

Feb. 2, 1954

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2,667,928

PRODUCTION PACKER APPARATUS

Filed April 23, 1948

2 Sheets-Sheet 1

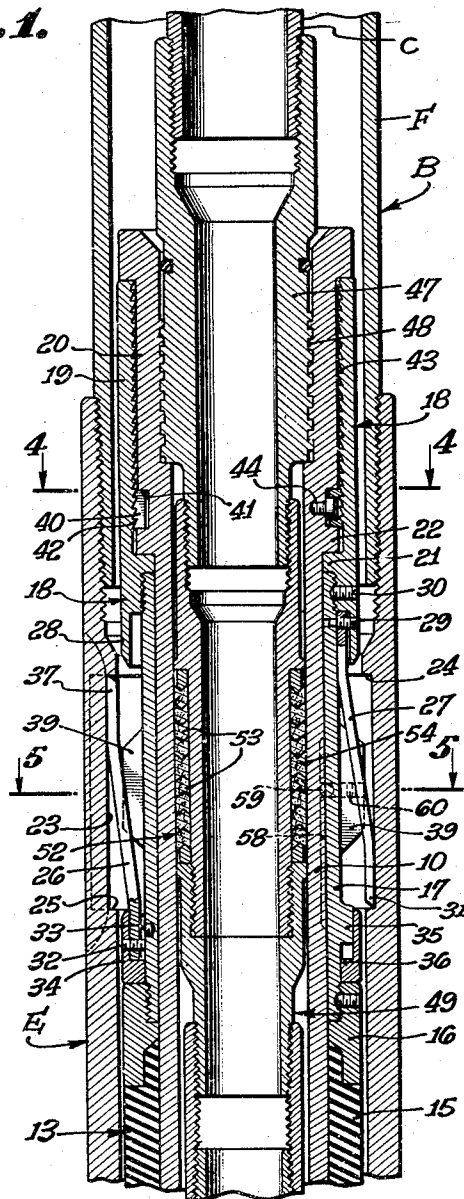
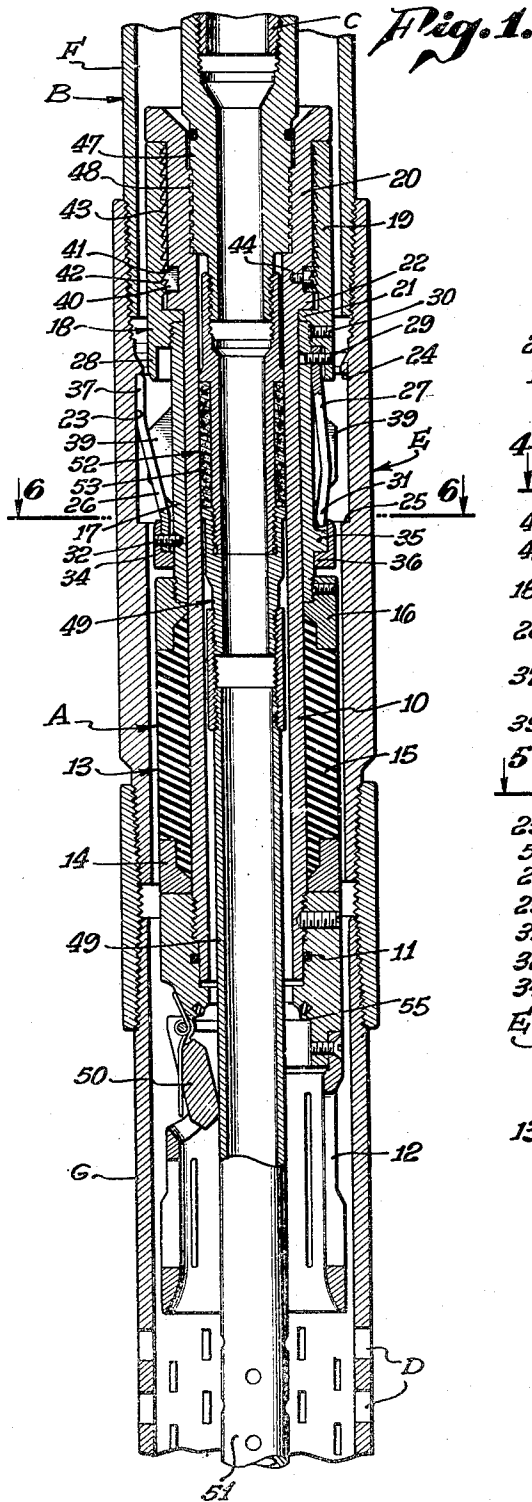


Fig. 2.

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2 Sheets-Sheet 2

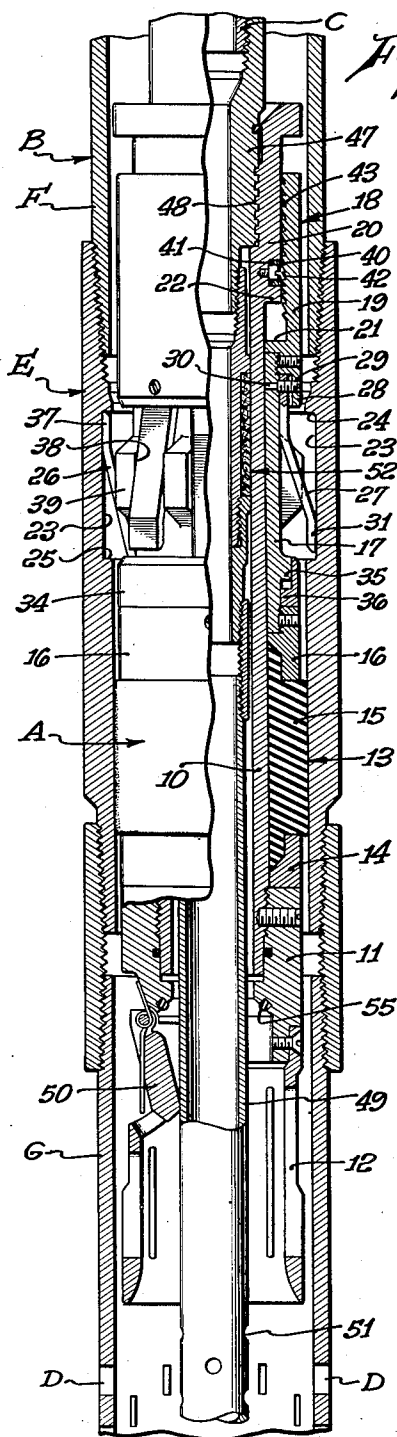


Fig. 3.

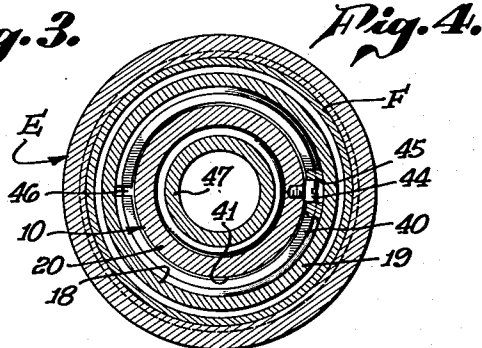


Fig. 4.

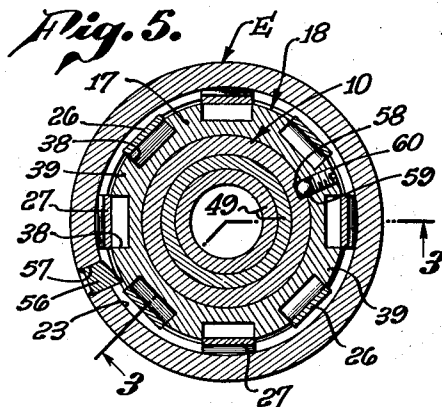


Fig. 5.

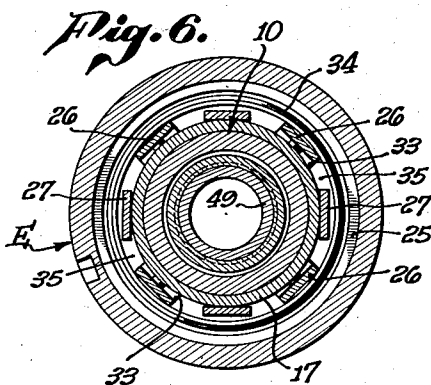


Fig. 6.

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2,667,928

PRODUCTION PACKER APPARATUS

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Application April 23, 1948, Serial No. 22,888

16 Claims. (Cl. 166—12)

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The present invention relates to well packers, being more particularly directed to packers of the type adapted to be anchored against longitudinal movement in a well casing, liner or similar conduit string.

Certain types of well packers are run and set in a well conduit, such as a well casing, with special setting tools that must be removed after the setting operation has been performed. Thereafter, a production string is run in the well casing for association with the packer, in order to conduct the well production to the top of the well bore. It is apparent that two trips into the well casing have heretofore been necessary; one for setting the packer, and the other for producing through the packer.

An object of the present invention is to obviate the need for running a tubing string into the well casing twice, by providing a well packer that can be set by the aid of a tubular string which remains in the casing to function as the producing string.

Another object of the invention is to provide an improved well packer capable of being anchored in packed-off condition in the well casing against longitudinal movement in both directions, and which can also withstand comparatively high pressures and temperatures without leakage or displacement from its set position.

A further object of the invention is to provide a well packer apparatus, which cannot be rotated in the well casing after having been set therein. This arrangement facilitates disconnection of the producing string from the packer whenever desired without disturbing the set condition of the packer in the casing.

Still another object of the invention is to provide an improved arrangement for anchoring a well packer to a well casing against movement in both longitudinal directions.

Yet another object of the invention is to provide an improved lock mechanism for holding the packer parts in their anchored and packed-off relation within the well casing.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it is embodied. This form is shown in the drawings accompanying and forming part of the present specification, and will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

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Referring to the drawings:

Figure 1 is a longitudinal section through a well packer disposed in a well casing, with its parts in the position they occupy for lowering the packer through the casing;

Fig. 2 is an enlarged longitudinal section, similar to Fig. 1, of part of the apparatus anchored to the casing against longitudinal movement;

Fig. 3 is a longitudinal view, partly sectional and partly elevational, of the well packer anchored in packed-off condition within the well casing;

Fig. 4 is a cross section taken along the line 4—4 on Fig. 2;

Fig. 5 is a cross section taken along the line 5—5 on Fig. 2; and

Fig. 6 is a cross section taken along the line 6—6 on Fig. 1.

The well packer A disclosed in the drawings is adapted to be anchored in packed-off condition within a well casing B positioned in a well bore. The packer is run in the well casing by means of a tubular string C to the desired setting point. As will be pointed out below, the tubing string C serves not only as the instrumentality for running the packer A in the well casing B, and for anchoring it to the well casing, but it also serves subsequently as the conduit for directing the production entering the casing perforations D below the packer to the top of the well bore.

The packer includes an elongate tubular body 10, having a guide 11 threaded on its lower end, to which is attached a slotted junk pusher 12 for preventing debris from fouling the equipment during its lowering in the well casing. Immediately above the guide 11, a packing assembly 13 surrounds the body. This assembly includes a lower retainer ring 14 into which the lower end of a packing sleeve 15 is received. An upper retainer member 16 receives the other end of the packing sleeve, and is threadedly secured to the lower member 17 of a locking sleeve 18 surrounding the body 10. The upper end of this member 17 is threaded into the upper member 19 of the locking sleeve 18, which projects upwardly around the enlarged head portion 20 of the body.

The packing retainer 16, packing sleeve 15, and locking sleeve 18 are all slidable longitudinally relative to the body 10, as will appear hereinafter. Downward movement of these members is limited by engagement of the lower retainer 14 with the guide 11, and upward movement of these members along the body is limited by engagement of an inner shoulder 21 on the upper setting sleeve member 19 with a lower shoulder 22 provided by the body head 20.

The packer A is adapted to be anchored at a predetermined point in the well casing B. This location is previously selected by the provision of a collar E in the casing string, which connects upper and lower adjacent casing sections F, G in spaced relation. The casing string collar E has an internal, elongate groove 23 providing upper and lower shoulders 24, 25 against which upper and lower locking elements 26, 27 on the packer are to bear, in order to prevent longitudinal movement of the packer in both directions.

For the purpose of preventing downward movement of the packer A with respect to the recessed collar E, the setting sleeve 18 carries a plurality of circumferentially spaced longitudinally extending and downwardly facing leaf springs 27. The upper end of each one of these springs 27 is secured to and between the lower sleeve member 17 and a depending skirt 28 of the upper sleeve member 19 by means of a headless screw 29 threaded into the skirt and through the upper end of the spring for reception within a hole 30 in the lower member 17. Each spring 27 extends downwardly along the lower member 17 and inherently tends to expand outwardly to dispose its free end 31 into the recess 23 for engagement with the lower shoulder 25 defining the lower end of the recess.

The packer is also adapted to be anchored against upward movement by a plurality of upwardly facing circumferentially spaced leaf springs 26, whose lower ends are secured to the lower member 17 by shear screws 32. Each spring is received within a pocket 33 formed between a retainer ring or sleeve 34, the lower setting member 17, and ribs 35 projecting outwardly from the latter. Initially, the retainer sleeve 34 is held in an upward position, with its intumed flange 36 engaging the lower shoulder on the projections 35 by the shear screws 32, which are threaded through the retainer sleeve 34 and through the lower ends of the upwardly directed springs 26 for threaded reception into the lower setting sleeve member 17. It is to be noted that the retainer sleeve is spaced initially above the upper end of the upper packing retainer 16 when the shear screws 32 are intact.

The leaf springs 26 extend in an upward direction and inherently tend to expand outwardly to place their free ends 37 within the collar groove 23, in order that they might engage the upper shoulder 24 defining the recess.

From the foregoing description, it is apparent that the upwardly directed springs 26 are intended to anchor the well packer against movement in an upward direction, when received within the collar recess 23; and that the downwardly directed springs 27 are adapted to prevent movement of the packer in a downward direction, when received within the collar recess. The upwardly and downwardly directed springs 26, 27 are alternately arranged around the circumference of the setting or locking sleeve 18, being guided in their inward and outward movement in grooves 38 formed by ribs or projections 39 extending from the setting sleeve member 17. These projections do not extend along the entire length of the setting sleeve 17, but only substantially along the mid-portion of the springs 26, 27, to prevent drilling mud or other fluids in the well casing from packing into the guiding grooves 38 during running of the well packer in the well casing. Such drilling mud, or other fluids, can flow through the grooves 38 without packing therein.

The collar groove 23 is sufficiently long to prevent the springs 26, 27 from being retracted after they have been expanded outwardly into it. The free ends 31, 37 of the springs, when positioned in the groove 23, are so designed and arranged as to occupy positions substantially parallel to the axis of the casing and packer, in order to exert a more direct transmission of force between the springs 26, 27 and the collar shoulders 24, 25. The free ends 31, 37 of the springs, which engage the wall of the recess 23, are also preferably made longer than the usual collar space formed when adjacent casing sections are connected together, in order that the springs may ride freely over such space.

Despite this preferred length of the free ends 31 of the downwardly directed springs 27, they are retained in retracted positions during lowering of the well packer A in the well casing B, to prevent their inadvertent catching in a casing collar space, which would prevent further lowering of the well packer beyond that point. These downwardly directed springs 27 are held in this retracted position by the retainer sleeve 34, which initially extends upwardly a sufficient distance to hold the free ends 31 of the downwardly directed springs inwardly against the lower setting member 17, in opposition to the inherent force of the springs 27 tending to expand them outwardly. It is unnecessary to retain the upwardly directed springs 26 in retracted position, since they will readily ride over the casing collar spaces during a lowering of the well packer within the casing string B.

The well packer is also provided with a locking device for holding the parts anchored in packed-off condition within the well casing. This locking device consists of a split ratchet ring 40 contained within an external groove 41 in a body head 20. It has downwardly directed external ratchet teeth 42 adapted for engagement with internal ratchet teeth 43 formed in the upper setting sleeve member 19. The ratchet teeth 42, 43 are so disposed as to permit upward movement of the packer body 10 and its head 20 within the sleeve 18, but to prevent downward movement of the body 10 within the sleeve 18.

The ratchet teeth 42 in the upper setting member 19 may be formed as a helical thread and a corresponding mating thread provided on the ratchet ring 40. In order to prevent rotation of the split ratchet ring 40 within the head 20, a stop screw 44 may be threaded in the body 10, which extends through a hole 45 in the ring defining its split portion 46 (Fig. 4). By preventing rotation of the ratchet ring 40, it is prevented from wedging in either an upward or downward direction against the sides of its grooves 41, in view of its threaded engagement with the helical ratchet teeth 43 in the setting member 19.

The well packer is run in the well bore with the downwardly directed springs 27 held in retracted positions by the retainer sleeve 34, and with the rubber packing sleeve 15 in retracted position against the packer body 10. At this time, the setting member shoulder 21 substantially abuts the body shoulder 22, and the ratchet ring 40 is disposed adjacent the lower ratchet portion of the upper setting member 19.

The well packer A is attached to the string of tubing C by means of a sub 47 that is threaded into the packer body 10, preferably through the use of a left hand threaded connection 48. Production tubing 49 is threaded on the lower end

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of the sub 47, and extends through the packer to a point therebelow. This tubing may retain a spring actuated flapper valve 50, pivoted on the lower end of the guide 11, in open position to one side of the guide. The tubing 49 may also have a perforated portion 51 to permit the well production to flow through the casing perforations D, and into the production tubing 49 for upward passage through the tubing string C to the top of the well bore. Leakage between the production tubing 49 and the body 10 of the well packer is prevented by a suitable packing assembly 52 mounted on the production tubing. This assembly may consist of upwardly and downwardly directed chevron packing 53 in sealing engagement with both the production tubing 49 and the inner wall of the body 10, the packing 53 being held in spaced relation by intervening spacer rings 54.

In the event that the production tubing 49 were to be removed from the packer after it had been set in the well casing, the flapper valve 50 would close against the seat 55 in the packer guide 11, and prevent the well production from flowing upwardly through the packer A.

The tool A is run in the well casing B on the string of tubing C extending to the top of the well bore, with the parts in retracted position, except for the upwardly directed lock springs 26, which ride freely over the casing coupling spaces and along the casing wall. The tool is lowered to a position below the location of the grooved collar E, and is then pulled upwardly slowly. When the upwardly directed springs 26 are disposed adjacent the collar groove or recess 23, they will expand into this enlarged diameter groove and come to rest with their upper ends 37 bearing against the upper groove shoulder 24. An upward strain may then be taken on the tubing string C, which will be transmitted through the body 10, guide 11, lower retainer 14, packing element 15, and upper retainer 16 to the lower setting member 17. When sufficient force has been applied in an upward direction, the shear screws 32 holding the retainer sleeve 34 to the lower setting member 17 will be disrupted and will enable the body 10, guide 11, packing assembly 13, and setting sleeve 18 to move upwardly, which will carry the downwardly directed springs 27 with them, since they are attached to the setting sleeve 18 by the screws 29. This upward movement of the downwardly directed lock springs 27 removes or raises them from the retainer sleeve 34 and allows them to spring inherently outwardly into the collar groove 23, as disclosed in Fig. 2, with their lower ends 31 immediately above the lower groove shoulder 25. The retainer sleeve 34 is thus removed from the free ends 31 of the downwardly directed springs 27, since the sleeve 34 is prevented from moving upwardly after engagement of the upwardly directed springs 26 with the upper collar shoulder 24.

Upward movement of the tubing string C is continued, which will carry the body 10, guide 11 and lower packing retainer 14 upwardly with it. The upper packing retainer 16 cannot move upwardly any further since it is now engaged with the retainer sleeve 34, which is prevented from moving in an upward direction by engagement of the springs 26 with the upper shoulder 24. Accordingly, the lower retainer 14 is moved toward the upper retainer 16, in order to shorten the packing sleeve 15 and expand it outwardly into sealing engagement with the

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casing wall, as disclosed in Fig. 3. During upward movement of the body 10, the ratchet ring 40 is displaced upwardly along the upward ratchet sleeve 19. Upon full expansion of the packing 15 against the casing or collar E and release of the upward strain on the tubing string C, the body 10 cannot lower again to permit retraction of the packing sleeve 15, because of the locking action of the ratchet ring 40 against the ratchet teeth 43 in the setting sleeve 19.

It is, therefore, apparent that the packer A has been fully anchored in packed-off condition within the well casing B. The upwardly directed springs 26 prevent upward movement of the packer within the well casing because of their engagement with the upper collar shoulder 24; the downwardly directed springs 27 prevent downward movement of the packer because of their engagement with the lower collar shoulder 25; and the packing sleeve 15 prevents leakage through the annulus between the body 10 and casing B. The ratchet ring 40 precludes downward movement of the body 10 and release of the packing 15 from its sealed condition between the casing B and body 10.

Under some conditions, it may be desired to disconnect the production tubing 49 from the well packer A and remove it from the well casing. This can be done by rotating the tubing string C to the right, which will unscrew the sub 47 from the packer body 10, because of their left hand thread interconnection 48. Following complete unthreading of the sub 47, the production tubing 49 may be withdrawn through the well packer A, the flapper valve 50 engaging its seat 55 to prevent upward flow of production through the packer.

In order to facilitate such unscrewing of the sub 47 from the body 10, positive means are provided for preventing rotation of the packer. To achieve this purpose, a stop lug 56, is inserted through a slot 57 in the casing collar E and extends into the collar groove 23 (Fig. 5). This lug 56 is welded to the collar so as to completely close the slot 57 and prevent leakage there-through. In addition, the packer body 10 is non-rotatably connected to the setting sleeve 18, as by providing a longitudinal groove or keyway 58 in the body 10 into which a ball 59 extends (Figs. 2 and 5). This ball is received partly in the groove 58 and partly within the lower member 17 of the setting sleeve 18, being held in such position by a screw 60 threaded into the setting sleeve 17. The keyway or groove 58 is elongated, so as to permit upward longitudinal movement of the body 10 within the setting sleeve member 17, 19 without interference by the ball keys 59.

When the tubing string C sub 47 and production tubing 49 are rotated, in order to disconnect these elements from the packer body 10, any tendency to rotate the body is transmitted through the ball 59 to the setting sleeve 17, and from the setting sleeve to the lock springs 26, 27. Should these parts rotate, they can only move several degrees before one of the springs will engage the stop lug 56, which will prevent any further rotation relative to the casing. The setting sub 47 may then be readily unthreaded from the body 10 without rotating the packer parts.

The inventor claims:

1. In a well tool: a body adapted to be lowered in a well conduit on a running-in string; tubular means slidable along said body; a first outwardly

expansible leaf spring on said tubular means engageable with a shoulder in the well conduit for holding said means against downward movement; a second outwardly expansible leaf spring on said tubular means engageable with a shoulder in the well conduit for holding said means against upward movement; and means releasably connecting said second leaf spring to said tubular means, said releasable means engaging and initially retaining said first leaf spring in retracted position, said releasable means being released from said first leaf spring upon continued upward movement of said tubular means while said second leaf spring is in holding engagement with the well conduit.

2. In combination: a well conduit having an internal recess therein; a body adapted to be lowered in said conduit on a running-in string; tubular means slidable along said body; a first leaf spring on said tubular means expandible into said recess and into engagement with the well conduit to hold said tubular means against downward movement in said conduit; a second leaf spring on said tubular means expandible into said recess and into engagement with the well conduit for holding said tubular means against upward movement in said conduit; and means releasably connecting said second leaf spring to said tubular means, said releasable means engaging and initially retaining said first leaf spring in retracted position to prevent its expansion into said recess, said releasable means being released from said first leaf spring upon continued upward movement of said tubular means while said second leaf spring is in holding engagement with the well conduit.

3. In combination: a well conduit having an internal recess therein; a body adapted to be lowered in said conduit on a running-in string; tubular means slidable along said body; a first member on said tubular means expandible into said recess and into engagement with the well conduit to hold said tubular means against downward movement in said conduit; a second member on said tubular means expandible into said recess and into engagement with the well conduit for holding said tubular means against upward movement in said conduit; means releasably connecting said second member to said tubular means, said releasable means engaging and retaining said first member in retracted position to prevent initially its expansion into said recess, said releasable means being released from said first member upon continued upward movement of said tubular means while said second member is in holding engagement with the well conduit within the recess; and means in said recess engageable with one of said members for preventing rotation of said tubular means.

4. In combination: a well conduit having an internal recess therein; a body adapted to be lowered in said conduit on a running-in string; tubular means slidable along said body; upwardly facing spring members operatively connected to said tubular means and expandible into said recess and into engagement with the well conduit for holding said tubular means against upward movement; downwardly facing spring members operatively connected to said tubular means and expandible into said recess and into engagement with the well conduit for holding said tubular means against downward movement; means mounted on and movable with respect to said tubular means and engaging said downwardly facing members for releasably holding said down-

wardly facing members in retracted position, said releasable means being released from said downwardly facing spring members upon continued upward movement of said tubular means while said upwardly facing spring members are in holding engagement with the well conduit within said recess; means in said recess engageable with at least one of said spring members for preventing rotation of said tubular means; and coengaging means on said body and tubular means for preventing relative rotation between said body and tubular means.

5. In a well tool: a body adapted to be lowered in a conduit on a running-in string; tubular means slidable along said body; a first outwardly expansible leaf spring operatively connected to said tubular means and engageable with a shoulder in the well conduit for holding said means against downward movement; a second outwardly expansible leaf spring operatively connected to said tubular means and engageable with a shoulder in the well conduit for holding said means against upward movement; means mounted on and movable with respect to said tubular means and engaging said first leaf spring for releasably retaining said first leaf spring in retracted position, said releasable means being released from said first leaf spring upon continued upward movement of said tubular means while said second leaf spring is in holding engagement with the well conduit; and coengaging means on said body and tubular means for preventing rotation of said body within said tubular means after said leaf springs have been expanded outwardly.

6. In a well tool: a body adapted to be lowered in a well conduit on a running-in string; tubular means slidable along said body; a first outwardly expansible leaf spring operatively connected to said tubular means and engageable with a shoulder in said well conduit for holding said means against downward movement; a second outwardly expansible leaf spring operatively connected to said tubular means and engageable with a shoulder in said well conduit for holding said means against upward movement; means mounted on and movable with respect to said tubular means and engaging said first leaf spring for releasably retaining said first leaf spring in retracted position, said releasable means being released from said first leaf spring upon continued upward movement of said tubular means while said second leaf spring is in holding engagement with the well conduit; and one-way lock means engageable with said body and tubular means for preventing longitudinal movement between said body and tubular means.

7. In a well packer: a body adapted to be lowered in a well conduit on a running-in string; an abutment on said body; tubular means slidable along said body; packing means on said body adapted to be compressed between said abutment and tubular means; a first outwardly expansible leaf spring on said tubular means engageable with a shoulder in the well conduit for holding said means against downward movement; a second outwardly expansible leaf spring on said tubular means and engageable with a shoulder in the well conduit for holding said means against upward movement; means on and movable with respect to said tubular means engaging said first leaf spring for releasably holding said first leaf spring in retracted position, said releasable means being released from said first leaf spring upon continued upward movement of said tubular means while said sec-

ond leaf spring is in holding engagement with the well conduit; and coengaging means on said body and tubular means for preventing movement between said body and tubular means in one direction.

8. In a well packer: a body adapted to be lowered in a well conduit on a running-in string; an abutment on the body; tubular means slidable along said body; packing means on said body adapted to be compressed between said abutment and tubular means; upwardly facing outwardly expansible leaf springs on said tubular means engageable with a shoulder in the well conduit for holding said tubular means against upward movement; downwardly facing outwardly expansible leaf springs on said tubular means engageable with a shoulder in the well conduit for holding said tubular means against downward movement; means engaging said downwardly facing leaf springs for releasably retaining said downwardly facing leaf springs in retracted position, said releasable retaining means being engageable with said upwardly facing leaf springs to be released from said downwardly facing leaf springs upon continued upward movement of said tubular means while said upwardly facing leaf springs are in holding engagement with the well conduit; and coengaging means on said body and tubular means for preventing longitudinal movement between said body and tubular means in one direction.

9. In combination: a well conduit having an internal recess therein; a body adapted to be lowered in said conduit on a running-in string; an abutment on the body; tubular means slidable along said body; packing means on said body adapted to be compressed between said abutment and tubular means; upwardly facing spring members on said tubular means expandible into said recess and into engagement with the well conduit for holding said tubular means against upward movement; downwardly facing spring members on said tubular means expandible into said recess and into engagement with the well conduit for holding said tubular means against downward movement; means engaging said downwardly facing members for releasably retaining said downwardly facing members in retracted position to prevent their expansion into said recess, said releasable retaining means being engageable with said upwardly facing members to be released from said downwardly facing members upon continued upward movement of said tubular means while said upwardly facing spring members are in holding engagement with the well conduit within the recess; and coengaging means on said body and tubular means for preventing longitudinal movement between said body and tubular means in one direction.

10. In combination: a well conduit having an internal recess therein; a body adapted to be lowered in said conduit on a running-in string; an abutment on the body; tubular means slidable along said body; packing means on said body adapted to be compressed between said abutment and tubular means; upwardly facing spring members on said tubular means expandible into said recess and into engagement with said conduit for holding said tubular means against upward movement; downwardly facing spring members on said tubular means expandible into said recess and into engagement with said conduit for holding said tubular means against downward movement; means engaging

said downwardly facing members for releasably retaining said downwardly facing members in retracted position to prevent their expansion into said recess, said releasable retaining means being engageable with said upwardly facing members to be released from said downwardly facing members upon continued upward movement of said tubular means while said upwardly facing spring members are in holding engagement with the well conduit within the recess; coengaging means on said body and tubular means for preventing longitudinal movement between said body and tubular means in one direction; means in said recess engageable with one of the spring members for preventing rotation of said tubular means; and means operatively connected to said body and tubular member for preventing relative rotation between said body and tubular means while permitting their relative longitudinal movement.

11. In combination: a well conduit having an internal recess therein; supporting means adapted to be lowered in said conduit; a first member on said supporting means expandible into said recess and into engagement with the well conduit to hold said supporting means against downward movement in said conduit; a second member on said supporting means expandible into said recess and into engagement with the well conduit for holding said supporting means against upward movement in said conduit; means releasably connecting said second member to said supporting means, said releasable means engaging and initially retaining said first member in retracted position to prevent its expansion into said recess; said releasable means being released from said first member upon continued upward movement of said supporting means while said second member is in engagement with the well conduit in the recess; and means in said recess engageable with one of said members for preventing rotation of said supporting means.

12. In combination: a well conduit having an internal recess therein; a body adapted to be lowered in said conduit on a running-in string; supporting means slidable along said body; upwardly facing spring members on said supporting means expandible into said recess and into engagement with the well conduit for holding said supporting means against upward movement; downwardly facing spring members on said supporting means expandible into said recess and into engagement with the well conduit for holding said supporting means against downward movement; releasable means engaging and initially retaining said downwardly facing members in retracted position; said releasable means being engaged and released from said downwardly facing spring members by said upwardly facing spring members upon continued upward movement of said supporting means while said upwardly facing spring members are in engagement with the well conduit in the recess; means in said recess engageable with at least one of said spring members for preventing rotation of said supporting means; and coengaging means on said body and supporting means for preventing relative rotation between said body and supporting means.

13. In a well tool: a body adapted to be lowered in a well conduit on a running-in string; tubular means slidable along said body; means on said body engageable by said body and tubular means to be expanded outwardly; a first out-

wardly expansible leaf spring on said tubular means engageable with a shoulder in the well conduit for holding said tubular means against downward movement; a second outwardly expansible leaf spring on said tubular means engageable with a shoulder in the well conduit for holding said tubular means against upward movement; releasable means on and movable with respect to said tubular means engaging said first leaf spring for holding initially said first leaf spring in retracted position, said releasable means being released from said first leaf spring upon continued upward movement of said tubular means while said second leaf spring is in holding engagement with the well conduit; and coengaging means on said body and tubular means for preventing movement between said body and tubular means in one direction.

14. In a well tool: a body adapted to be lowered in a well conduit on a running-in string; tubular means slidable along said body; means on said body engageable by said body and tubular means to be expanded outwardly; upwardly facing outwardly expansible leaf springs on said tubular means engageable with a shoulder in the well conduit for holding said tubular means against upward movement; downwardly facing outwardly expansible leaf springs on said tubular means engageable with a shoulder in the well conduit for holding said tubular means against downward movement; means engaging said downwardly facing leaf springs for releasably retaining said downwardly facing leaf springs in retracted position, said releasable retaining means being engageable with said upwardly facing leaf springs to be released from the downwardly facing leaf springs upon continued upward movement of said tubular means while said upwardly facing leaf springs are in holding engagement with the well conduit; and coengaging means on said body and tubular means for preventing longitudinal movement between said body and tubular means in one direction.

15. In combination: a well conduit having an internal recess therein; supporting means adapted to be lowered in said conduit; a first member on said supporting means expandible into said recess and into engagement with the well conduit to hold said supporting means against downward movement in said conduit; a second member on said supporting means expandible into said recess and into engagement with the well conduit for holding said support-

ing means against upward movement in said conduit; retaining means engageable by said second member and engaging said first member to retain initially said first member in retracted position to prevent expansion of said first member into said recess; and means releasably connecting said retaining means to said supporting means, in order that continued upward movement of said supporting means while said second member is in holding engagement with the well conduit in the recess will cause said second member to release said releasable means and relatively shift said retaining means from said first member to allow expansion of said first member into holding engagement with the well conduit within said recess.

16. In a well tool: a body adapted to be lowered in a well conduit on a running-in string; supporting means slidable along said body; a first outwardly expansible leaf spring on said supporting means engageable with a shoulder in the well conduit for holding said means against downward movement; a second outwardly expansible leaf spring on said supporting means engageable with a shoulder in the well conduit for holding said means against upward movement; retaining means engageable by said second leaf spring and engaging said first leaf spring to retain initially said first leaf spring in retracted position to prevent its expansion into holding engagement with the well conduit; and means releasably connecting said retaining means to said supporting means, in order that continued upward movement of said supporting means while said second leaf spring is in holding engagement with the well conduit will cause said second leaf spring to release said releasable means and relatively shift said retaining means from said first leaf spring to allow expansion of said first leaf spring into holding engagement with the well conduit.

REUBEN C. BAKER.

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