of a running-in string, and on which the hanger and liner are run into the well, and by the manipulation of which, through the running-in string, the hanger slip means are set after which the tool is disconnected from the hanger and removed from the well.

In some instances, the setting of the hanger involves rotation of the running-in string. In others this is accomplished merely by vertical movement of the string.

It is an object of the present invention to provide a novel and simple liner hanger of the latter type which is rugged in construction and reliable in operation.

Another object of the invention is to provide such a liner hanger which embodies a packer which is set against the well casing incidental to the setting of the hanger in said casing merely by the application of the weight of the running-in string to said hanger.

Other objects of the invention will hereinafter be described or will become apparent to those skilled in the art and the novel features thereof will be defined in the appended claims.

Referring to the drawings:

FIG. 1 is a view in vertical section showing a well device embodying the invention in a running-in condition on a running-in string, and disposed in a well casing;

FIG. 2 is an enlarged view in section longitudinally of the device of the invention, and more particularly showing the control mechanism, with the parts in the relationships assumed thereby following slight elevation of the running-in string so as to release the stop means;

FIG. 3 is a view similar to FIG. 2, but showing the device with the slips set in engagement with the casing as well as with a packer ring expanded and engaged with the casing;

FIG. 4 is a view in transverse section as taken on the line 4—4 of FIG. 2;

FIG. 5 is a view in transverse section as taken on the line 5—5 of FIG. 2; and

FIG. 6 is a view in transverse section as taken on the line 6—6 of FIG. 2.

Like reference characters in the several figures of the drawings and in the ensuing description designate corresponding parts.

Referring first to FIG. 1, a well casing is shown at C, and disposed in the well casing is a well device 1 made in accordance with the invention and supporting in the well, by way of example, an inner casing 2. The device of the invention comprises a tubular body 3 having at its upper end a coupling 4 provided with an internal left hand acme thread 5 for engagement by a complementally threaded pin end of a running-in string 6. The coupling 4 provides a shoulder 7 at its lower end beneath which is disposed a packing ring or element 8 of rubber or

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other material, which upon axial compression will expand into engagement with the inner wall of casing C as will be hereinafter more particularly described.

Disposed upon the body 3 beneath the packer element 8 is an annular cone 9 having in its inner periphery toothed split ring wedging means 10 disposed in a recess providing an upwardly and inwardly inclined surface 11 in the cone 9, with a marcel spring 12 or the like beneath the base of the split ring 10 and normally biasing the same up the wedge surface 11 so as to effect engagement of teeth on the split ring 10 with the other surface of the body 3.

A slip assembly 13 is disposed about the body 3 for cooperative engagement with the cone 9. The assembly 13 includes a circularly arranged series of segmental slips 14 having wickers 15 thereon adapted to bite into the wall of casing C. The slip segments 14 are formed on the ends of resilient ribs 16 integrally formed on an annular slip ring 17, which is freely disposed about body 3. A stop ring 18 is also disposed about the body 3 beneath the slip ring 17, and a suitable number of keys 19 (see FIG. 5) are provided on the stop ring 18 and these extend into keyways 20 provided on the body 3 to prevent relative rotation therebetween. Rigidly connected to the stop ring 18, as by welding at 21 (see FIG. 2), is a suitable plurality of circumferentially spaced resilient fingers 22 having inwardly projecting lugs 23 at their lower extremities. The body 3 is provided with appropriate recesses 24 adapted to receive the lugs 23 when the device is in the running-in condition as shown in FIGS. 1 and 2. Lower portions of the spring fingers 22, on which lugs 23 are provided, are biased outwardly to withdraw lugs 23 out of recesses 24 as shown in FIG. 3, when said lower portions of fingers 22 are unrestrained. In order to retain the lower extremities of the spring fingers 22 in position with the lugs 23 seated in the recesses 24, a retainer ring 25 is releasably disposed about the ends of the spring fingers 22 in confining relation thereto as shown in FIG. 1. When the lugs 23 are engaged in the recesses 24, it will be noted that the stop ring 18 is effectively locked to the body and may not move relative to the body. Suitably secured to the body 3 in spaced relation beneath the recesses 24 is a seating collar 26, and in the illustrative embodiment, this collar is affixed to the body 3 as by means of a plurality of set screws 27.

Casing engaging friction means in the form of a drag spring assembly 28 is provided for unseating the retainer ring 25 and for setting the slips in a manner which will hereinafter be more particularly described. In the illustrative embodiment the drag spring assembly 28 includes an upper ring 29 slidably disposed about the spring fingers 22 and providing a shoulder at its upper extremity as indicated at 30, for engagement beneath the ring 18, previously described. Disposed in axially spaced relation to the ring 29 is a ring 31 also slidably disposed about the spring fingers 22 and providing a lower shoulder 32 for engagement with the retainer ring 25. Spanning the rings 29 and 31 and connected thereto as by means of screws, rivets or the like, as indicated at 33, is a suitable plurality of circumferentially spaced bowed drag springs 34 adapted to frictionally engage the inner surface of casing C.

In operation the device is run into a well in the condition shown in FIG. 1. Upon reaching the desired elevation in the well the running-in string 6 will be elevated slightly. Thus the entire assembly, except for the friction means 28, the springs 34 of which are frictionally engaged with the casing C, will likewise move upwardly with respect to the casing C. Whereupon the lower extremity 32 of the ring 31 of the friction means 28 will contact the upper extremity of ring 25, thereby forcing the latter off of the extremities of spring fingers 22, at

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which time ring 25 will gravitate to rest on the collar 26, as shown in FIG. 2.

As there is very little clearance between the lower end 32 of ring 31 and retaining ring 25 at the moment the latter drops onto collar 26, as shown in FIG. 2, the upward movement of the running-in string 6 will generally be continued until ring 31 comes to rest on retaining ring 25. At this time, although the retaining ring 25 has been displaced from its position circling the lower ends of spring fingers 22, the latter are nevertheless restrained from expanding by their being surrounded by the ring 31 of the drag spring assembly 28.

The next step in the operation of the device is accomplished by halting the lifting of the body 3 in the well casing C and lowering said body in said casing. Frictional engagement of the springs 34 of the drag device 23 against the inner wall of the casing C causes the drag device to remain fixed with respect to the casing C, and as the spring fingers 22 move downwardly through the friction means 28, as shown in FIG. 3, they will be free to flex outwardly with respect to the body 3, so that the projections 23 thereon will be disengaged from the recesses 24 on the body 3. The upper abutment surface 30 of the friction means 28 will engage ring 18 which, in turn, is engaged beneath slip ring 17, and as a consequence, downward movement of the assembly will shift the cone 9 downwardly within the tapered surfaces 14' of the slips 14, as shown in FIG. 3, thus forcing the slips 14 laterally as permitted by the flexible ribs 16 by which the slip segments 14 are supported. The wickers 15 on the slip segments 14 will bite into the wall of the casing C. When the cone 9 and slips 14 have been tightly wedged into engagement with the casing C, the body 3 may still move further downwardly until the resilient packer element 8 has been compressed axially to such an extent that it will be expanded radially into engagement with the casing wall as shown in FIG. 3.

The wedge elements 10 in wedge seats 11, during this downward movement, will permit free movement of the body 3 downwardly through the cone 9, but the spring means 12 beneath the wedges 10 normally bias them upwardly in the direction tending to wedge the same against the body 3, and the teeth on the elements 10 will bite into the body 3 tending to prevent upward movement thereof, so that the device will be firmly set within the casing C.

Following these operations, the running-in string 6 may be detached from the body 3 merely by rotating the string 2 to the right in the conventional manner, this being the direction of rotation tending to tighten the joints in the running-in string. The left hand acme thread 5 hereinbefore described, will accordingly become disconnected from the lower extremity of the running-in string which may then be retrieved.

In view of the foregoing, it will be recognized that a well device has been provided which is extremely simple in its construction and which is by reason of its simplicity, dependable in operation as well as capable of strongly resisting displacement of the device within the casing once it has been set.

While the invention as herein specifically shown contemplates anchoring an inner casing within an outer casing within a well it will be understood that the device may also be available for hanging liners, production packers, or other devices, as will be apparent to those skilled in the art.

Changes and alterations may be resorted to without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. A well device of the class described comprising a body adapted to be run into a well casing on a running-in string of pipe; means on said body shiftable into engagement with said casing and operable to secure the device against downward movement in the well; means shiftable

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disposed on said body for operating said securing means; retainer means releasably retaining said operating means against operation; and casing engaging friction means engageable with said retaining means for releasing said retaining means upon longitudinal movement of said body in one direction with respect to said casing and engageable with said operating means for shifting said operating means upon subsequent longitudinal movement of said body in the other direction with respect to said casing to operate said securing means.

2. A well device comprising a tubular body adapted to be run into a well casing; cooperative slips and slip expander means upon said body; a ring disposed about said body and shiftable thereby adjacent said slips; locking means connected to said ring and extended longitudinally of said body and releasably connected to said body in spaced relation to said ring; and casing engaging friction means disposed about said body and shiftable relative to said locking means for releasing said locking means from said body upon movement of said body longitudinally of said casing in one direction and for shifting said ring into engagement with said slips to shift the latter into engagement with said slip expander means to expand said slips against said casing upon subsequent longitudinal movement of said body in said casing in the other direction.

3. A well device adapted to be run into a well casing comprising a longitudinally extended body; cooperative slip and expander cone elements relatively shiftable disposed on said body; means for shifting one of said elements relative to the other including a ring disposed about said body; a plurality of spring fingers connected to said ring and extending longitudinally of said body, said spring fingers having means for engagement with said body to lock the ring to said body but being biased to spring out of such engagement; retainer means engageable with said fingers to releasably hold said fingers in locking engagement with said body; and casing engaging means for disengaging said retainer means from said spring fingers and for relatively shifting said cone and said slip elements upon alternate movement of said body in opposite directions longitudinally of the casing.

4. In a well device adapted to be run into a well on a running-in string comprising a longitudinally extended body; slip means shiftable on said body for engaging the well wall; means on said body engageable with said slip means for shifting the same into such engagement including a drag device shiftable disposed on said body, said shifting means including a member releasably locked to said body; means for releasably retaining said member locked to said body, said drag device and said retaining means having portions disposed for engagement to release said member from said locked relation with said body upon longitudinal movement of said body in one direction, relative to said drag device, a subsequent longitudinal movement of said body in the other direction relative to said drag device bringing said shifting means into engagement with said drag device whereby said slip means is shifted into engagement with said well wall.

5. In a well device adapted to be run into a well on a running-in string comprising a longitudinally extended body; slip means shiftable on said body for engaging the well wall; and means on said body engageable with said slip means for shifting the same including a drag device shiftable disposed on said body, said shifting means including a member having a projection, said body having a recess in which said projection is releasably disposed; means removably disposed on said member for retaining said projection in said recess, said drag device and said retaining means having portions disposed for engagement to shift said retaining means off of said member upon relative longitudinal movement between said drag device and body in one direction; and key means for maintaining said projection aligned with said recess when the latter are disengaged, said drag device and said shifting means

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having portions which are brought into engagement to expand said slip means against the well wall by subsequent relative movement between said drag device and said body in the opposite direction.

6. In a well device adapted to be run into a well on a running-in string comprising a longitudinally extended body; slip means shiftable on said body for engaging the well wall; and means on said body engageable with said slip means for shifting the same, including a ring disposed about said body, said ring having a plurality of spring fingers thereon extending longitudinally of said body, said spring fingers having means engageable with said body for locking said ring in place on said body, said spring fingers being biased to remove said means from locking relation with said body; a retainer ring disposed about the spring fingers to hold the latter in locking relation with said body; and casing engaging friction means slidable on the body relative to said spring fingers, said friction means being brought into engagement with said retainer ring for shifting said ring with respect to said spring fingers to release the latter, by longitudinal movement of said body in one direction relative to said friction means, the latter being brought into engagement with said first aforementioned ring by subsequent longitudinal movement of said body in the opposite direction relative to said friction means, to shift said slip means into engagement with said well wall.

7. A well device of the character described adopted to be run into a well casing, said device comprising a hollow body; cooperative casing gripping means including a cone element and slip elements mounted on said body for relative longitudinal movement; means for shifting said slip elements relative to said cone element including a plurality of members extending longitudinally of said body, said members having means at one end engageable with said slips for shifting the same and having means at their other end releasably connected to said body to prevent longitudinal movement thereof relative to said body; means releasably retaining said members in said connected engagement with said body; and casing engaging friction means slidably disposed on said mem-

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bers and engageable with said retaining means for shifting the same out of retaining relation with said members upon movement of said body in one direction in said well and for relatively shifting said cone and slip elements upon subsequent movement of said body in the opposite direction in said well, to expand said slip elements into gripping relation with the well casing.

8. A well device comprising: a hollow body; an expandable packer element disposed about said body; means for expanding said packer element including shiftablely related cone means and slip means; a shoulder on said body at one end of said packer element, one of said cone means and slip means being disposed at the opposite end of said packer element; means for relatively shifting said cone means and slip means and expanding said packer element including a plurality of members extending longitudinally of said body, said members having means at one end engageable with one of said cone means and slip means for relatively shifting the same to expand said slip means and said packer element, said members having means at the other end releasably connected to said body to prevent movement thereof; means releasably retaining said members in said connected engagement with said body; and casing engaging friction means slidably disposed on said members and engageable with said retaining means for shifting the same relative to said members to release the latter from said connection with said body upon movement of said body in one direction in said well and for relatively shifting said cone means and slip means upon subsequent movement of said body in the opposite direction in said well to expand said slip means and said packer element.

References Cited in the file of this patent

UNITED STATES PATENTS

1,431,426	Robinson	Oct. 10, 1922
1,506,881	Broberg	Sept. 2, 1924
2,345,888	Scott	Apr. 4, 1944
2,568,867	Otis	Sept. 25, 1951
2,644,527	Baker	July 7, 1953
3,012,612	Wright et al.	Dec. 12, 1961