Oct. 1, 1963 G. M. RAULINS 3,105,556

ANCHORING AND SEALING DEVICES

Filed May 28, 1959 2 Sheets-Sheet 1

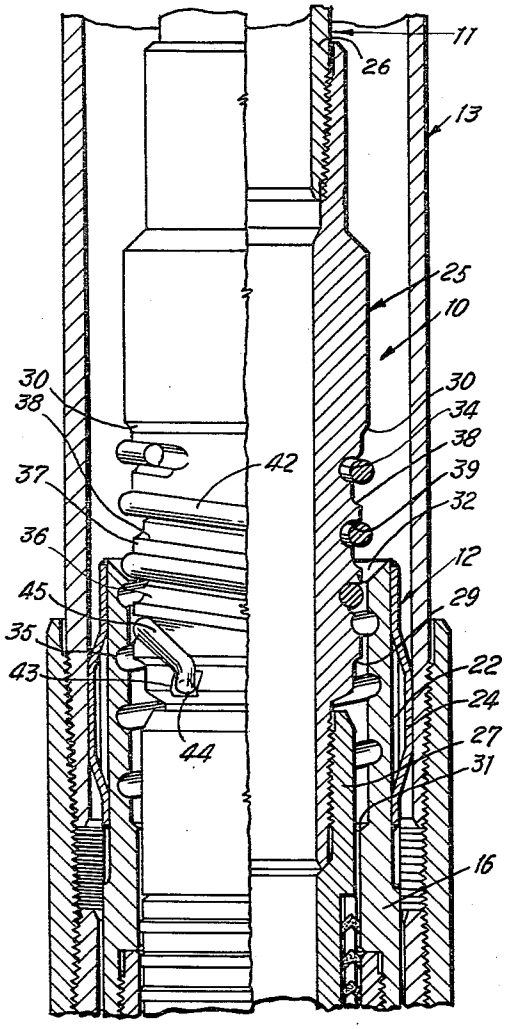


Fig.1

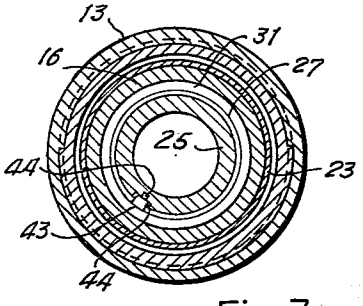


Fig.3

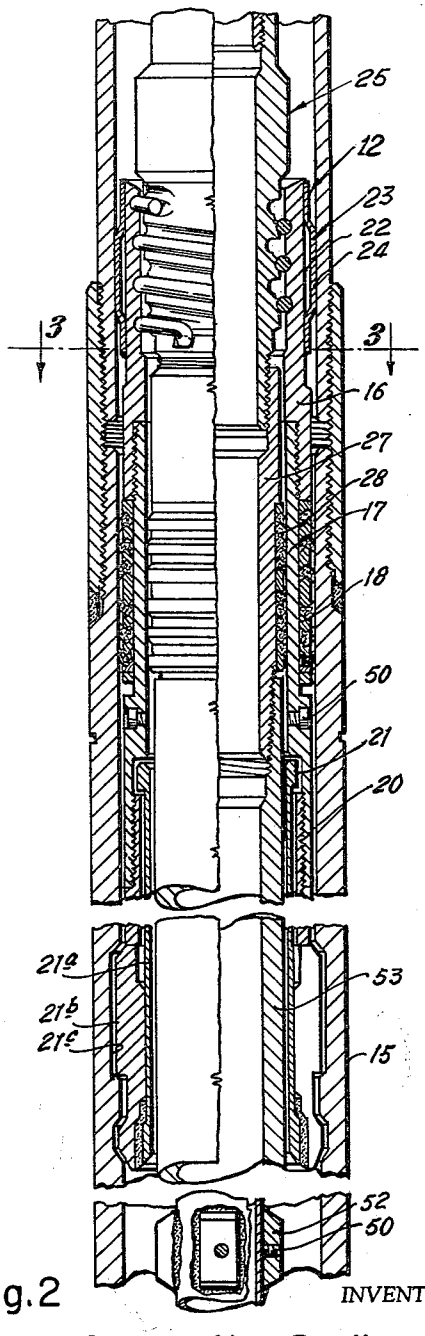


Fig.2

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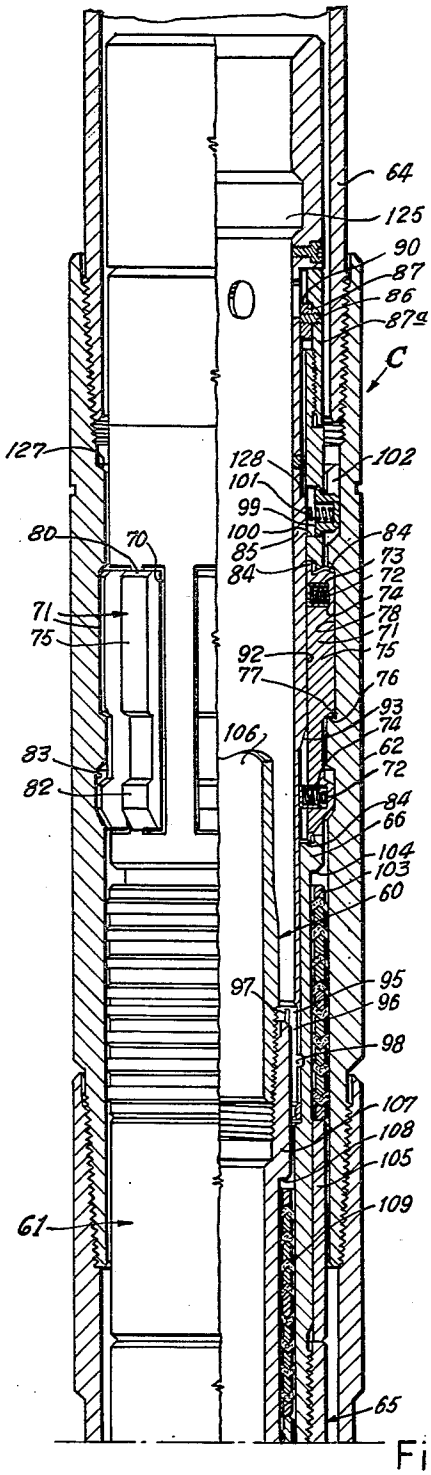


Fig. 5

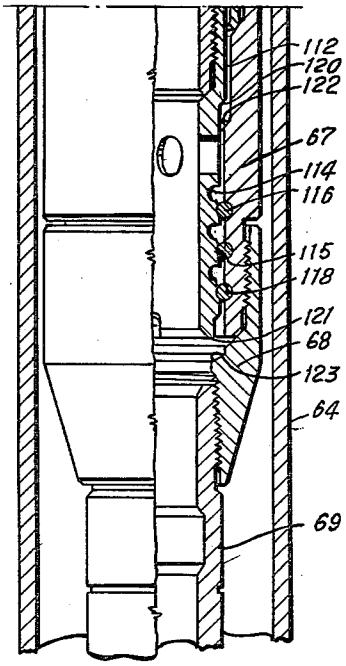


Fig. 6

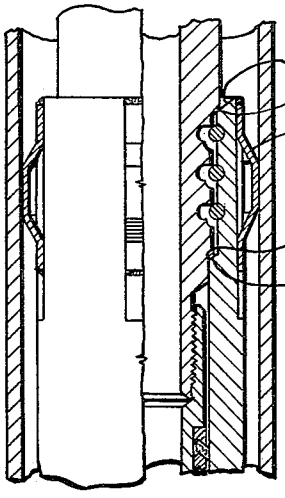


Fig. 4

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3,105,556

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3,105,556

ANCHORING AND SEALING DEVICES

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Filed May 28, 1959, Ser. No. 816,567
15 Claims. (Cl. 166—214)

This invention relates to connecting or anchoring devices for well tools and more particularly to an anchoring device for releasably securing one body in a bore of another body.

An object of the invention is to provide new and improved anchoring means for releasably securing well tools in the bores of sub bodies or packer bodies, tubing strings, and other well tools.

Another object is to provide an anchoring means for releasably securing well tools against both upward and downward displacement in the bores of such bodies.

Still another object is to provide an anchoring means for releasably securing one well tool in another well tool by longitudinal movement of one well tool into the other to a predetermined locking position from which it can be released only by rotation of one well tool relative to the other.

A further object of the invention is to provide a new and improved anchoring means for well tools installable in a bore of a well tool body which does not permit appreciable relative movement between the two well tools until they are disconnected from one another.

A still further object of the invention is to provide an anchoring means for a well tool receivable in the bore of a well tool body which includes alignable helical grooves in the well tool and in the well tool body and a resilient spring, which, when the tool bodies have once been aligned, prevent longitudinal movement between the well tool and the well tool body except upon rotational movement in a predetermined direction therebetween.

Another object is to provide an anchoring device wherein the well tool is provided with a pair of helical grooves, one helical groove extending deeply into the outer surface of the well tool and being disposed above and in communication with the other shallow helical groove to permit the resilient spring to move into the deep groove upon meeting upwardly facing obstructions to permit downward movement of the anchoring well tool past such upwardly facing obstructions.

Still another object is to provide an anchoring means for well tools of the type described wherein coengageable means are provided on the anchoring means in the well tool body to stop longitudinal movement of the anchoring means when the deep or retractor helical groove or recess is aligned with the helical lock groove of the well tool body to permit the resilient helical lock member to move outwardly into the helical lock groove of the well tool body whereupon further upward movement brings the shallow lock groove of the anchoring device into alignment with the lock groove of the well tool body to limit further upward movement of the anchoring means through the well tool body.

Another object is to provide an anchoring device for releasably securing one body in a bore of another body.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of devices constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

FIGURE 1 is a view, partly in elevation and partly in section, of a well flow conductor provided with an anchoring device embodying the invention showing the anchoring device as it appears while being lowered into the bore of another well tool locked in a well flow conductor or tubular string;

FIGURE 2 is a view similar to FIGURE 1 and shows the anchoring device in operative position in the bore of the well tool preventing upward movement of the well flow conductor in the bore of the well tool;

FIGURE 3 is a sectional view taken on line 3—3 of FIGURE 2;

FIGURE 4 is a view similar to FIGURES 1 and 2 and shows the anchoring device in its lowermost position in the bore of the well tool and with the helical locking member aligned with and received in the lock groove of the well tool;

FIGURE 5 is a vertical view, partly in elevation and partly in section, of the upper portions of an anchoring device locked in a supporting and sealing well tool of the tubing string; and,

FIGURE 6 is a view similar to FIGURE 5, being a continuation thereof, and showing the lower portions of the anchoring device and the well tool.

Referring now particularly to FIGURES 1 through 4 of the drawings, the anchoring device **10** embodying the invention is shown connected in and forming a part of a well flow conductor or flow string **11** which is releasably connectable in a supporting assembly **12** mounted in a casing string **13**. The supporting assembly **12** may be of the type disclosed in the co-pending application of Raulins et al., No. 636,320, now Patent No. 2,948,338, by means of which the supporting assembly is held against longitudinal movement in the casing string **13**.

The supporting assembly includes an upper supporting section **16** to whose lower end is secured a packing mandrel section **17** on which is disposed a packing assembly **18**. A retaining and supporting housing **20** is secured to the packing mandrel section to hold a collet **21** for limited longitudinal movement relative to the packing mandrel section. The collet has dependent fingers **21***a* having lugs which have bosses **21***b* for entry into suitable recesses **21***c* of the landing nipple **15** to locate and lock the supporting assembly in the casing string **13** as is more fully set forth in the co-pending application of Raulins et al.

The upper supporting section **16** is provided with longitudinal slots **22** in which are secured leaf springs **23**. Opposite end portions of the leaf springs are disposed in the slots **22** and are rigidly secured thereto by any suitable means, such as welds. Intermediate portions **24** of the springs extend outwardly of the grooves **22** and of the outer surface of the supporting section **16** to engage the internal wall surfaces of the casing string **13** to prevent rotation of the supporting means **12** in the tubing string.

The anchoring device **10** includes a tubular hold down body **25** which is threadedly connected in and forms a part of the well flow conductor of flow string **11**, its upper end being connected to a pipe section **26** while its lower end is connected to a packer mandrel **27** about which is disposed a packing assembly **28** to seal between the packer mandrel **17** of the supporting means and the packing mandrel section **27** of the pipe string. The hold down body has lower and upper downwardly facing external shoulders **29** and **30** which are adapted to engage the lower and upper upwardly facing shoulders **31** and **32**, respectively, of the supporting section **16** to limit downward movement of the hold down body in the supporting section. The hold down body is provided intermediate its downwardly facing shoulders with a deep helical groove **34** which, when the hold down body is disposed in the supporting section with the downwardly facing shoulders of the hold down body abutting the upwardly facing shoulders of the supporting section, is aligned with an

internal helical lock groove 35 of the supporting section 16 located between the upwardly facing shoulders thereof as illustrated in FIGURE 4. A similar helical shallow groove 36 is provided on the hold down body immediately below the deep groove, each turn of the shallow groove being disposed immediately below and communicating with a turn of the deep groove. Each turn of the shallow groove is spaced from each turn of the deep groove immediately below it so that a helical shoulder 37 is formed therebetween whose upper helical arcuate surface 38 defines lower portion of each turn of the shallow groove and a lower surface 39 which defines an upper portion of each turn of the deep groove.

A resilient helical lock member or spring 42 of such dimensions that its normal position is in alignment with the shallow grooves 36 is disposed about the hold down body and in the grooves and has a lower reduced portion 43 which extends downwardly into an upwardly opening slot 44 of the tubular hold down body. The slot extends through the lower portion of the helical shoulder and the inwardly angularly extending end portion 45 of the lock member at the lower reduced portion 43 thereof extends into a suitable bore which opens outwardly into the slot 44 of the hold down body. The exterior surface of the lower reduced portion 43 does not extend beyond the outer surface of the helical shoulder 37 and therefore does not at any time engage the supporting section 16. The lower end portion 45 secures the lower end of the locking member to the hold down body.

The deep helical groove of the hold down body is sufficiently long to accommodate the helical locking member when it is moved to the upper position illustrated in FIGURE 1 so that the upper end of the helical locking member is never forced or displaced out of the grooves.

When it is desired to lock a well tool such as the well flow conductor or pipe string 11 in the casing string 13, the supporting means is releasably secured to the pipe string 11 in the lower position relative to the hold down body by any suitable means; for example, by the shear screws 50 which extend into suitable bores of lugs 52 of the supporting means, as is illustrated in the co-pending application, Serial No. 636,320, of Raulins et al. The hold down body is now spaced above the upper end of the upper supporting section 16 with the helical lock member disposed in the shallow groove 36 since its inherent configuration conforms to the shallow helical groove. Outer portions of the lock member then extend outwardly of the hold down body.

The assembly of the supporting means 12 and the flow string 11 is then moved downwardly through the casing string 13 until the collet locking means of the supporting means engage in a suitable recess of the landing nipple 15 constituting a portion of the casing string whereupon further downward movement of the supporting means is arrested as is more fully explained in the co-pending application of Raulins et al., Serial No. 636,320, now Patent No. 2,948,338. Further downward movement of the well flow conductor or flow string 11 then causes the shear screw 50 to shear to permit downward movement of the flow string through the supporting means. Such further downward movement first causes a locking sleeve of the flow string, such as the locking sleeve 53 which is more fully described in the co-pending Raulins et al. application, to engage the collet locking means to hold them in engagement with the landing nipple. Continued downward movement of the flow string then causes the hold down body 25 to telescope downwardly into the supporting section 16 until the downwardly facing shoulders 29 and 30 thereof abut the upwardly facing shoulders 31 and 32 of the supporting section to arrest further downward movement. During such downward movement of the hold down body into the supporting section, the helical lock member is initially prevented from moving with the hold down body due to the engagement of the outwardly projecting portions thereof with the upper inwardly beveled end shoulder 32 of the supporting section until the hold down body moves downwardly relative to each coil of the locking member to position such coils in alignment with the deep groove 34. The camming engagement of the inwardly beveled end shoulder as it engages each coil moves the coils inwardly into the deep groove and thus causes the locking member to permit downward longitudinal non-rotational movement of the hold down body into the supporting section. When the hold down body is positioned in its lowermost position in the support section 16 as illustrated in FIGURE 4, the deep helical groove is aligned with the internal helical groove 35 of the support section and, since its inherent position is one outwardly of the deep groove 34, the resilient helical locking member moves outwardly into the internal groove, the depth of the internal groove being somewhat less than half the diameter of the locking member.

If an upwardly acting force is now exerted on the pipe string 11 it may move upwardly a limited distance to the position illustrated in FIGURE 2 until the upward arcuate helical surface 38 of the helical flange 37 engages the lower portions of the locking member which extend inwardly of the internal groove. Further upward movement of the hold down body 25 and of the flow string 11 is then prevented by the engagement of the locking member in the shallow groove of the hold down body and in the internal groove of the support section 16 of the supporting means 12. The flow string is then held against longitudinal displacement in the supporting means 12 in either direction and since the collet locking means of the supporting means are now locked in expanded positions in engagement with the landing nipple 15 of the casing string, the flow string and the supporting means 12 are held against longitudinal displacement in the casing string 13.

If it should now be desired to remove the flow string 11 from the supporting means 12, the flow string 11 is rotated in a clockwise manner, as seen from above, and the body is in effect screwed out of the upper supporting section, the outwardly extending portions of the helical locking member acting as screw threads. During such rotation of the flow string and therefore of the hold down body, the helical locking member is held against rotational movement with respect thereto since the inturned end 44 prevents such rotational movement about the hold down body. The supporting section, of course, is held against rotation in the tubing string due to the engagement of the leaf springs 23 with the internal surfaces of the tubing string 13. When the hold down body has been screwed out of the upper supporting section 16 the flow string may be removed upwardly from the tubing string.

Should it thereafter be desired to remove the supporting section, a suitable running tool may be lowered into the tubing string to engage the helical grooves 35 or some other downwardly facing obstruction of the supporting means 12 to pull the supporting section upwardly relative to the collet means and thus move the locking sleeve out of engagement with the locking means of the collet to free the collet locking means for movement out of engagement with the landing nipple and thus permit upward removal of the supporting means.

It will now be seen that a new and improved hold down or anchoring device has been illustrated and described which includes a hold down body provided with a pair of aligned communicating helical grooves, one being disposed above the other and the upper extending more deeply from the outer surface of the tubular hold down body, which grooves are alignable individually with an internal helical groove of similar pitch and configuration of a tubular body in which the hold down body may telescope.

It will further be seen that the hold down body is provided with a resilient helical locking member, one of whose ends is secured to the hold down body against

movement relative thereto, and that the resilient inherent characteristics of the lock member are such as to cause it to be disposed in the shallow lower groove when free to do so, the coils of the lock member upon engaging upwardly facing obstructions being movable upwardly and then inwardly into the upper deep helical groove where their outer surfaces do not extend outwardly of the outer surface of the hold down body to free the hold down body for downward movement into the tubular body provided with the internal helical groove.

It will further be seen that upon such movement into the tubular body to a position wherein the upper deep groove is aligned with the internal helical groove of the tubular body, the coils of the lock member will extend outwardly into such internal groove whereupon subsequent upward movement of the hold down body causes the shallow groove to be aligned with the coils of the helical locking member which are then partially disposed in the internal groove and partially in the shallow groove to prevent upward movement of the hold down body relative to the tubular member.

It will further be seen that the hold down body may be disengaged from the tubular body upon rotational movement therebetween to cause the lock member to act as a screw thread in the internal groove to cause longitudinal movement therebetween and to free the hold down body from the tubular body.

It will further be seen that should it at any time become desirable to reinstall the flow string **11** while the supporting means is still disposed in the tubing string and in engagement with the landing nipple, the flow string **11** may again be lowered into the tubing string **13** until the hold down body again telescopes in the manner described above into the supporting section **16** and then when the helical lock member is again engaged both in the shallow groove of the hold down body and in the internal groove of the supporting section the flow string will again be anchored against iongitudinal non-rotational movement in either direction relative to the supporting means.

It will further be seen that a new and improved anchoring device has been illustrated and described which may be used to secure a well tool in a tubular body, such as the upper supporting section **16**, against non-rotational longitudinal movement in one direction relative thereto.

It will further be seen that such hold down body or well tool may be moved into such tubular body longitudinally and non-rotationally to a locking position therein.

It will further be seen that such well tool may be disengaged in the one direction from the supporting section from the tubular body upon relative rotational movement therebetween.

It will further be seen that a new and improved supporting means or well packer **12** has been illustrated and described in which a flow string may be removably installed and which has means engageable with the hold down body of the flow string for releasably securing the flow string in the well packer.

It will now be seen that a well packer **12** and flow string **11** have been illustrated and described which have coengageable means for releasably securing the flow string against longitudinal movement in the well packer and wherein the well packer and the flow string are provided with sealing means whereby all fluid flow through the well flow conductor in which the well packer and tubing string are installed can take place only through the flow string.

It will further be seen that the well packer is provided with locating and locking means for locating and locking the well packer in a predetermined position in a well flow conductor such as a casing string.

It will further be seen that the supporting means or well packer is provided with means engageable with the well flow conductor in which it is disposed for preventing

rotational movement of the well packer in such well flow conductor.

The modified anchoring device **50** of FIGURES 5 and 6 releasably secures a flow string **60** in a well packer **61**. The well packer is releasably locked in a landing nipple **62** of a casing string C, the casing string including the usual sections **64** which are threadedly connected at adjacent ends, the landing nipple being connected between two adjacent sections and forming part of the casing string. The well packer or supporting means **61** includes an elongate tubular body or mandrel **65** having a key retainer and packer section **66**, a supporting section **67** threaded on the lower end of the key retainer section, and a connector sub **68** which connects the lower end of the supporting section with a landing nipple **69**, a flow conductor, or any other well tool as may be desired.

The retainer and packer section **66** has a plurality of longitudinal slots **70** through which extend the selector keys **71** which are biased outwardly by springs **72** bearing against internal surfaces of the keys and of the caps **73** slidably disposed in the internal recesses **74** of the keys. The keys have selector bosses **75** which provide abrupt downwardly facing shoulders **76** adapted to engage the upwardly facing shoulders **77** provided by the internal selector recess **78** of the landing nipple **62**. The upper shoulders **80** of the selector bosses of the keys are beveled inwardly and upwardly so that the keys may be biased inwardly upon meeting downwardly facing obstructions in the tubing string during upward removal of the well packer through the tubing string. The keys **71** are also provided with guide bosses **82** having outwardly convergent upper and lower shoulders and receivable in a guide recess **83** of the landing nipple located below the locking recess **78**. Upper and lower extensions **84** of the keys are adapted to engage the retainer and packer section above and below the slots **70** to limit outward movement of the keys.

A locking sleeve **85** is telescoped into the key retainer and packer section **66** and is initially held in an upper position by means of a shear screw **86** which extends through aligned apertures in a retainer ring **87***a* threaded on the upper end of the retainer and packer section, a stop ring **87** and the locking sleeve. The stop ring is disposed between the upper end of the retainer and packer section and the downwardly facing shoulder **90** provided on the upper end of the rtainer ring.

The external locking surface **92** of the locking sleeve is adapted to abut the internal surfaces of the keys, when the keys are in their expanded positions and when the locking sleeve is in its lowermost position relative to the retainer and packer section, to lock the keys against inward movement from their expanded locking positions. The upwardly and outwardly extending cam shoulder **93** of the locking sleeve below the locking surface is disposed above the keys when the locking sleeve is in its uppermost position in the retainer and packer section, the annular cam shoulder facilitating the downward passage of the lock sleeve towards locking position and camming the keys outwardly if they are not at that time in their fully expanded positions. The lower end portion of the locking sleeve is provided with an internal recess **95** which reduces the thickness of the resilient strips **96** formed in the lower portion of the lock sleeve by longitudinal slots **97**. The resilient strips **96** are provided with external bosses **98** which are adapted to be received in an internal latch recess of the retainer and packer section **66** of the mandrel to releasably hold the lock sleeve in the lower operative position illustrated in FIGURES 5 and 6 wherein the locking sleeve holds the keys **71** in their expanded positions.

A detent **99** is disposed in an aperture **100** of the retainer and packer section above the slots **70** and is biased outwardly by a spring **101**. Outward movement of the detent is limited by the engagement of its end flanges with internal stop shoulders provided in the retainer and

packer section adjacent the aperture. The detent is receivable in an upwardly opening slot 102 of the landing nipple to prevent rotational movement of the mandrel 65 in the landing nipple.

A packer assembly 103 is disposed about the retainer and packer section below a downwardly facing annular shoulder 104 thereof which limits upward movement of the packer assembly on the key retainer section. Downward movement of the packer assembly is limited by the upper end of a spacer sleeve 105 disposed about the retainer and packer section the lower end of the spacer sleeve abutting the upper end of the supporting section 67. The packer assembly 103 is adapted to seal between the landing nipple 62 and the mandrel 65.

The flow string 60 is composed of the usual tubing or pipe sections 106, the lowermost of which has a packer mandrel 107 secured to its lower end. The packer mandrel is provided with a downwardly facing annular shoulder 108 intermediate its ends which limits upward movement of a packer assembly 109 disposed on the packer mandrel. Downward movement of packer assembly 109 is limited by the upper end of the hold down body 112 threaded on the lower end of the packer mandrel. The packer assembly seals between the retainer and packer section 66 and the packer mandrel when the flow strong is operatively positioned in the well packer.

The hold down body 112 is similar to the hold down body 25 illustrated in FIGURES 1 and 2 and is provided with an upper deep helical groove 114 and a shallow helical groove 115 disposed below and communicating with the deep helical groove. A lock member 116 is secured to the hold down body, in the same manner as is the lock member 42 illustrated in FIGURES 1 and 2 and is adapted to be received in the internal helical recess 118 of the supporting section 67. The hold down body is provided with a pair of downwardly facing shoulders 120 which abut the upwardly facing shoulders 122 and 123, respectively of the supporting section 67 and the connecting sub 68, to limit downward movement of the hold down body in the packer mandrel 65 when the deep helical groove 114 is aligned with the internal helical recess of the supporting section 67.

In use, when it is desired to position the supporting means or well packer 61 and the flow string 60 in the casing string C, the well packer is in the well casing string C by lowering it downwardly into the casing string by means of a running tool, which may engage in the internal recess 125 of the locking sleeve, while the locking sleeve is held in an upper position on the mandrel 65 by means of the shear screw 86. The annular downwardly facing shoulder 93 of the locking sleeve is then positioned above the upper ends of the keys 71 and the keys therefore are free to move inwardly against the resistance of the springs 72 upon meeting upwardly facing obstructions of the tubing string. The upwardly and outwardly beveled lower shoulders of the guide bosses 82 of the keys hold the keys in inner retracted positions to permit the downwardly facing shoulders 76 thereof to move past such upwardly facing obstructions.

The detent 99 is similarly cammed inwardly upon meeting downwardly facing obstructions due to the provision of the outwardly and upwardly extending camming shoulder at its outer end. When the detent comes into contact with the upwardly facing annular shoulder 127 of the landing nipple, rotational movement is imparted to the mandrel by means of the running tool until the detent moves into alignment with the upwardly opening internal slot 102 of the landing nipple whereupon the detent moves into the slot and continued further downward movement of a packer into the landing nipple can take place. The lower shoulder defining the slot 102 has an inwardly and downwardly extending lower shoulder which cams the detent inwardly if the landing nipple does not have a selector recess of the same configuration as the selector bosses of the keys in order to permit further downward movement of the well packer through such non-selected landing nipple. The detent prevents rotational movement of the well packer in the landing nipple.

When the well packer enters into the landing nipple 62 having the selector recess 78 of the same dimensions or configuration as the selector bosses 75 of the keys, the keys move outwardly into the selector recess and thereupon the engagement of their downwardly facing shoulders 76 with the upwardly facing shoulders 77 of the lock recess prevents further downward movement of the mandrel 65 through the landing nipple.

Downward jars are then imparted to the upper end of the locking sleeve by means of the running tool to cause it to move downwardly in the mandrel 65 whereby its locking surface 92 moves inwardly of the keys to hold them in their outer expanded positions, the shear screw 86 shearing to permit such downward movement of the locking sleeve.

When the locking sleeve is moved downwardly to the locking position as illustrated in FIGURE 5, the external bosses 98 of the resilient strips 96 enter into the internal latch recess of the retainer and packer section of the packer mandrel and latch the locking sleeve in its lower position against accidental displacement therefrom.

The flow string 60 is then lowered into the casing string. During such downward movement of the flow string, the helical lock member 116 of the hold down body is moved upwardly into alignment with the deep grooves 114 whenever outer portions thereof engage any upwardly facing obstructions of the tubing string or of the well packer until downward movement of the flow string is stopped by the engagement of the downwardly facing sholders 120 and 121 of the hold down body with the upwardly facing shoulders 122 and 123, respectively, of the supporting section and of the connecting sub. At this time the hold down body is so positioned in the supporting section of the mandrel that the deep helical groove 114 is aligned with the internal helical groove of the support section whereby the helical locking member enters into the internal helical groove of the supporting section. Any upward movement of the flow string and of the hold down body then causes the lower surface of the shallow groove 115 to enter into engagement with the helical lock member while the latter is positioned in the internal groove of the supporting section and thus limits further upward movement of the hold down body and therefore of the flow string in the supporting section. The packing assembly 109 then seals between the packer mandrel 107 of the flow string and the mandrel 65 of the supporting means 62 so that all fluid flow through the casing string must take place through the bore of the flow string.

When it is desired to remove the flow string from the tubing string, the flow string is rotated in a clockwise manner, as viewed from above, to cause the helical member to unscrew from the internal groove of the supporting section and thus free the flow string for upward movement from the packer mandrel. If it is desired thereafter to remove the well packer itself from the casing string, a suitable running tool is lowered into the casing string to engage in the annular recess 125 of the locking sleeve whereupon an upward force exerted on the locking sleeve through the running tool causes the locking sleeve to move upwardly in the mandrel 65, the flexible strips 96 flexing inwardly to permit the bosses 98 thereto to move out of the latch recess of the retainer and packer section 66 of the mandrel 65. The locking sleeve then continues to move upwardly in the mandrel 65 until its upwardly facing shoulder 128 engages the stop ring 87 whereupon further continued upward movement of the locking sleeve causes the mandrel 65 to move upwardly also. Such upward movement can take place since the upper downwardly and outwardly extending shoulders 80 of the keys and the similar downwardly and outwardly extending

upper shoulders of the guide bosses 82 cam the keys inwardly upon engaging downwardly facing obstructions, such as the upper shoulders of the selector and guide grooves 78 and 83.

It will now be seen that in both of the illustrated devices a flow string 11 or 106 has been provided with a hold down body to enable it to be locked against non-rotational longitudinal movement out of a tubular body, such as the well packers 12 and 60 illustrated in the drawings.

It will further be seen that the well packers are provided with means for preventing rotation of the well packers in the casing strings in which they are disposed and with packing or sealing means for sealing between the packer mandrel and the casing string.

It will also further be seen that each of these packer mandrels is provided with a supporting section having an internal helical groove alignable with a shallow groove and a deep groove of the hold down body and that the helical resilient lock member is adapted to enter into the internal groove of the supporting section to prevent upward movement of the hold down body, and therefore of the flow string of which it is a part, relative to the well packer and therefore relative to the casing string.

It will further be seen that the lock member is resilient and has an external inherent diameter which is substantially equal to the largest diameter of the internal lock recess of the supporting section whereby it will move resiliently outwardly into such internal lock groove when aligned therewith.

It will further be seen that the lock member is deformable inwardly and upwardly into the deep groove of the hold down body when its outwardly projecting portions engage upwardly facing obstructions of the casing string or of the well packers during its downward movement therethrough whereby the helical member is moved into retracted position in the deep or retracted groove to permit downward movement of the hold down body through the bore of a body, such as the supporting section 16 and 67, whose internal diameters are smaller than the inherent external outer diameter of the helical lock member.

It will further be seen that the hold down body may then be removed from such supporting section or body only by imparting rotational movement thereto to cause the lock member to unscrew from the internal helical recess of the supporting section or body.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A well tool comprising: an elongate tubular member; locking means on said tubular member and having outwardly projecting boss means disposed below the lower end of the tubular member and adapted to move laterally between retracted and projecting positions to extend outwardly of the tubular member; a body insertable into the upper end of and movable longitudinally into the tubular member to a position to engage and hold the locking means with the boss means in projecting positions; cooperating sealing means on the tubular member and the body for sealing therebetween; means on the tubular member and the body engageable with each other for limiting movement of the body longitudinally into said tubular member, whereby the body is positioned in the tubular member to engage and hold the locking means in projecting position and the sealing means is positioned to seal between the body and the tubular member; and cooperating lock means on the tubular member and the body for preventing non-rotational movement of the body out of the tubular member and permitting rotational movement of the body out of said tubular member.

2. A well tool comprising: an elongate tubular member; locking means on said tubular member and having outwardly projecting boss means disposed below the lower end of the tubular member and adapted to move laterally between retracted and projecting positions to extend outwardly of tubular member; a body insertable into the upper end of and movable longitudinally into the tubular member to a position to engage and hold the locking means with the boss means in projecting positions; cooperating sealing means on the tubular member and the body for sealing therebetween; means on the tubular member and the body engageable with each other for limiting movement of the body longitudinally into said tubular member, whereby the body is positioned in the tubular member to engage and hold the locking means in projecting position and the sealing means is positioned to seal between the sleeve and the tubular member; and cooperating lock means on the tubular member and the body for preventing non-rotational movement of the body out of the tubular member, said cooperating means comprising an internal helical groove provided in the tubular member, a complementary external helical groove formed on the body and a helical lock member connected to and movably disposed in the groove of the body and resiliently movable to a position in both of the grooves when said grooves are aligned to prevent non-rotational movement of the body out of the tubular member, said helical lock member being movable in said internal helical groove upon rotation of the body to permit simultaneously rotational and longitudinal movement of the body out of the tubular member.

3. A well tool including: an elongate tubular member positionable in a well flow conductor; means carried by said tubular member and engageable with the well flow conductor for locking the tubular member to limit downward movement of the tubular member in the well flow conductor; and a body insertable into and movable longitudinally downwardly in the tubular member, said body and the tubular member having cooperating means for limiting downward movement of the body in the tubular member, the tubular member and the body having coengageable means permitting upward rotational longitudinal movement of the body from the tubular member and preventing upward non-rotational longitudinal movement of the body from the tubular member, said means including: an external helical groove on said body; an internal helical groove in said tubular member; and an elongate helical resilient lock member secured at one end to said body and having its coils movably disposed loosely longitudinally in the external recess of said body, said lock member having an inherent external diameter substantially equal to the diameter of the internal recess of said tubular member and normally having a longitudinal portion projecting from said external recess, said lock member being engageable in both said external recess of said body and said internal recess of said tubular member to prevent upward non-rotational longitudinal movement of the body from the tubular member.

4. A well tool including: an elongate tubular member positionable in the well flow conductor; means engageable with the well flow conductor for locking the tubular member to limit downward movement of the tubular member in the well flow conductor; and a body insertable into and movable longitudinally downwardly in the tubular member, said body and the tubular member having cooperating means for limiting downward movement of the body in the tubular member, the tubular member and the body having coengageable means preventing upward non-rotational longitudinal movement of the body from the tubular member, said coengageable means including an internal groove provided in the tubular member, an external helical groove provided in the body and a helical lock member connected at one end to the body and extending loosely longitudinally of said external helical groove of said body, said lock member being resiliently movable to

a position in engagement with both said external groove of said body and said internal helical groove of said tubular member when said grooves are aligned to prevent non-rotational movement of the body out of the tubular member.

5. A well tool including: an elongate tubular member; a plurality of resilient depending fingers on the tubular member projecting therebelow to a position below the lower end of said tubular member; a locking and supporting member on the lower end of each of said fingers and disposed below the lower end of said tubular member, said locking and supporting members each having an outwardly projecting boss thereon adapted to engage a well casing to limit movement of said tubular member in said casing; an upwardly facing stop shoulder on said tubular member; and a locking and sealing assembly including a stop member and a locking sleeve insertable into and movable longitudinally downwardly in said tubular member, said stop member engaging said stop shoulder on said tubular member to limit downward movement of said assembly in said tubular member and to dispose said locking sleeve in a position to be engaged by said locking members to prevent inwardly retracting movement to said locking members, said locking and sealing assembly and said tubular member having co-engageable means for preventing longitudinal non-rotational movement of the locking and sealing assembly upwardly out of said tubular member while permitting longitudinal non-rotational movement of said locking and sealing assembly downwardly into the tubular member and to permit movement of the locking and sealing assembly upwardly out of the tubular member upon rotation of the locking and sealing assembly relative to the tubular member.

6. A well tool including: an elongate tubular member; locking means carried by said tubular member and having outwardly projecting boss means adapted to move laterally between retracted and projecting positions to extend outwardly of said tubular member; lock means insertable into the upper end of and movable longitudinally into said tubular member to a position to engage and hold said locking means with the boss means in projecting positions; a body insertable into the upper end of and movable longitudinally into said tubular member; cooperating stop means on said tubular member and said body for limiting downward longitudinal movement of the body in said tubular member; and coengageable means on said tubular member and said body for preventing non-rotational upward longitudinal movement of the body in said tubular member, said coengageable means permitting upward longitudinal movement of the body in said tubular member upon rotation of said body relative to said tubular member.

7. A well tool including: an elongate tubular member; a plurality of resilient depending fingers on the tubular member projecting therebelow to a position below the lower end of said tubular member; a locking and supporting member on the lower end of each of said fingers and disposed below the lower end of said tubular member, said locking and supporting members each having an outwardly projecting boss thereon adapted to engage a well casing to limit movement of said tubular member in said casing; an upwardly facing stop shoulder on said tubular member; and a locking and sealing assembly including a stop member and a locking sleeve insertable into and movable longitudinally downwardly in said tubular member, said stop member engaging said stop shoulder on said tubular member to limit downward movement of said assembly in said tubular member and to dispose said locking sleeve in a position to be engaged by said locking members to prevent inwardly retracting movement of said locking members, said locking and sealing assembly and said tubular member having co-engageable means for preventing longitudinal non-rotational movement of the locking and sealing assembly upwardly out of said tubular member while permitting longitudinal non-rotational movement of said locking and sealing assembly downwardly into the tubular member, said coengageable means permitting longitudinal rotational movement of the locking and sealing assembly upwardly out of said tubular member; said coengageable means including an internal groove provided in the tubular member, an external helical groove provided in the locking sleeve and a helical lock member connected to the locking sleeve and resilently movable to a position in the grooves when said grooves are aligned to prevent non-rotational movement of the sleeve out of the tubular member and to permit movement of the sleeve out of the tubular member upon rotation of the sleeve.

8. A well tool including: an elongate tubular member; locking means carried by the tubular member and having outwardly projecting boss means adapted to move laterally between retracted and projecting positions to extend outwardly of said tubular member; lock means insertable into the upper end of and movable longitudinally into the tubular member to a position to engage and hold the locking means with the boss means in projecting positions; a body insertable through said lock means into the upper end of and movable longitudinally into the tubular member; cooperating stop means on the tubular member and the body for limiting downward longitudinal movement of the body in the tubular member; and coengageable means on the tubular member and the body for preventing non-rotational upward longitudinal movement of the body from the tubular member, said co-engageable means comprising an external helical recess provided on the body, a resilient helical lock member connected to the body having an inherent outer diameter greater than the internal diameter of the tubular member, the body being provided with a recess means permitting inward movement of the helical lock member to retracted position upon encountering obstructions during downward movement of the body in the tubular member, the tubular member having an internal recess, the lock member having portions extending into said internal recess of the tubular member to limit non-rotational upward movement of the body from the tubular member, said lock member permitting upward movement from the tubular member upon rotation of the body relative to the tubular member.

9. A well tool including: an elongate tubular member; locking means carried by the tubular member and having outwardly projecting boss means adapted to move laterally between retracted and projecting positions to extend outwardly of said tubular member; lock means insertable into the upper end of and movable longitudinally into the tubular member to a position to engage and hold the locking means with the boss means in projecting positions; a body insertable through said lock means into the upper end of and movable longitudinally into the tubular member; cooperating stop means on the tubular member and the body for limiting downward longitudinal movement of the body in the tubular member; and coengageable means on the tubular member and the body for preventing non-rotational upward longitudinal movement of the body from the tubular member, said co-engageable means comprising an external helical recess provided on the body, a resilient helical lock member connected to the body having an inherent outer diameter greater than the internal diameter of the tubular member, the body being provided with a recess means permitting inward movement of the helical lock member to retracted position upon encountering obstructions during downward movement of the body in the tubular member, the tubular member having an internal recess, the lock member having portions extending into said internal recess of the tubular member to limit non-rotational upward movement of the body from the tubular member, said recess means in said internal recess being helical and alignable when the cooperating means stops downward longitudinal movement of the body into the tubular member.

10. A well tool including: an elongate tubular member; locking means carried by the tubular member and having outwardly projecting boss means adapted to move laterally between retracted and projecting positions to extend outwardly of said tubular member; lock means insertable into the upper end of and movable longitudinally into the tubular member to a position to engage and hold the locking means with the boss means in projecting positions; a body insertable through said lock means into the upper end of and movable longitudinally into the tubular member; cooperating stop means on the tubular member and the body for limiting downward longitudinal movement of the body in the tubular member; and coengageable means on the tubular member and the body for preventing non-rotational upward longitudinal movement of the body from the tubular member, said co-engageable means comprising an external helical recess provided on the body, a resilient helical lock member connected at one end to the body having an inherent outer diameter greater than the internal diameter of the tubular member, the body being provided with a recess means permitting inward movement of the helical lock member to retracted position upon encountering obstructions during downward movement of the body in the tubular member, the tubular member having an internal recess, the lock member having portions extending into said internal recess of the tubular member to limit non-rotational upward movement of the body from the tubular member, said lock member permitting upward movement of the body from the tubular member upon rotation of the body relative to the tubular member, the lock member having one end secured to the body, the other end of said lock member being free to move in said recess means.

11. A well tool including: an elongate tubular member; locking means carried by the tubular member and having outwardly projecting boss means adapted to move laterally between retracted and projecting positions to extend outwardly of said tubular member; lock means insertable into the upper end of and movable longitudinally into the tubular member to a position to engage and hold the locking means with the boss means in projecting positions; a body insertable through said lock means into the upper end of and movable longitudinally into the tubular member; cooperating stop means on the tubular member and the body for limiting downward longitudinal movement of the body in the tubular member; and coengageable means on the tubular member and the body for preventing non-rotational upward longitudinal movement of the body from the tubular member, said coengageable means comprising an external helical recess provided on the body, a resilient helical lock member connected to the body having an inherent outer diameter greater than the internal diameter of the tubular member, the body being provided with a recess means permitting inward movement of the helical lock member to retracted position upon encountering obstructions during downward movement of the body in the tubular member, the tubular member having an internal recess, the lock member having portions extending into said internal recess of the tubular member to limit non-rotational upward movement of the body from the tubular member, said lock member permitting upward movement of the body from the tubular member upon rotation of the body relative to the tubular member, the lock member having one end secured to the body, the other end of said lock member being free to move in said recess means, said internal recess being helical and alignable with said external recess when the cooperating means stops downward longitudinal movement of the body in the tubular member.

12. A well tool including: an elongate tubular member; locking means carried by said tubular member and having outwardly projecting boss means adapted to move laterally between retracted and projecting positions to extend outwardly of said tubular member; lock means insertable into the upper end of and movable longitudinally into said tubular member to a position to engage and hold said locking means with the boss means in projecting positions; a body insertable into the upper end of and movable longitudinally into said tubular member; cooperating stop means on said tubular member and said body for limiting downward longitudinal movement of the body in said tubular member; coengageable means on said tubular member and said body for preventing non-rotational upward longitudinal movement of the body in said tubular member, said co-engageable means permitting upward longitudinal movement of the body in said tubular member upon rotational movement of the body relative to said tubular member, and means on said tubular member projecting laterally outwardly therefrom and engageable in an internal upwardly opening slot of a well flow conductor in which said elongate tubular member is positionable for preventing rotational movement of the tubular member in the well flow conductor when said tubular member is disposed in the well flow conductor with the boss means of the locking means in projecting positions.

13. A well tool including: an elongate tubular member; locking means carried by said tubular member and having outwardly projecting boss means adapted to move laterally between retracted and projecting positions to extend outwardly of said tubular member; lock means insertable into the upper end of and movable longitudinally into said tubular member to a position to engage and hold said locking means with the boss means in projecting positions; a body insertable into the upper end of and movable longitudinally into said tubular member; cooperating stop means on said tubular member and said body for limiting downward longitudinal movement of the body in said tubular member; coengageable means on said tubular member and said body for preventing non-rotational upward longitudinal movement of the body in said tubular member said co-engageable means permitting upward longitudinal movement of the body from said tubular member upon rotational movement of said body relative to said tubular member; and means on said tubular member projecting laterally outwardly therefrom and engageable in an internal upwardly opening slot of a well flow conductor in which said elongate tubular member is positionable for preventing rotational movement of the tubular member in the welll flow conductor when said tubular member is disposed in the well flow conductor with the boss means of the locking means in projecting positions.

14. A well tool including: an elongate tubular member; a plurality of resilient depending fingers on the tubular member projecting therebelow to a position below the lower end of said tubular member; a locking and supporting member on the lower end of each of said fingers and disposed below the lower end of said tubular member, said locking and supporting members each having an outwardly projecting boss thereon adapted to engage a well casing to limit movement of said tubular member in said casing; an upwardly facing stop shoulder on said tubular member; and a locking and sealing assembly including a stop member and a locking sleeve insertable into and movable longitudinally downwardly in said tubular member, said stop member engaging said stop shoulder on said tubular member to limit downward movement of said assembly in said tubular member and to dispose said locking sleeve in a position to be engaged by said locking members to prevent inwardly retracting movement of said locking members, said locking and sealing assembly and said tubular member having coengageable means for preventing longitudinal non-rotational movement of the locking and sealing assembly upwardly out of said tubular member while permitting longitudinal non-rotational movement of said locking and sealing assembly downwardly into the tubular member, said co-engageable means

permitting upward movement of said locking and sealing assembly from said tubular member upon rotational movement of said locking and sealing assembly relative to said tubular member; said coengageable means including an internal groove provided in the tubular member, an external helical groove provided in the locking sleeve and a helical lock member connected to the locking sleeve and resiliently movable to a position in the grooves when said grooves are aligned to prevent non-rotational movement of the sleeve out of the tubular member; and means on said tubular member engageable with a well flow conductor in which the tubular member is positionable to prevent rotational movement of said tubular member in the well flow conductor.

15. A well tool comprising: an elongate tubular member; locking means on said tubular member and having outwardly projecting boss means disposed below the lower end of the tubular member and adapted to move laterally between retracted and projecting positions to extend outwardly of the tubular member; a body insertable into the upper end of and movable longitudinally into the tubular member to a position to engage and hold the locking means with the boss means in projecting positions; cooperating sealing means on the tubular member and the body for sealing therebetween; means on the tubular member and the body engageable with each other for limiting movement of the body longitudinally into said tubular member, whereby the body is positioned in the tubular member to engage and hold the locking means in projecting position and the sealing means is positioned to seal between the body and the tubular member; and cooperating lock means on the tubular member and the body for preventing non-rotational movement of the body out of the tubular member, said cooperating lock means permitting movement of the body out of the tubular member upon rotational movement of the body relative to the tubular member, said elongate tubular member being adapted to form a portion of a well flow conductor.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,105,556 October 1, 1963

George Max Raulins

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, line 26, for "strong" read -- string --; line 37, after "120" insert -- and 121 --; column 11, line 23, for "to", second occurrence, read -- of --.

Signed and sealed this 14th day of April 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents