Aug. 26, 1958 R. C. BAKER ET AL 2,849,069

SUBSURFACE WELL TOOLS

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Fig. 1.

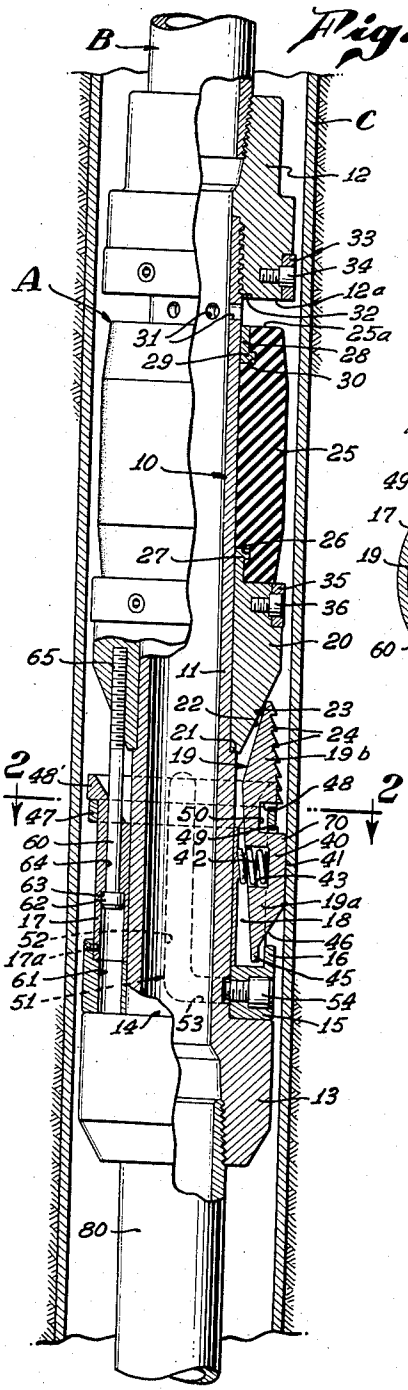


Fig. 2.

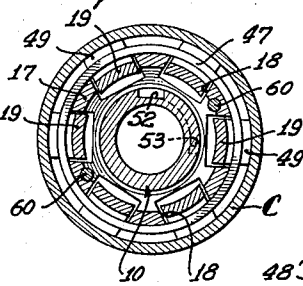
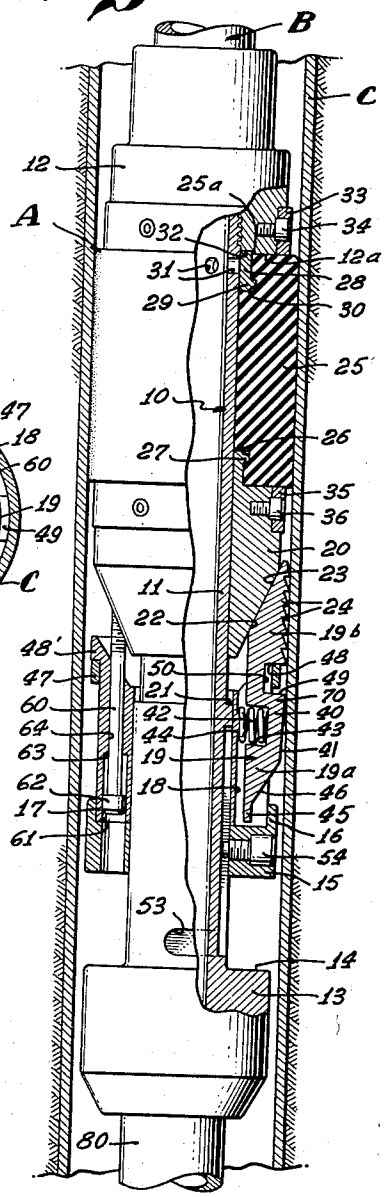


Fig. 3.



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SUBSURFACE WELL TOOLS

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23 Claims. (Cl. 166—138)

The present invention relates to subsurface well devices particularly useful in the performance of cementing, acidizing, testing, anchoring, producing and other functions in well bores.

An object of the present invention is to provide a subsurface well tool capable of being anchored in a well bore conduit, such as a string of well casing, which is comparatively short and compact, thereby effecting economies in manufacture, as well as making the tool easier to drill up in the event such action becomes necessary.

Another object of the invention is to provide a subsurface well packer of greatly simplified structure capable of being anchored in a well conduit, such as a well casing, which is comparatively short and compact, and which, if desired, can be made substantially entirely of readily drillable material, like cast iron.

A further object of the invention is to provide a subsurface well packer embodying a valve control by-pass, in which the normally retracted packing of the well packer is utilized as part of the valve mechanism itself.

Yet a further object of the invention is to provide a subsurface well tool embodying slips for anchoring the tool in a well conduit, the slips being set through use of a casing engaging drag device, in which the drag device is incorporated in the slips themselves, thereby greatly shortening and simplifying the well tool.

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 may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It 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.

Referring to the drawings:

Figure 1 is a longitudinal section, parts being shown in side elevation, of a subsurface well tool, with its parts in the position they occupy during longitudinal movement of the well tool through a well casing disposed in a well bore;

Fig. 2 is a cross-section taken along the line 2—2 on Fig. 1;

Fig. 3 is a longitudinal section, similar to Fig. 1, disclosing the well tool anchored in packed-off condition in a well casing.

In the form of invention specifically disclosed in the drawings, the well tool consists of a well packer A adapted to be secured to the lower end of a string of tubing or drill pipe B extending to the top of a well bore. This combination is lowered in a conduit string C, such as well casing, to be anchored therein in packed-off condition at any desired location. After having been

anchored in packed-off condition in the well casing, the well tool can be released therefrom and moved longitudinally in the well casing to any other desired location, or completely withdrawn from the well casing.

The well packer A includes a main body 10 having a central generally cylindrical portion 11 threadedly secured to an upper body portion or sub 12, which is, in turn, adapted to be threaded onto the lower end of the tubular string B. The lower portion 13 of the body is enlarged in a lateral outward direction to provide a shoulder 14 on which a slip stop and lock ring 15 can rest, this slip stop and lock ring having an upwardly extending rim portion 16 into which is received the lower portion of a sleeve 17 extending upwardly from the ring. The sleeve and ring are secured together by the screws 17a. This sleeve 17 is provided with a plurality of circumferentially spaced and longitudinally extending grooves 18 in which the lower portions of casing engaging slips 19 are contained. These slips extend upwardly from the sleeve and are cooperable with an expander 20 slidably mounted on the cylindrical intermediate portion 11 of the packer body. Downward movement of the expander 20 with respect to the body is determined and limited by engagement of the lower end of the expander with a laterally extending shoulder 21 on the body. The expander 20 is adapted to expand the slips 19 outwardly into engagement with the wall of the well casing C, by reason of the cooperation between the downward and inwardly tapering external surface 22 on the expander engaging internally tapered surfaces 23 on the upper portions of the slips. It is apparent that downward movement of the expander 20 within the slips 19 will wedge the tapered surface 22 of the expander into the slips 19 and urge the latter laterally outward to embed the external wickers 24 on the slips into the wall of the casing C. In the form of device specifically shown in the drawings, the slips 19 are designed to anchor the tool against downward movement in the well casing, for which reason the wickers 24 face in a downward direction.

The upper end of the expander 20 is coupled to the lower portion of a packing structure 25, disclosed as being in the form of a rubber or rubber-like packing sleeve surrounding the body 10. The lower portion of the packing sleeve has an internal groove 26 therein for receiving a flange 27 at the upper end of the expander 20, to prevent relative longitudinal movement between the packing sleeve 25 and expander. The packing sleeve 25 extends upwardly from the expander along the body, being engageable with the exterior of the body 10 above the expander, the upper end of the packing sleeve being coupled to a valve head and port bridging device 28, in the form of a ring or sleeve, slidable along the periphery of the body 10 and having a lower external flange 29 received within a companion internal groove 30 in the upper portion of the sleeve 25, to connect the two parts together and prevent longitudinal movement therebetween. Initially, the upper ends of the packing sleeve 25 and of the valve head 28 are disposed slightly below a plurality of by-pass or side ports 31 extending through the body, the ports being disposed immediately below the lower end of the upper body portion 12. This body portion has a transverse valve seat 12a adapted to be engaged by the transverse upper end 25a of the packing sleeve 25, whenever the side ports 31 are to be closed. The valve head 28 is slidable across the by-pass ports 31 to close them, its upper end being received within a recess or circumferential groove 32 in the lower end of the upper body portion 12, to insure against squeezing of the rubber packing material around the

ring 28 when the packing sleeve 25 is expanded against the casing C and subjected to comparatively high pressures.

Although not essential to the present invention, the lower portion of the upper body member 12 may have a gauge ring 33 secured thereto by one or more screws 34, to minimize the annular clearance space between the well tool A and the wall of the well casing C through which the rubber packing material may tend to squeeze or cold flow during use of the tool. In a similar fashion, the upper portion of the expander 20 also has a lower gauge ring 35 secured thereto by screws 36, this lower gauge ring being contactable with the lower end of the rubber packing sleeve 25, and reducing the clearance space between the tool and the wall of the well casing through which the rubber packing material may tend to squeeze under high pressure and/or temperature operating conditions.

As was stated above, the slips 19 are set upon downward movement of the expander 20 relative thereto. To secure such relative downward movement, retarding means are provided, tending to resist longitudinal movement of the slips in the well casing C. In the present instance, the retarding device is provided on the lower portion 19*a* of the slips themselves. As specifically disclosed, such retarding devices include the formation of friction drag block portions 40 on the slips having outer faces 41 adapted to contact the wall of the well casing C. The frictional contact between the drag block portions 40 of the slips and the casing wall is secured by a plurality of helical compression springs 42 having their axes transverse to the axis of the body 10, each spring being disposed in one of the slip sleeve grooves 18. The outer portion of each spring is disposed within a socket 43 formed in the slip adjacent its outer casing engaging face 41, the spring bearing against the base of the socket 43 and also against the base of the longitudinal sleeve groove 18. If desired, the spring 42 may be maintained in a central position by causing its inner end portion to engage a boss 44 extending laterally outward from the base of each groove 18.

The extent of lateral outward movement of each slip 19 is limited, there being a lower finger or leg portion 45 on each slip adapted to engage the rim 16 of the stop ring 15. Normally, when the tool is disposed within the well casing, these leg portions 45 are located inwardly by a substantial distance from the rim 16 of the stop ring. However, when the tool is out of the well casing and in an unconfined condition, then the springs 42 can urge the lower portions 19*a* of the slips outwardly to the extent limited by engagement of the leg portions 45 with the rim 16. When the tool is inserted in the well casing, the upper end of the casing will engage the tapered surfaces 46 of the slips 19 adjacent the foot portions 45, to urge the slips in an inward direction up against the force of the springs 42.

Lateral outward movement of the slips 19 is also limited by a retaining and retracting ring 47 encompassing the sleeve 17 and disposed in external circumferential grooves 48 formed in the intermediate portions of the slips 19 below the wickered surfaces 24 of the slips. The upper end of this ring 47 is engaged by a transverse shoulder 48 extending outwardly from the upper end of the slip sleeve 17, the lower end of the ring being adapted to engage the lower side 49 of the slip grooves 48, in order to pull the slips 19 in a downward direction when the tool A is being lowered in the well casing C. The ring 47 also limits the extent of lateral outward movement of the slips 19 under the influence of the springs 42, particularly when the tool is unconfined and out of the hole, the base portions 50 of the slip grooves 48 engaging the inner surface of the retaining ring 47.

In order to prevent relative downward movement of the expander 20 within the slips 19, until the latter are to be anchored against the well casing C at the desired

setting point therewithin, a suitable lock device is provided. As disclosed, this lock device consists of a J-type of slot and pin arrangement, the J slot 51 being provided in the external portion of the body 10 below the tapered expander 20 and the body shoulder 21. This J slot includes a longitudinal leg portion 52 that merges into a circumferential foot portion 53, both of these portions being adapted to receive the inner end of a lock pin 54 secured to the lower stop ring 15, as by being threaded thereinto. When the lock pin 54 is disposed in the foot portion 53 of the J slot, the expander 20 is prevented from being moved downwardly within the slips 19, inasmuch as the slip sleeve 17 is connected to the stop ring 15 by the screws 17*a* and the body 10 is connected to the ring 15 through the pin 54. It is evident that during such location of the pin 54 in the foot portion 53 of the slot, downward movement of the body 10 will be transmitted through the pin 54 to the stop ring 15, and through the screws 17*a* to the slip sleeve 17, the sleeve shoulder 48 engaging the retaining ring 47, which will engage the lower sides 49 of the slip grooves 48 to move the slips 19 in a downward direction with the body.

During such downward movement, it is also preferred that the expander 20 and the rubber packing sleeve 25 move in a downward direction, to prevent relative upward movement of the rubber packing sleeve 25 and the valve head 28 along the body to close the by-pass or side ports 31. To accomplish this last-mentioned objective, one or more limit pins or screws 60 may be inserted through longitudinally aligned sockets or bores 61 in the stop ring and slip sleeve, the head 62 of the pin engaging a shoulder 63 formed between the lower enlarged bore portion 61 and a smaller diameter bore portion 64 through the slip sleeve 17, through which the shank of each screw 60 extends. The upper ends of the screws 60 are threaded, being received within companion longitudinally extending threaded holes 65 in the expander 20. The limit screws 60 extend through the slip sleeve 17 and into the expander 20 between the slips 19, so as to avoid interference with the operation of the latter.

Because of the engagement of the limit pin heads 62 with the shoulders 63 of the slip sleeve, downward movement of the body 10, with the lock pin 54 received within the horizontal foot portion 53 of the J slot, will cause the slip sleeve 17 to move downwardly, engaging the heads 62, and, through the limit pins 60, moving the expander 20 in a downward direction, which will carry the packing sleeve 25 downwardly with the body 10 as well, moving its upper end below the body ports 31, in order that the latter will remain in an open condition.

The slips 19 are capable of rocking or pivoting with respect to the expander 20 and the well casing C. It is to be noted that when the friction drag faces 41 of the slips are fully engaging the wall of the well casing, the inner tapered surfaces 23 of the slips are disposed at an angle to the companion tapered surface 22 on the expander 20, the tapered surfaces on the expander and slips diverging with respect to each other in a downward direction. Similarly, the wickered faces 24 of the slips are inclined to the wall of the well casing, these faces and the wall diverging from each other in an upward direction, the angle of divergence being substantially the same as the angle of divergence between the expander surface 22 and the inner tapered slip surfaces 23. When the expander 20 is moved downwardly with respect to the slips 19, it rocks the slips about the upper end portions 70 of the drag blocks 40, which serve as fulcrum points against the casing C, urging the lower parts 19*a* of the slips inwardly against the force of the springs 42, the expander surface 22 coming into full bearing engagement with the tapered slip surfaces 23, which places the wickered faces 24 of the slips substantially parallel to the wall of the well casing, whereby the wickered faces of

the sips can be wedged along their entire length into the casing wall. When the expander **20** is moved relatively in an upward direction out of the slips **19**, then the springs **42** will rock the slips about their points of fulcrum contact **70** with the well casing, urging the lower portion **19***a* of the slips outwardly, to cause the drag blocks **40** to fully engage the casing wall C, and swinging the upper portion **19***b* of the slips inwardly and completely out of engagement with the well casing C.

In the running and operation of the tool in the well bore, the body **10** is elevated within the parts surrounding it until the horizontal foot portion **53** of the J slot receives the inner end of the locking pin **54**, whereupon the body is turned fully to the left so that the pin **54** engages the end of the horizontal slot portion **53** of the J slot **51** remote from its longitudinal slot portion **52**. When in this condition, the parts occupy the position disclosed in Fig. 1. The tool A may now be lowered through the well casing C by means of the string of tubing or drill pipe B, the drag block portions **40** of the slips **19** being urged outwardly into frictional contact with the wall of the well casing by the springs **42**. However, in view of the locking action of the J slot **51** and pin **54** arrangement, the parts will occupy the position shown in Fig. 1, the drag block portions **40** being forced to slide along the wall of the well casing C. During the downward movement of the tool in the well casing, the fluid in the well bore can by-pass around the exterior of the well tool, because of the retracted condition of the rubber packing sleeve **25**. In addition, fluid can pass upwardly through the body **10** of the tool, continuing on up through the tubing string B, or passing outwardly through the open ports **31** for continued upward passage around the tubing string above the well tool A. During such lowering action, the ports **31** are maintained open because of the engagement of the heads **62** of the limit pins **60** with the shoulders **63** on the slip sleeve **17**, as described above.

When the location in the well casing C is reached at which it is desired to set the tool A in packed-off condition, all that need be done is to rotate the tubular string B to the right, which will correspondingly rotate the body **10** of the tool with respect to the parts surrounding it. The drag block portions **40** of the slips are engaging the wall of the well casing C, and, inasmuch as the slips **19** are contained within grooves **18** in the slip ring **17**, the slip ring is prevented from rotating by the friction action of the drag blocks against the casing. Similarly, the expander **20** is prevented from rotating because of its connection to the slip sleeve **17** by the limit pins or screws **60**. Accordingly, the tubing string B is rotated a partial revolution to the right to rotate the body **10** a partial revolution, until the longitudinal portion **52** of the J slot **51** is aligned with the pin **54**, whereupon the tubing string B, and the body **10** of the well tool connected thereto, can be lowered, the packing sleeve **25**, expander **20**, slip sleeve **17**, stop ring **15** and slips **19** being prevented from lowering by virtue of the engagement of the drag block portions **40** of the slips against the wall of the well casing C.

The first action of lowering the body **10** of the tool will produce downward movement of the transverse valve seat **12***a* into engagement with the upper end **25***a* of the packing sleeve **25**, and the shifting of the ports **31** within the valve head and bridging device **28**, the latter element being received within the inner lower groove **32** in the upper body portion **12**. The by-pass or side ports **31** are thus closed. Continued downward movement of the body **10** will now shift the packing sleeve **25** and the expander **20** connected thereto in a downward direction, downward movement of the slips **19** still being prevented by the frictional engagement of their drag block portions **40** against the wall of the well casing C. Accordingly, the expander **20** will be shifted downwardly within the slips **19**, its tapered surface **22** engaging the upper ends of the slips **19** and urging them in a lateral outward direction, the fulcrums **70** of the slips rocking about the casing C to move the slips **19** into engagement with the wall of the well casing C, the lower portion **19***a* of the slips being rocked inwardly against the force of the springs **42**. The expander **20** moves downwardly until there is full engagement between the tapered expander surface **22** and the slip tapered surfaces **23**, the slips being shifted radially outward until the wickers **24** are engaged fully with the wall of the well casing C.

Further downward movement of the well tool body **10** will now be incapable of shifting the expander **20** in a downward direction, since such action is prevented by engagement of the slips **19** with the well casing. Accordingly, the downward movement of the body **10** now moves the upper body portion **12** toward the expander **20**, which will foreshorten the rubber packing sleeve **25** and expand it laterally into sealing engagement with the wall of the well casing C. A sufficient downward force can be imposed on the tubing string B and the packing **25** of the well tool to insure the firm wedging of the expander **20** into the slips **19** and the embedding of the wickers **24** on the latter into the wall of the well casing C, as well as the leakproof engagement of the rubber packing sleeve **25** with the wall of the well casing and the external surface of the packer body **10**. The downward force will also insure a positive seal between the upper end **25***a* of the packing sleeve **25** and the transverse valve seat **12***a*, the rubber packing material being prevented from flowing between the inner surface of the valve head **28** and the packer body **10** because of the relatively small running clearance therebetween, and also being prevented from flowing around the upper end of the valve ring **28** because of its reception in the groove **32** and its close engagement with the upper end of this groove, as well as its outer wall.

The aforenoted relative downward movement of the body **10** with respect to the other part is permitted, inasmuch as the lock pin **54** cannot interrupt downward movement of the body, being slidable within the longitudinal J slot groove **52**. During the downward movement of the expander **20** into wedging engagement with the slips **19**, the heads **62** of the limit pins **60** move downward away from the companion shoulders **63** on the slip sleeve **17**.

The desired action can now be performed in the well bore. If the tubing B is to be swabbed, the annulus load between it and the well casing C will be supported by the rubber packing sleeve **25**, the expander **20** and the slips **19**. The device will also support the tubing string B in the event the packer A is used in a production operation, the well bore fluid flowing into the well casing and passing upwardly through a tailpipe **80** that might be screwed into the lower portion of the body **10**, and on up through the body itself into the tubing string B. Of course, the side ports **31** in the body will be closed, so that the well production is incapable of flowing out of the body and into the annular space between the tool and the well casing, as well as into the annulus between the tubing string B and the well casing C.

When it is desired to release the tool from the well casing, it is merely necessary to move the tubing string B and the body **10** in an upward direction. The upper ends **70** of the friction drag blocks **40** are still engaging the well casing C to resist upward movement of the slips. However, the body **10** is movable upwardly, the upper body portion **12** moving away from the rubber packing sleeve **25**, allowing the latter to inherently return to its initial retracted position, such as disclosed in Fig. 1, the side ports **31** being elevated above the valve head **28** and the upper end **25***a* of the rubber packing sleeve **25**, to be placed in an open condition, providing communication between the interior of the body **10** and the tubing B and the exterior of the packer. Continued upward movement of the body will engage the body shoulder **21**

with the lower end of the expander 20, causing the expander to be shifted in an upward direction out of the slips 19, whereupon the springs 42 are effective to rock the slips 19 about their fulcrums 70, in order to shift the upper wickered portions 19*b* of the slips inwardly and out of engagement with the well casing, the slips 19 and all of the parts returning to the relative positions disclosed in Fig. 1 in the drawings. When the parts are fully retracted, the lock pin 54 will be disposed in alignment with the foot portion 53 of the slot 51, whereupon the tubing string B and the body 10 can be turned a partial revolution to the left to relocate the lock pin 54 fully within the slot foot 53.

The tool A can now be elevated in the well casing, to be set at another location therein, or for complete removal from the well casing. If this latter action is to occur, it is actually unnecessary to reposition the lock pin 54 in the horizontal or locking portion 53 of the slot, since the elevation of the body in the well casing automatically locates the rubber packing sleeve 25 and the slips 19 in their retracted position. However, should it be desired to lower the tool A in the well casing C and set it at another location, the disposition of the locking pin 54 in the foot portion 53 of the slot 51 will allow all of the parts to be lowered in the well casing, with the wickered portions 24 of the slips in retracted position, the rubber packing sleeve 23 in retracted position, and with the by-pass or side ports 31 open. Upon reaching the new location in the well casing, the body 10 is turned to the right, as explained above, to place the lock pin 54 in alignment with the longitudinal locking slot portion 52, whereupon it is merely necessary to lower the tubing string B and the packer body 10 to insure the anchoring of the slips 19 against the casing and the sealing off of the packing sleeve 25 against the casing C, packer body 10 and the transverse valve seat 12*a*, for the purpose of preventing passage of fluid between the body 10 and the casing C, and to close the by-pass or side ports 31.

From the foregoing description, it is evident that a well tool has been provided that is comparatively short and compact, which decreases the cost of manufacture. All of the metallic parts of the tool, with the possible exceptions of the various screws disclosed, can be made of readily drillable material, such as cast iron, to enable the tool to be drilled up in the event it becomes stuck in the hole. Economies are effected in drilling up the tool, since, in view of its short length, it can be disintegrated in a much shorter period of time. The decreased length is attributable to the combining of the slips 19 and friction drag blocks 40 in one unit, as well as the utilization of the packing sleeve 25 for part of the valve device that determines the opened and closed condition of the side ports 31.

The inventors claim:

1. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip mounted on said body to rock with respect thereto and having a gripping portion engageable with the well conduit for anchoring the body to the well conduit, said slip having a drag portion adjacent said gripping portion and frictionally engageable with the well conduit to resist movement of the slip therewithin; the faces of said drag portion and gripping portion which confront the inner wall of the conduit diverging in a direction inwardly of the conduit; means engaging said slip to expand and urge said drag portion against the conduit, and to rock said slip on its drag portion to move said gripping portion inwardly away from the well conduit; and means on said body engaging said slip to rock said slip on its drag portion and shift said gripping portion laterally outward into engagement with the well conduit against the force of said expanding and urging means.

2. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip on said body having a gripping portion engageable with the well conduit for anchoring the body to the well conduit, said slip having a drag portion frictionally engageable with the well conduit to resist movement of the slip therewithin; said drag portion having a pivot region engaging the well conduit and about which said slip can rock, said slip gripping portion being disposed on one side of said pivot region; means engaging said slip on the other side of said pivot region to force said drag portion outwardly against the conduit and to rock said slip about said pivot region to move said gripping portion inwardly away from the well conduit; and means on said body engaging said slip to rock said slip about said pivot region and shift said gripping portion laterally outward into engagement with the well conduit.

3. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip on said body having a gripping portion engageable with the well conduit for anchoring the body to the well conduit, said slip having a drag portion frictionally engageable with the well conduit to resist movement of the slip therewithin; said drag portion having a pivot region engaging the well conduit and about which said slip can rock, said slip gripping portion being disposed on one side of said pivot region; means engaging said slip on the other side of said pivot region to force said drag portion outwardly against the conduit and to rock said slip about said pivot region to move said gripping portion inwardly away from the well conduit; and a tapered expander on said body movable longitudinally relative to and engaging said slip to rock said slip about said pivot region and wedge said gripping portion laterally outward into engagement with the well conduit.

4. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; said body having a port; said body having a transverse valve seat thereon on one side of said port; a normally retracted packing structure slidable on said body and disposed on the other side of said port; said structure having one end engageable with said valve seat to close said port; an expander slidable on said body and engaging the other end of said packing structure; functionally integral, rigid slips cooperable with said expander for lateral movement to engage the conduit upon relative longitudinal movement between said expander and slips; said slips having gripping portions engageable with the conduit and drag portions frictionally engageable with the conduit to resist movement of the slips therewithin; each of said drag portions having a pivot region engaging the conduit and about which said slip can rock, said slip gripping portion being disposed on one side of said pivot region; means engaging each of said slips on the other side of said pivot region to force said drag portions outwardly against the conduit and to rock said slips about said pivot region to move said gripping portions inwardly away from the well conduit; and releasable lock means between said body and slips to prevent relative longitudinal movement between said expander and slips whereby said gripping portions remain out of engagement with the conduit.

5. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip mounted on said body and movable relative thereto and having a gripping portion engageable with the surface of the inner wall of the well conduit for anchoring the body to the well conduit, said slip having a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion being slidable longitudinal-

ly along the conduit in both longitudinal directions; the faces of said drag portion and gripping portion which confront the inner wall of the conduit diverging in a direction inwardly of the conduit; laterally arranged spring means engaging said slip behind said drag portion to urge said drag portion against the conduit wall and gripping portion inwardly away from the conduit wall, the line of action of said spring means intersecting said drag portion; and means on said body engageable wtih said slip to shift said slip gripping portion laterally outward of said body into engagement with the well conduit wall against the force of said spring means.

6. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip mounted on said body and movable relative thereto and having a gripping portion engageable with the surface of the inner wall of the well conduit for anchoring the body to the well conduit, said slip having a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion being slidable longitudinally along the conduit in both longitudinal directions; the faces of said drag portion and gripping portion which confront the inner wall of the conduit diverging in a direction inwardly of the conduit; a helical compression spring engaging said slip behind said drag portion to urge said drag portion against the conduit wall and gripping portion inwardly away from the conduit wall, the axis of said spring intersecting said drag portion; and means on said body engaging said slip to shift said slip gripping portion laterally outward of said body into engagement with the well conduit wall against the force of said spring.

7. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip mounted on said body and movable relative thereto and having a gripping portion engageable with the surface of the inner wall of the well conduit for anchoring the body to the well conduit, said slip having a drag portion frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion being slidable along the conduit in both longitudinal directions; the faces of said drag portion and gripping portion which confront the inner wall of the conduit diverging in a direction inwardly of the conduit; a helical compression spring engaging said slip behind said drag portion to force said drag portion against the conduit wall, said spring being adapted to rock said slip on its drag portion to move said gripping portion inwardly away from the well conduit wall; and means on said body engaging said slip to rock said slip on its drag portion to shift said gripping portion laterally outward into engagement with the well conduit wall against the force of said spring.

8. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip on said body having a gripping portion engageable with the well conduit for anchoring the body to the well conduit, said slip having a drag portion frictionally engageable with the well conduit to resist movement of the slip therewithin; said drag portion having a pivot region engaging the well conduit and about which said slip can rock, said slip gripping portion being disposed on one side of said pivot region; a helical compression spring engaging said slip on the other side of said pivot region to force said drag portion outwardly against the conduit and to rock said slip about said pivot region to move said gripping portion inwardly away from the well conduit; and means on said body engaging said slip to rock said slip about said pivot region and shift said gripping portion laterally outward into engagement with the well conduit.

9. In a slip assembly for a well tool: a functionally integral, rigid slip having a gripping portion engageable with the surface of the inner wall of a well conduit and a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion being slidable longitudinally along the conduit in both longitudinal directions; and means engaging said slip behind said drag portion urging said drag portion into engagement with the inner surface of the conduit wall and said gripping portion out of engagement with the conduit wall.

10. In a slip assembly for a well tool: a functionally integral, rigid slip having a gripping portion engageable with the surface of the inner wall of a well conduit and a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion being slidable longitudinally along the conduit in both longitudinal directions; and a helical compression spring engaging said slip behind said drag portion urging said drag portion into engagement with the inner surface of the conduit wall and said gripping portion out of engagement with the conduit wall.

11. In a slip assembly for a well tool: a functionally integral, rigid slip having a gripping portion engageable with the surface of the inner wall of a well conduit and a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion having a pivot region engaging the well conduit wall and about which the slip can rock; said slip gripping portion being disposed on one side of said pivot region; and means engaging said slip on the other side of said pivot region to force said drag portion outwardly against the conduit wall and to rock said slip about said pivot region to move said gripping portion inwardly away from the well conduit wall.

12. In a slip assembly for a well tool: a functionally integral, rigid slip having a gripping portion engageable with the surface of the inner wall of a well conduit and a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion having a pivot region engaging the well conduit wall and about which the slip can rock; said slip gripping portion being disposed on one side of said pivot region; and means engaging said slip behind said drag portion and on the other side of said pivot region to force said drag portion outwardly against the conduit wall and to rock said slip about said pivot region to move said gripping portion inwardly away from the well conduit wall.

13. In a slip assembly for a well tool: a functionally integral, rigid slip having a gripping portion engageable with the surface of the inner wall of a well conduit and a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion having a pivot region engaging the well conduit wall and about which the slip can rock; said slip gripping portion being disposed on one side of said pivot region; and a helical compression spring engaging said slip on the other side of said pivot region to force said drag portion outwardly against the conduit wall and to rock said slip about said pivot region to move said gripping portion inwardly away from the well conduit wall.

14. In a slip assembly for a well tool: a functionally integral, rigid slip having a gripping portion engageable with the surface of the inner wall of a well conduit and a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of

the well conduit to resist movement of the slip therewithin; said drag portion having a pivot region engaging the well conduit wall and about which the slip can rock; said slip gripping portion being disposed on one side of said pivot region; and a helical compression spring engaging said slip behind said drag portion and on the other side of said pivot region to force said drag portion inwardly against the conduit wall and to rock said slip about said pivot region to move said gripping portion inwardly away from the well conduit wall.

15. In a slip assembly for a well tool: a sleeve structure; a plurality of functionally integral, rigid slips on said structure; each slip having a gripping portion engageable with a well conduit and a drag portion frictionally engageable with the well conduit to resist movement of the slip therewithin; said drag portion being slidable longitudinally along the conduit in both longitudinal directions; means engaging said sleeve structure and each slip to force said drag portions against the conduit; and means coupling said sleeve structure and slips for conjoint longitudinal movement.

16. In a slip assembly for a well tool: a sleeve structure; a plurality of functionally integral, rigid slips on said structure; each slip having a gripping portion engageable with a well conduit and a drag portion frictionally engageable with the well conduit to resist movement of the slip therewithin; means engaging said sleeve structure and each slip to force said drag portions against the conduit; each of said slips having an external groove between said gripping portion and drag portion; a ring encompassing said slips and disposed in said groove to couple said slips for longitudinal movement together; and means on said sleeve structure engageable with said ring to cause said sleeve structure and slips to move jointly in a longitudinal direction.

17. In a slip assembly for a well tool: a sleeve structure having a plurality of circumferentially spaced and longitudinally extending grooves; a plurality of functionally integral, rigid slips in said grooves; each slip having a gripping portion engageable with a well conduit and a drag portion frictionally engageable with the well conduit to resist movement of the slips therewithin; means engaging said sleeve structure and each slip to force said drag portions against the conduit; and means coupling said sleeve structure and slips for conjoint longitudinal movement.

18. In a slip assembly for a well tool: a sleeve structure having a plurality of circumferentially spaced and longitudinally extending grooves; a plurality of functionally integral, rigid slips in said grooves; each slip having a gripping portion engageable with the well conduit and a drag portion frictionally engageable with a well conduit to resist movement of the slips therewithin; means engaging said sleeve structure and each slip to force said drag portions against the conduit; each of said slips having an external groove between said gripping portion and drag portion; a ring encompassing said slips and sleeve structure and disposed in said external groove to couple said slips for longitudinal movement together; and means on said sleeve structure engageable with said ring to cause said sleeve structure and slips to move jointly in a longitudinal direction.

19. In a slip assembly for a well tool: a sleeve structure having a plurality of circumferentially spaced and longitudinally extending grooves; a plurality of functionally integral, rigid slips in said grooves; each slip having a gripping portion engageable with a well conduit and a drag portion frictionally engageable with the well conduit to resist movement of the slips therewithin; a helical compression spring in each longitudinal groove engaging said sleeve structure and each slip behind said drag portion to force said drag portion against the conduit; and means coupling said sleeve structure and slips for conjoint longitudinal movement.

20. In a slip assembly for a well tool: a sleeve structure having a plurality of circumferentially spaced and longitudinally extending grooves; a plurality of functionally integral, rigid slips in said grooves; each slip having a gripping portion engageable with a well conduit and a drag portion frictionally engageable with the well conduit to resist movement of the slips therewithin; a helical compression spring in each longitudinal groove engaging said sleeve structure and each slip behind said drag portion to force said drag portion against the conduit; each of said slips having an external groove between said gripping portion and drag portion; a ring encompassing said slips and sleeve structure and disposed in said external groove to couple said slips for longitudinal movement together; and means on said sleeve structure engageable with said ring to cause said sleeve structure and slips to move jointly in a longitudinal direction.

21. In a slip assembly for a well tool: a sleeve structure having a plurality of circumferentially spaced and longitudinally extending grooves; a plurality of functionally integral, rigid slips in said grooves; each slip having a gripping portion engageable with a well conduit and a drag portion frictionally engageable with the well conduit to resist movement of the slip therewithin; said drag portion having a pivot region engaging the well conduit and about which the slip can rock; said slip gripping portion being disposed on one side of said pivot region; a helical compression spring in each longitudinal groove engaging said sleeve structure and each slip on the other side of said pivot region and behind said drag portion to force said drag portion against the conduit; each of said slips having an external groove between said gripping portion and drag portion; a ring encompassing said slips and sleeve structure and disposed in said external groove to couple said slips for longitudinal movement together; and means on said sleeve structure engageable with said ring to cause said sleeve structure and slips to move jointly in a longitudinal direction.

22. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip mounted on said body movable relative thereto and having a gripping portion engageable with the surface of the inner wall of the well conduit for anchoring the body to the well conduit, said slip having a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion being slidable along the well conduit in both longitudinal directions; means acting on said slip urging said drag portion into engagement with the inner surface of the wall of the conduit and said gripping portion out of engagement with the conduit wall; and means on said body engaging said slip to move the slip to bring the gripping portion into engagement with the surface of the inner wall of the well conduit.

23. In a well tool: a body adapted to be connected to a running-in string for moving the well tool longitudinally in a conduit positioned in a well bore; a functionally integral, rigid slip mounted on said body movable relative thereto and having a gripping portion engageable with the surface of the inner wall of the well conduit for anchoring the body of the well conduit, said slip having a drag portion adjacent said gripping portion and frictionally engageable with the surface of the inner wall of the well conduit to resist movement of the slip therewithin; said drag portion being slidable along the well conduit in both longitudinal directions; means engaging said slip behind said drag portion urging said drag portion into engagement with the inner surface of the wall of the conduit and said gripping portion inwardly away from the conduit wall; and means on said body engaging said slip to move the slip to bring the gripping

portion into engagement with the surface of the inner wall of the well conduit against the force of said urging means.

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