Dec. 2, 1958 J. H. BOSTOCK ET AL 2,862,560

WELL TOOLS

Filed Dec. 28, 1953 4 Sheets-Sheet 1

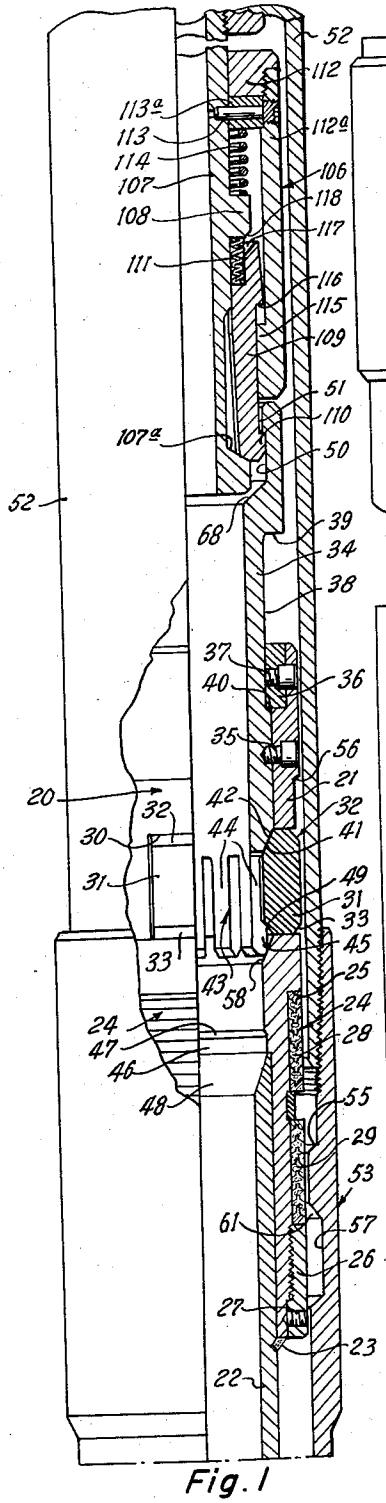



Fig. 1

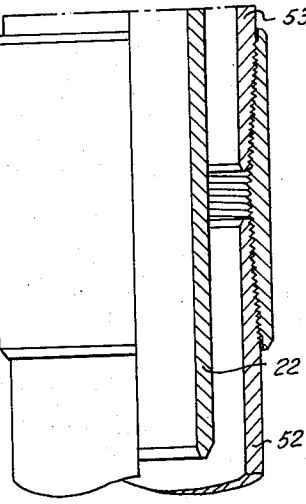



Fig. 2

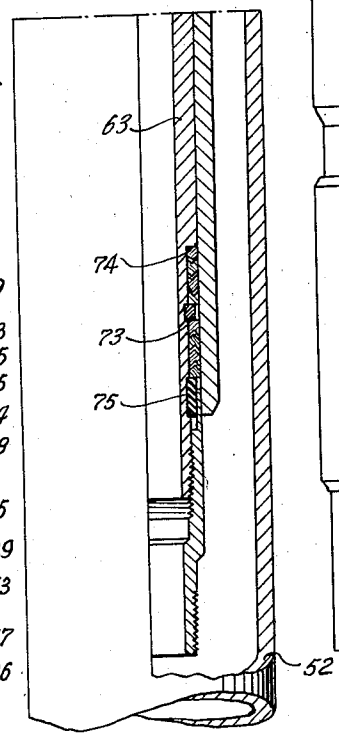



Fig. 4

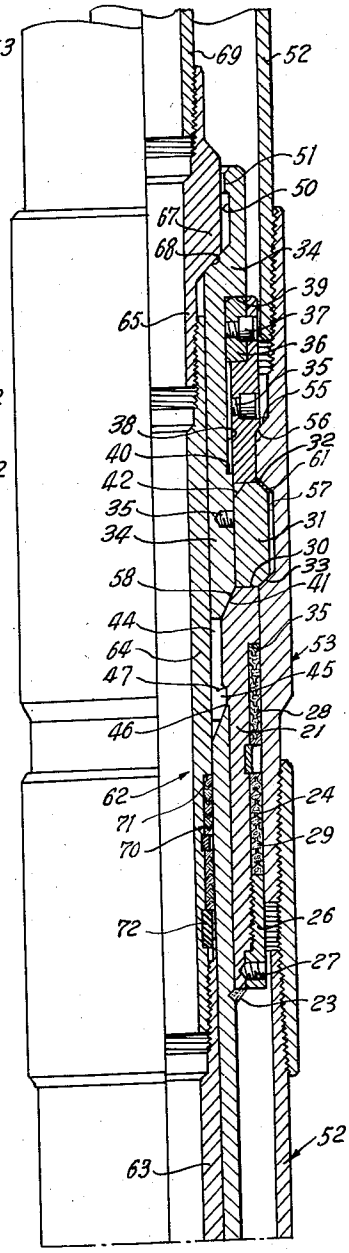



Fig. 3

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WELL TOOLS

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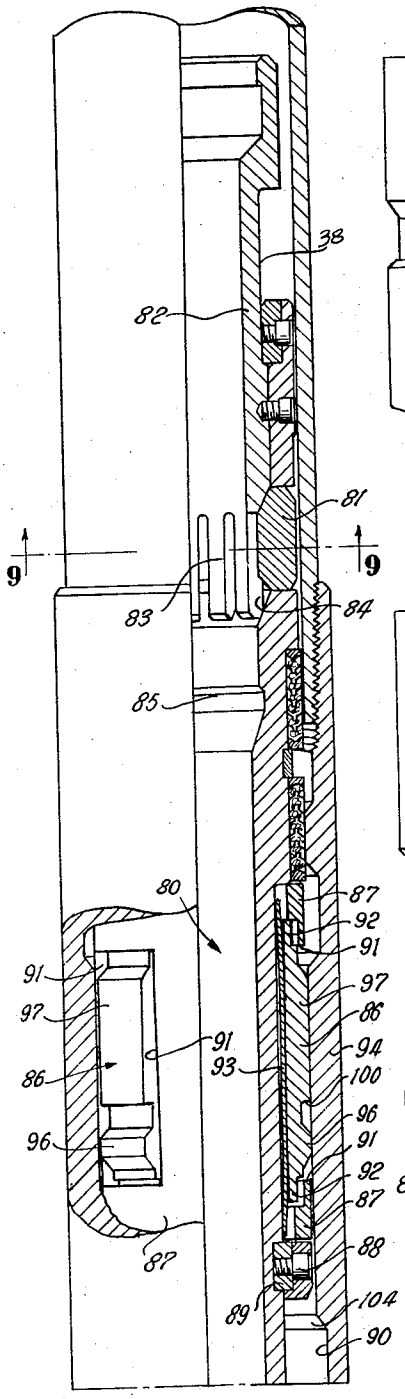



Fig. 5

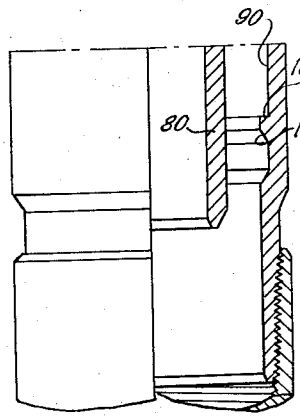



Fig. 6

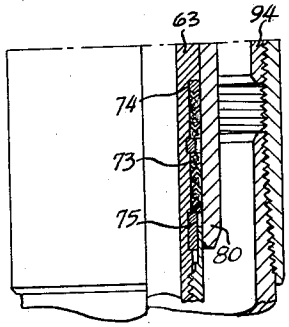



Fig. 8

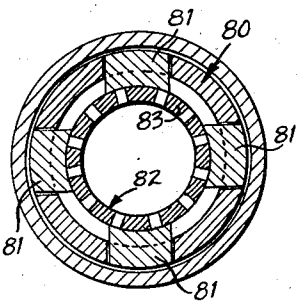



Fig. 9

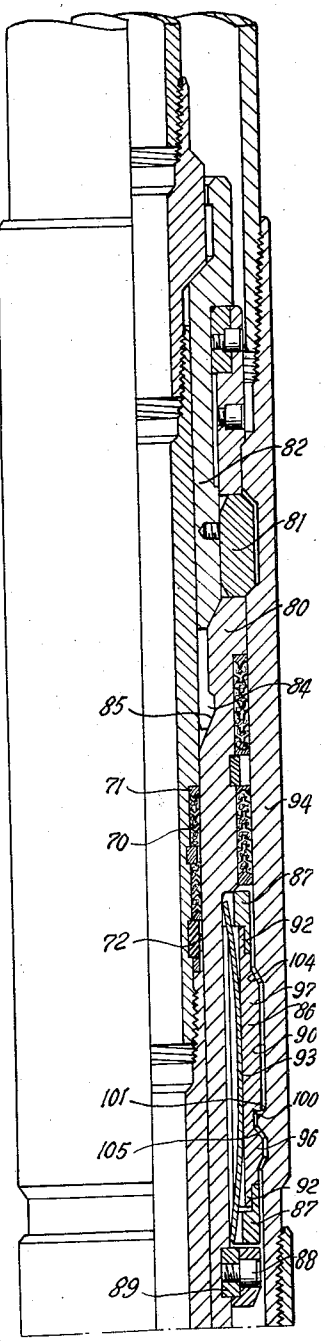



Fig. 7

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WELL TOOLS

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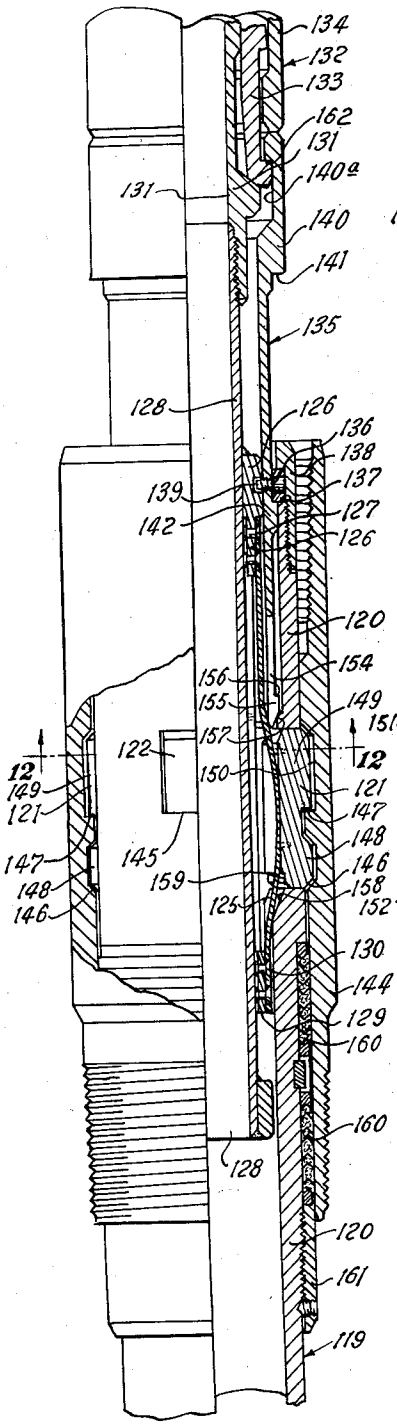



Fig. 10

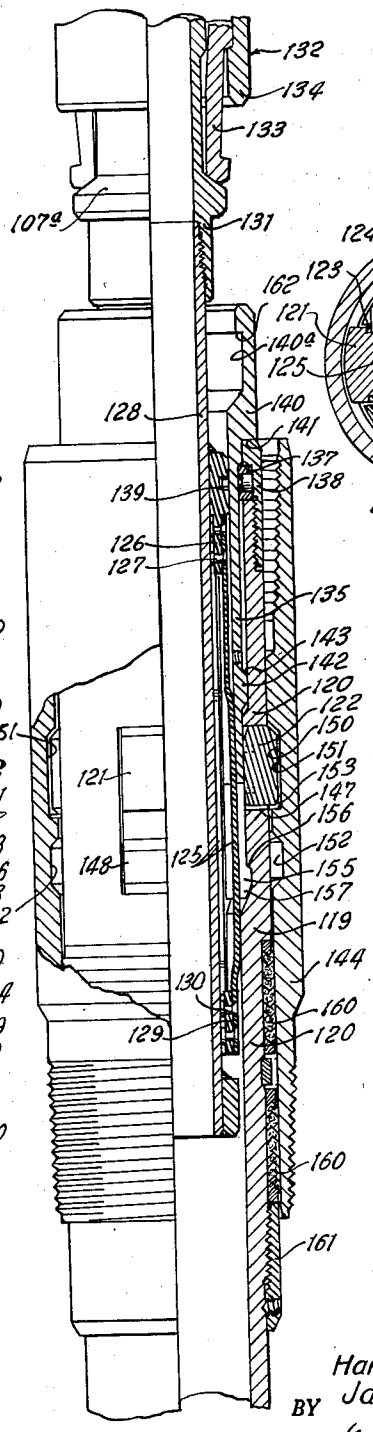



Fig. 11

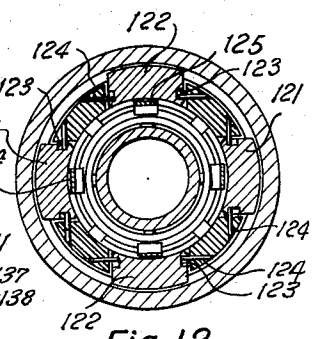



Fig. 12

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WELL TOOLS

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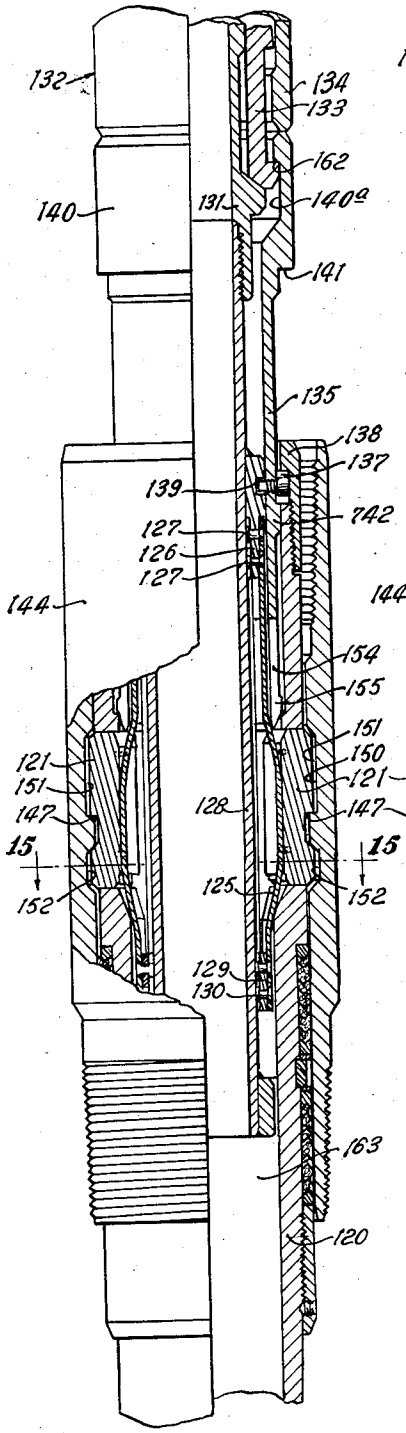



Fig. 13

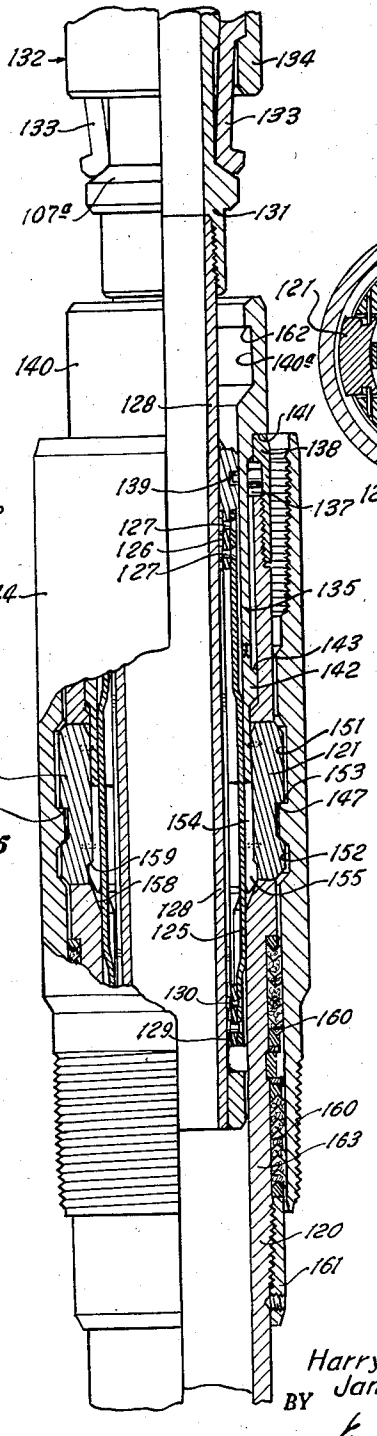



Fig. 14

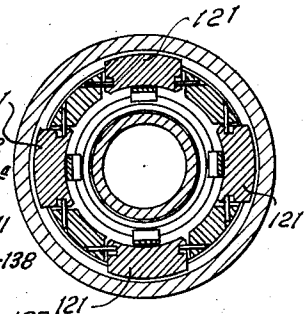



Fig. 15

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2,862,560

# WELL TOOLS

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Application December 28, 1953, Serial No. 400,444

24 Claims. (Cl. 166—125)

This invention relates to well tools and more particularly to well packers.

One object of the invention is to provide a new and improved packer for supporting tubing or the like in the well casing.

Another object of this invention is to provide a packer, of the type described, which may be lowered into place in the well and removed therefrom by means of a flexible line.

Still another object of the invention is to provide a removable packer having expansible lugs for holding the packer in place and a locking means for locking said lugs in expanded position when a seal nipple is disposed in said packer.

A further object of the invention is to provide a new and improved packer having selector lugs for arresting downward movement of the packer at a selected location in a well casing.

A still further object of the invention is to provide a packer, of the type described, wherein releasable locking means is provided for locking the selector lugs in expanded position.

Another object of the invention is to provide a new and improved packer, of the type described, having means biasing the selector lugs toward expanded position and a locking means for locking said selector lugs in expanded position.

Still another object of the invention is to provide a new and improved packer, of the type described, wherein the biasing means are mounted on and form a part of the running tool by means of which the packer is lowered into the well.

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

Figures 1 and 2 are views, partly in elevation and partly in section, of a new and improved packer showing the same being lowered through a well casing;

Figures 3 and 4 are views, similar to Figures 1 and 2, showing the packer locked in place in the well casing and supporting a seal nipple;

Figures 5 and 6 are views, partly in elevation and partly in section, of a modified form of packer, which has selector keys, showing the same being lowered through a well casing;

Figures 7 and 8 are views, similar to Figures 5 and 6, showing the modified form of packer locked in place in the well casing and supporting a seal nipple;

Figure 9 is a horizontal sectional view taken on the line 9—9 of Figure 5;

Figure 10 is a view, partly in elevation and partly in section, of another modified form of the packer having locking lugs as well as selector keys, showing the selector keys and locking lugs in position in a landing nipple but not locked therein;



Figure 11 is a view, similar to Figure 10, showing the packer positioned in the landing nipple with the locking lugs in locked position;

Figure 12 is a horizontal sectional view taken in the line 12—12 of Figure 10;

Figure 13 is a view, partly in elevation and partly in section, of a further modified form of the packer having selector locking keys only, showing the selector locking keys in position in a landing nipple but not locked therein;

Figure 14 is a view similar to Figure 13 showing the selector locking keys in locking position in the landing nipple, and,

Figure 15 is a horizontal sectional view taken on the line 15—15 of Figure 13.

Referring now especially to Figures 1 through 4 of the drawings, the numeral 20 designates a well packer which includes an elongate tubular packer body or mandrel formed of an upper tubular packer section 21 and a lower tubular section 22 whose upper end is telescoped in the lower end portion of the upper packer section 21, the two sections being rigidly secured to one another, as by a weld 23. A packing assembly 24, which may be of the chevron type, is disposed on the reduced lower end portion of the upper packer section 21 and is held in place between an external annular downwardly facing shoulder 25 and a retaining ring 26 threaded on the lower end of the upper section and held against rotation thereabout by a net screw 27. The packing assembly 24, as shown, includes two sets 28 and 29 of chevron rings which face in opposite directions whereby flow of fluids in either direction past the outer surface of the packer may be prevented, though other arrangements may be used if desired.

The upper section 21 of the packer body or mandrel is provided with a plurality of lateral apertures 30 in which are movably disposed expansible lugs 31. The lugs have downwardly and outwardly inclined beveled surfaces or shoulders 32 at their upper ends, and upwardly and outwardly inclined beveled surfaces or shoulders 33 at their lower ends, which are adapted to cam the lugs inwardly as they contact obstructions in the passage of the packer through a well conductor.

The lugs are movable into expanded positions by an expander sleeve 34 which is slidably mounted in the upper section 21. The expander sleeve is initially held in raised position in the upper packer section 21, as shown in Figure 1, by a shear pin or bolt 35, and its movement in the upper section is limited by a split ring stop 36 secured to the upper section by bolts 37, said ring stop extending inwardly into an external annular groove 38 provided in the expander sleeve. It will be seen that the upper annular shoulder 39 and the lower annular shoulder 40 defining the groove 38 are adapted to abut opposite ends of the ring stop to limit the movement of the expander sleeve 34 in opposite directions with respect to the upper packer section.

The expander sleeve is provided with an annular inwardly and downwardly inclined or beveled expanding surface 41, and this expanding surface is adapted to contact an upwardly and outwardly inclined bevel surface or shoulder 42 at the upper inner end of each of the lugs as the expander sleeve is moved downwardly from the position shown in Figure 1 to the position shown in Figure 3. The expander sleeve thus expands the locking lugs when it is moved downwardly therebetween.

The expander sleeve 34 also has a lower collet section 43 providing resilient prongs 44. The prongs have bosses 45 which are adapted to extend into an annular groove or recess 46 in the bore of the packer defined by the downwardly and outwardly inclined shoulder 47 of the

upper packer section 21 and the outwardly and upwardly inclined shoulder 48 of the lower section 22. The bosses 45 have downwardly and outwardly inclined surfaces 49 which are adapted to contact the shoulder 47, when the expander sleeve is raised upwardly in the packer, whereby the prongs 44 are cammed inwardly to permit continued upward movement of the expander sleeve. Thus, the expanding surface 41 may move to a position above the lugs 31, which are then free to move inwardly.

The upper end of the expander sleeve 34 has an internal groove 50 at the upper end of which is an internal flange 51 disposed to be engaged by a suitable running tool secured to a flexible line running mechanism (not shown). The picker may be lowered into a well casing 52 by means of the running tool and flexible line.

The well casing 52 includes a landing nipple 53 having suitable threaded end portions whereby the said nipple may be connected to adjacent sections of said well casing. The landing nipple is provided with an internal stop shoulder 55 which engages an external downwardly facing annular stop shoulder 56 on the upper packer section to stop downward movement of the packer in the well casing. When the downward movement of the packer is stopped, the lugs 31, which are then in retracted position, are aligned with an internal locking groove 57 formed in the bore of the landing nipple, and downward jars imparted to the upper end of the expander sleeve 34 by the running tool will shear the shear pin 35. Further downward jars then move the expander sleeve downwardly and cause the expanding surface 41, which contacts the surfaces 42 of the lugs, to move the lugs outwardly into the locking groove. Also, the prongs 44 are caused to bend inwardly due to the camming action of the beveled surface 58 of the upper packer section 21 on the bosses 45, as the expander sleeve moves downwardly in the packer. The expander sleeve is moved downwardly until the bosses on the prongs are aligned with the annular groove 46, whereupon the prongs flex outwardly and the bosses are engaged in the annular groove and thus hold the expander sleeve against movement in the packer. Further downward movement of the expander sleeve is now limited by the engagement of the expander surface 41 with the beveled shoulder 58 in the bore of the upper packer section.

The running tool 106 shown in Figure 1 may be employed to lower the packer into and remove it from the well casing string. The running tool includes a tubular carrier or body 107 on whose upper end may be threaded a connector fiitting by means of which it is secured to a flexible line running mechanism. The tubular carrier is provided intermediate its ends with an external flange 108 below which are disposed a plurality of supporting members or dogs 109 having outwardly extending hooks or catches 110 at their lower ends. The dogs are biased outwardly into engagement with the flange 51 of the expander sleeve by springs 111, which bear against the under side of the carrier flange 108 and the upper ends of the dogs and force the lower ends of the dogs along a downwardly and outwardly inclined wedge surface 107*a* at the lower end of the tubular carrier. A sleeve 112 having a skirt 112*a* is releasably secured to the tubular carrier by a shear pin 113, which extends through a shear ring 113*a* secured in the upper end of the skirt and holds the skirt in the position shown in Figure 1 against the upward force exerted by the strong helical coil spring 114 which is supported on the external flange 108 of the carrier and bears against the shear ring carried by the skirt.

It will be apparent that when downward jars are imparted to the running tool through the flexible line running mechanism, the pin 113 will be sheared and the strong spring 114 will move the skirt upwardly against the force of the weak spring 111. An internal flange 115 at the lower end of the skirt engages external flanges 116 near the upper ends of the dogs and carries the dogs upwardly during such movement of the skirt. Upwardly and outwardly beveled surfaces 117 on the upper ends of the dogs then come into contact with a similarly beveled surface 118 on the lower edge of the external flange 108, which causes the lower ends of the dogs to pivot inwardly and out of engagement with the flange 51 in the upper end of the bore of the expander sleeve of the packer. After downward jars have been imparted to the expander sleeve to drive it downwardly, the running tool may then be removed from the casing leaving the packer in place.

When the expander sleeve is pulled up to the position wherein the annular shoulder 40 of said expander sleeve engages the stop 36 of the packer, further upward movement of the expander sleeve will cause the packer 20 to be moved upwardly in the casing. When this happens the beveled shoulders 32 on the upper outer edges of the lugs contact the downwardly and outwardly inclined annular shoulder 61 at the upper end of the internal locking groove of the landing nipple 53, and the lugs are cammed inwardly. The lugs are free to move inwardly since the expanding surface 41 is then disposed above the lugs. Thus, the packer may be easily moved into and locked in position in the landing nipple by a suitable running tool operable by means of a flexible line running mechanism, and may also be easily removed by such a tool and flexible line mechanism.

The packer 20 is adapted to receive a tubular sealing nipple 62 having a lower section 63, an upper section 64 threaded into the upper end of the lower section 63, and a landing head section 65 threaded into the upper end of the upper section. The landing head section has an external flange providing a stop or head 67 which engages an internal stop shoulder 68 in the upper portion of the expander sleeve 34 to limit downward movement of the sealing nipple in the packer. The landing head section is threaded on the lower end of a joint of the string of flow pipe or tubing 69 by means of which the sealing nipple and landing head are lowered into the well.

The upper sealing nipple section 64 fits closely in the expander sleeve and locks the prongs 44 of the collet section 13 of the expander sleeve in the position shown in Figure 3, so that the packer can not be moved upwardly until the sealing nipple is removed from the packer. During the time the sealing nipple is in the packer, the bore of the packer is reduced thereby and the upward force exerted on the packer by the pressure of the well fluid is greatly increased. However, the packer is positively held in place against upward displacement because the bosses on the prongs 44 of the collet section cannot be moved out of engagement with the shoulder 47 in the upper packer section due to the presence of the upper section 64 of the sealing nipple in the bore of the expander sleeve.

An upper packing assembly 70 on the upper section 64 of the sealing nipple is held in place between an annular shoulder 71 on the upper section and a split lock ring 72 secured on the lower end of said upper section by the upper end of the lower section 63 of the sealing nipple.

An annular lower seal or packing assembly 73 on the lower section 63 of the sealing nipple is held in place between an annular shoulder 74 on the lower end of the lower section and a split lock ring 75 which is secured on said lower section by a sub threaded on the lower end thereof. The lower end of the sub may be threaded whereby tubing may be connected to the lower end of the sealing nipple.

It will be noted that the friction between the packing assemblies 70 and 73 and the bore wall of the expander sleeve cannot move the expanding sleeve upwardly when the sealing nipple is moved upwardly, because of the engagement of the bosses 45 of the collet with the shoulder 47 of the upper packer section. This is of great advantage since it is often desirable to remove the sealing nipple while leaving the packer in place.

It will now be seen that a new and improved packer 20 has been provided which may be lowered into a well

casing by means of a flexible line running mechanism, and which may be removably locked in position in a well by means of the lugs **31** after its downward movement has been stopped by the stop shoulder **56** of the packer abutting the shoulder **55** of the landing nipple in the well casing. It will be seen that the lugs **31** are moved into and held in expanded position by an expander sleeve **34** which is in turn held in a lower locking position by engagement of the bosses **45** of the collet section **43** of the sleeve in the annular groove or recess **46**. Moreover, it will be seen that the packer is adapted to receive a sealing nipple **62** and that the sealing nipple, when in position in the packer, abuts the collet section to prevent inward movement of the prongs **44** thereof whereby the packer is held positively against upward movement in the casing as long as the sealing nipple is in place.

In Figures 5 through 9 is shown a modified form of the invention, wherein the packer **80** is provided with lugs **81** moved into expanded position by an expander sleeve **82** having a collet section **83**. The collet section has bosses **84** which extend into the annular recess **85** in the bore wall of the packer to hold the expander sleeve in its lower position. It will be seen that the packer **80** is in these particulars identical in structure and function with the packer **20** illustrated in Figures 1 to 4. The packer **80** differs from the packer **20** in that its downward movement in the well casing is arrested, not by stop shoulders such as the stop shoulders **55** and **56** of the packer and the well casing shown in Figures 1 and 2, but by selector keys **86** slidably mounted on the extended lower portion of the body or mandrel of the packer **80** by means of a retainer or carrier sleeve **87** which is locked in place on the packer by bolts **88** extending through the carrier sleeve into a split retainer ring **89** in an annular recess in the lower portion of the packer.

The carrier sleeve has a plurality of radially spaced longitudinal slots **91** and a selector key **86** is disposed in each slot. The outward movement of the selector keys is limited by the engagement of their upper and lower end portions **92** with the wall of the carrier sleeve at the upper and lower ends of the slots. Each selector key is biased outwardly by a spring **93** whose opposite ends bear against the packer body or mandrel and whose intermediate portion bears against the inner side of the selector key, though the spring may be oppositely positioned and still function properly.

Each selector key **86** has an outer configuration which corresponds to the inner configuration of a selector groove **90** in the bore of only one of several landing nipples **94** which may be connected in the well casing of a well at various depths of the well and each having selector grooves of different configuration or size or both. When it then becomes desirable to install a packer **80** in the well casing at a selected depth, the packer is provided with selector keys **86** whose configuration conforms to that of the selector groove **90** of the landing nipple **94** found at that selected depth.

The packer is then lowered into the well, and the selector keys engage the walls of the casing and move inwardly against the force of the springs **93** since the beveled surface of the lower guide bosses **96** of the keys cam the keys inwardly as they contact obstructions during such downward movement. The selector keys also have upper selector bosses **97**, and the keys are unable to move to expanded position until they are aligned with the annual selector groove **90** of a landing nipple **94** of the same size and configuration as the boses **97** and **96** of the selector keys. When the keys move outwardly into expanded position the downwardly facing stop shoulder **100** at the lower end of the selector boss of each key engages the upwardly facing stop shoulder **101** of the selector groove of the proper landing nipple, and since these shoulders are disposed substantially perpendicular to the longitudinal axis of the landing nipple, further downward movement of the packer is stopped. The expander sleeve **82** may then be jarred downwardly to expand the lugs and lock the packer against upward movement.

It will be seen that, as the upper ends of the bosses **96** and **97** are inclined upwardly and inwardly and the upper shoulders **104** and **105** of the selector groove are similarly inclined, the keys will be cammed inwardly by the engagement of the ends of the bosses with those shoulders upon upward movement of the packer in the landing nipple. The selector keys thus limit downward movement of the packer but permit upward movement thereof.

It will be apparent that in this modified form of the packer, the selector keys and selector groove permit use of landing nipples having larger internal diameters and unrestricted bores, due to the omission of an inwardly extending stop shoulder in the nipple which would restrict the bore of the nipple. Moreover, it will be seen that the absence of such a stop shoulder permits the use of a series of this form of packers in the same string of casing, since each packer may pass through all landing nipples of the casing except the one whose selector groove has an internal configuration and size which corresponds to the configuration and size of the lugs of the selector keys of the packer.

Another form of the packer is shown in Figures 10 through 12, wherein the packer **119** includes a mandrel or body **120** which is provided with a pair of selector keys **121** and a pair of locking lugs **122** mounted in lateral apertures in the mandrel. Each of the keys and lugs has notches or recesses **123** formed in its sides which receive the projecting ends of pins **124** carried by the mandrel and engaging in the recesses to limit the inward and outward movement of the keys and lugs.

The keys and lugs are each yieldably biased outwardly by a spring **125** secured at its upper end to a retaining ring **126** by rivets **127** or the like. The retaining ring is rigidly secured to an elongate tubular stem **128**, as by welding. The lower ends of the springs are secured to a lower slide ring **129**, as by rivets **130**, and said slide ring is longitudinally movable on the tubular stem.

The upper end of the tubular stem is threaded to the tubular carrier or body **131** of a running tool **132**, similar to that of the running tool shown in Figure 1. The running tool is similar in all other respects to the running tool **106** of Figure 1, and will not, therefore, be described in further detail, except to point out that the dogs **133** and skirt **134** correspond to the dogs **109** and the skirt **112** of the running tool shown in Figure 1.

A locking sleeve **135** is releasably secured to the packer mandrel **120**, in the position shown in Figure 10, by a plurality of shear screws **136** threaded through a ring **137** rigidly secured on the upper end of the packer mandrel by a cap ring **138** threaded on the upper end of said packer mandrel. The shear screws have inner ends which extend into an annular groove **139** formed in the exterior of the spring retaining ring **126**, so that the locking sleeve is also releasably connected to the packer mandrel.

The enlarged head **140** at the upper end of the locking sleeve has an internal annular recess **140***a* in which the hooks on the lower ends of the dogs **133** of the running tool may engage, and the annular downwardly facing stop shoulder **141** at the lower end of the head is adapted to engage the upper end of the packer mandrel to limit downward movement of the locking sleeve in said packer mandrel. The locking sleeve also has an external annular flange **142** intermediate its ends providing an upwardly facing stop shoulder **143** which is adapted to engage the lower end of the ring **137** to limit upward movement of the locking sleeve with respect to the packer mandrel.

The selector keys **121** have an outer configuration and size which correspond to the inner configuration and size of the selector groove of only one of the several landing nipples **144** which may be connected in the well casing of a well at various depths therein. The landing nipples

are threaded at both ends so that they may be connected to and between two adjoining sections of the well casing so as to form a part of said string of casing. When it becomes desirable to install a packer in the well casing at a selected depth, the packer is provided with selector keys whose size and configuration conforms to that of the landing nipple disposed at that desired depth.

The packer is lowered into the well by means of the running tool **132**, the selector keys **121** and the locking lugs **122** engaging the walls of the casing and camming inwardly against the resistance of the springs **125** as they encounter obstructions, since the downwardly facing shoulders **145** of the lugs and downwardly facing shoulder **146** of the lower guide bosses **148** of the selector keys are beveled upwardly and outwardly. The guide bosses prevent the stop shoulder **147** at the lower end of the selector boss **149** from engaging obstructions until the selector keys are aligned with a landing nipple selector groove section **150** having annular grooves **151** and **152** of the same length and spacing as the bosses of the selector keys.

When the selector keys move outwardly into expanded position in the selector groove, the downwardly facing stop shoulder **147** of each key engages an upwardly facing stop shoulder **153** in the selector groove, and since these shoulder are disposed substantially perpendicular to the longitudinal axis of the landing nipple, further downward movement of the packer mandrel **120** is stopped. The various elements of the running tool and the packer **119** are then in the positions shown in Figure 10, the selector bosses **149** and the locking lugs **122** being disposed in the upper groove **151** of the selector groove section and the guide bosses **148** being disposed in the lower groove **152** of said selector groove section.

Downward jars are then imparted to the running tool, and by means of the skirt **132** of the running tool to the upper end of the locking sleeve **135**, to shear the shear screws **136** and drive the locking sleeve downwardly in the packer mandrel between the selector keys and locking lugs and the springs **125**.

The locking sleeve has resilient collet prongs **154**, provided at their lower ends with bosses **155** having outwardly convergent upper and lower shoulders **156** and **157** which cause the collet prongs to cam inwardly upon meeting internal obstructions in the bore of the packer mandrel.

When the locking sleeve reaches the limit of its downward movement the stop shoulder **141** engages the upper end of the packer mandrel and the collect prong bosses enter into an annular recess or groove **158** formed in the bore of the packer mandrel below the locking lugs and adjacent the lower ends of the selector keys, so that the collet prong bosses detachably lock the locking sleeve in the lower locking position shown in Figure 11. It will be noted that the lower inner ends of the selector keys are provided with recesses **159** corresponding with the groove **158** and which receive the upper portions of the collet prong bosses so that these bosses also engage and hold the selector keys expanded when the locking sleeve is in the locking position.

Further downward jars are then imparted to the running tool to cause the dogs **133** to retract, and the running tool is then pulled upwardly to remove the tubular stem **128** and the springs **125** from within the bore of the packer mandrel. The packer is thus left in place with the locking sleeve holding the locking lugs and selector keys locked in expanded positions, so that fluid pressure differentials will not dislodge the packer from the landing nipple.

The packer mandrel, of course, is provided with an external packing assembly **160** held in place on the mandrel by a retainer ring **161**, and this packing assembly seals between the packer mandrel and the landing nipple. A sealing nipple, such as the nipple **62** of Figures 3 and 4, may then be positioned in the bore of the packer **119**, if desired.

When it is desired to remove the packer, a suitable running tool is lowered into the well casing and engages the shoulder **162** at the upper end of the internal groove **140***a* in the head of the locking sleeve, whereby the locking sleeve may be pulled upward. When the locking sleeve is pulled upwardly, the beveled upper surfaces **156** of the collet prong bosses cam the prongs inwardly, thus permitting the locking sleeve to move upwardly in the packer mandrel until the stop shoulder **143** on the sleeve abuts the lower end of the ring **137**, whereupon further upward movement of the locking sleeve causes the packer mandrel to move upwardly. This upward movement of the packer mandrel is now possible because the locking sleeve is now above the locking lugs and selector keys, and the latter are free to move inwardly, their upwardly facing shoulders being inclined downwardly and outwardly so that, upon engaging surfaces of the landing nipple and the casing string, they urge the keys and lugs inwardly to retracted positions.

It will be seen that in this modified form of the packer, the springs **125** which bias the locking lugs and selector keys outwardly are a part of the running tool and are removed after the packer has been located and locked in a selected landing nipple, thereby providing a packer having a very large bore as compared with the packer shown in Figures 5 through 9. Also, the locating of the locking lugs and selector keys in radially offset positions, so they may engage in a common selector groove in the landing nipple, provides a shorter packer and landing nipple, while retaining the benefits of the full opening through the landing nipple.

In Figures 13 to 15 is shown a packer **163**, which is similar in all respects to the packer **119** of Figures 10 through **12**, except that the locking lugs **122** are replaced by another pair of selector keys **121**. Since the mode of operation and structure of the packer **163** is identical in all other respects with those of the packer **119**, all corresponding elements have been provided with the same reference numerals and will not be described further.

It will be seen that the selector keys **121** serve to hold the packer in place in the landing nipple when the locking sleeve is in the position shown in Figure 14, wherein it engages the inner surfaces of the selector keys to prevent inward movement of the keys.

This form of the packer has all the advantages of the form shown in Figures 10 through 12, and in addition provides a greater shear area on the selector keys which lock the packer in place in the landing nipple.

The foregoing description of the invention is explanatory only, and changes in the details of the constructions 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 we claim and desire to secure by Letters Patent is:

1. A well tool adapted to be moved into and out of a selected landing nipple of a conductor provided with a plurality of landing nipples, each of said landing nipples having a selective locking groove of different configurations than the corresponding grooves of the other nipples and formed with an upwardly facing stop shoulder, said well tool including: an elongate tubular body provided with a lateral port; a lug having a selector key face corresponding in configuration to the configuration of the selective locking groove of said selected landing nipple and having a downwardly facing stop shoulder thereon, said lug being movably mounted in the lateral port in said body for movement between expanded and retracted positions and engageable with said selective locking groove of said selected landing nipple whereby the stop shoulder on the lug is engageable with the stop shoulder of said selective locking groove for limiting

downward movement of said tubular body through said landing nipple; resilient means biasing said lug outwardly of said port toward expanded position; and an expander sleeve slidably mounted in said tubular body for limited longitudinal movement therein between an upper position and a lower position, said sleeve engaging and holding said lug in expanded position when said sleeve is moved to one of said positions after the lug has moved outwardly to expanded position with its selector key face engaging with the selective locking groove of said selected landing nipple, whereby said well tool is positively locked against displacement from said landing nipple.

2. In combination with the well tool of claim 1, a running tool having a central member extending downwardly through said sleeve and body; and wherein the means biasing said lug toward expanded position is carried by the central member of the running tool.

3. A well tool for use with a landing nipple having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool comprising: an elongate tubular member; means on said tubular member providing a downwardly facing stop shoulder engageable with the upwardly facing shoulder of the landing nipple; locking means mounted on said tubular member for lateral movement thereon between retracted non-locking position and projected locking position; resilient means biasing said locking means to locking position and permitting said locking means to retract from such locking position; a sleeve mounted for movement on said tubular member to a position engaging and holding said locking means in locking position; and restraining means on said sleeve and tubular member co-acting to restrain movement of said sleeve from such engaging and holding position.

4. A well tool for use with a landing nipple having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool comprising: an elongate tubular member; means on said tubular member providing a downwardly facing stop shoulder engageable with the upwardly facing shoulder of the landing nipple; locking means mounted on said tubular member for lateral movement thereon between retracted non-locking position and projected locking position; resilient means biasing said locking means to locking position and permitting said locking means to retract from such locking position; a sleeve mounted for movement on said tubular member to a position engaging and holding said locking means in locking position; restraining means on said sleeve and tubular member co-engageable and co-acting to restrain movement of said sleeve from such engaging and holding position; and a locking sleeve insertable in said tubular member engaging said restraining means to positively hold the same locked in restraining position.

5. A well tool comprising: an elongate tubular member; means on said tubular member providing an external downwardly facing stop shoulder; a locking member mounted on said tubular member for free lateral movement between projecting locking and retracted non-locking positions thereon; a sleeve member slidable longitudinally within said tubular member between upper and lower positions and engageable with said locking member in one of said positions to hold said locking member in locking position; shoulder means on said tubular member and said sleeve member engageable with each other for limiting movement of said sleeve member longitudinally of said tubular member between said positions; and restraining means on said sleeve member and said tubular member co-acting resiliently for restraining said sleeve member in positions engaging and holding said locking member in locking position.

6. A well tool comprising: an elongate tubular member provided with a lateral opening; a lug movably mounted in said opening and adapted to move laterally between retracted and projecting position to extend outwardly of said tubular member; a sleeve mounted for movement longitudinally within said tubular member to a position engaging and holding said lug in projecting position; means on said tubular member and said sleeve engageable with each other for limiting movement of said sleeve longitudinally of said tubular member; means co-acting with said sleeve and said tubular member for restraining said sleeve in position engaging and holding said lug in projection position; and a member insertable into the sleeve to engage said restraining means to lock said restraining means in position holding the sleeve in position holding the lug in projecting position.

7. In combination with the well tool of claim 6, a running tool having a central member extending downwardly through said sleeve; and means on said central member engageable with the lug for biasing said lug toward expanded position, said central member being detachably connected to said tubular member, said running tool and biasing means being removable from connection with said well tool, and said biasing means being removable with said running tool from biasing engagement with said lug.

8. A well tool comprising: an elongate tubular member provided with a lateral opening; a locking member movably mounted in said opening and movable between retracted and projecting position and adapted to move to projecting position to extend outwardly of said tubular member; an elongate sleeve mounted for movement longitudinally within said tubular member to a position engaging and holding said member in projecting position; means on said tubular member engageable with said sleeve for limiting movement of said sleeve on said tubular member; and restraining means on said sleeve and said tubular member resiliently co-engageable for locking said sleeve in said position engaging and holding said locking member in projecting position.

9. A well tool for use with a landing nipple having a locking recess, said well tool including: an elongate tubular member; a stop means on said tubular member engageable with said landing nipple for limiting downward movement of said tubular member through said nipple; a lock means laterally movably mounted on said tubular member and movable thereon into position projecting into said locking recess to lock said tubular member against upward movement from said landing nipple; a sleeve means mounted in said tubular member for longitudinal movement therein between upper and lower positions and when in one of said positions in said tubular member engaging and holding said lock means in projecting position; and resilient collet means on the lower end of said sleeve means engageable with said elongate tubular member to lock said sleeve means in position holding said lock means in projecting position.

10. A well tool for use with a landing nipple having a locking groove, said well tool including: an elongate tubular member; a stop means on said tubular member engageable with said landing nipple for limiting downward movement of said tubular member through said nipple; a lock means movably mounted on said tubular member and movable laterally outwardly thereof into said locking groove to lock said tubular member against upward movement from said landing nipple; a sleeve means slidably mounted on said tubular member and movable longitudinally downwardly therewithin to a lower position engaging and holding said lock means in locking position; and depending resilient catch means on said sleeve means and groove means on said tubular member co-engageable for locking said sleeve means in said lower position.

11. A well tool for use with one of a plurality of landing nipples each having an internal selective locking groove provided with an upwardly facing stop shoulder, said well tool including: an elongate tubular member; a

first means on said tubular member engageable with said landing nipple for limiting downward movement of said tubular member through said nipple; said first means including a selector key having a configuration conforming to the configuration of the selector locking groove of a selected landing nipple and provided with a downwardly facing stop shoulder engageable with the upwardly facing stop shoulder of the selective locking groove of said selected landing nipple to stop downward movement of said tubular member through said selected landing nipple; a second means carried by and laterally movable on said tubular member between retracted and projecting positions and when in projecting position having a portion projecting into said locking groove to lock said tubular member against upward movement in said landing nipple; a third means mounted in said tubular member and movable longitudinally thereof between upper and lower positions and when in one such position engaging and holding said second means in projecting position; and resilient collet finger means on said third means and groove means in said tubular member co-engageable to hold said third means in each of said upper and lower positions.

12. A packer for receiving an inner sleeve and adapted for use with a landing nipple having a locking groove and having an upwardly facing stop shoulder, said packer including: an elongate tubular member; a stop means on said tubular member engageable with the upwardly facing shoulder of said landing nipple for limiting downward movement of said tubular member through said nipple; lock means on said tubular member movable laterally thereof between retracted and projecting positions and when in projecting position having a portion projecting into said locking groove to lock said tubular member against upward movement from said landing nipple; a sleeve means mounted in said tubular member and movable longitudinally therewithin between upper and lower positions and when in one such position engaging and holding said lock means in expanded position; a depending resilient catch means on said third means engageable with said tubular member for locking said third means in said holding position; and an inner sleeve slidable in said tubular member to a position abutting said fourth means to prevent movement of said sleeve means from holding position in engagement with said tubular member when said inner sleeve is in such position in said tubular member.

13. A well tool adapted to be moved by means of a flexible line into and out of a well conductor landing nipple provided with a locking groove, said well tool including: an elongate tubular member; an outwardly extending stop shoulder on said tubular member engageable with said landing nipple for limiting downward movement of said tubular member through said nipple; lock means on said tubular member movable laterally thereof between expanded and retracted position and when in projecting position engageable in said locking groove to lock said tubular member against upward movement from said landing nipple; a sleeve means slidably mounted in said tubular member for limited longitudinal movement between an upper position and a lower position and having resilient means engageable with said lock means for initially moving said lock means into expanded position when said sleeve means is moved to said lower position; said sleeve means having means on its upper end whereby sad sleeve means may be attached to a flexible line; a restraining groove in said tubular member; and a catch means on said resilient means on said sleeve means engageable with said restraining groove in said tubular member for releasably locking said sleeve means in said lower position.

14. A well tool adapted to be moved by means of a flexible line into and out of a landing nipple providing a downwardly facing locking shoulder in a well casing, said well tool including: an elongate tubular member;



an outwardly extending stop shoulder on said tubular member engageable with said landing nipple for limiting downward movement of said tubular member through said nipple; lock means on said tubular member movable laterally thereof between expanded and retracted position and when in expanded position projecting to engage beneath said downwardly facing locking shoulder to lock said tubular member against upward movement from said landing nipple; a sleeve means slidably mounted in said tubular member for limited longitudinal movement between an upper position and a lower position and engageable with said lock means for moving said lock means into expanded position when said sleeve means is moved to said lower position; a restraining groove in said tubular member; a catch means on said sleeve means engageable with said restraining groove in said tubular member for releasably locking said sleeve means in said lower position; and a tubular nipple insertable through said tubular member and engageable with said catch means to positively hold said catch means in engagement with said restraining groove in said tubular member to hold said sleeve means in said lower position when said tubular nipple is in position in said tubular member.

15. A well tool adapted to be moved into and out of a landing nipple of a well casing provided with a locking groove and having an upwardly facing stop shoulder, said tool including: an elongate tubular packer mandrel provided with a plurality of lateral ports; an outwardly extending stop shoulder on said packer mandrel engageable with the upwardly facing shoulder of said landing nipple for limiting downward movement of said tubular mandrel through said landing nipple; lugs movably mounted in said ports for movement between retracted position and expanded position; an expander sleeve slidably mounted in said packer mandrel for limited longitudinal movement therein between an upper position and a lower position, said expander sleeve engaging and moving said lugs from retracted to expanded position when said expander sleeve is moved from the upper position to the lower position when the downward movement of the packer mandrel through the landing nipple has been stopped by said shoulders; said expander sleeve having means on its upper end whereby said expander sleeve may be attached to a running and pulling mechanism; and co-engageable means on said expander sleeve and said tubular packer mandrel engageable when said expander sleeve is in said lower position to retain said expander sleeve in such lower position holding the lugs in expanded position.

16. A well tool adapted to be moved into and out of a landing nipple of a well casing provided with a locking groove and also having an upwardly facing stop shoulder, said tool including: an elongate tubular member provided with a plurality of lateral ports; an outwardly extending stop shoulder on said tubular member engageable with said upwardly facing stop shoulder of said landing nipple for limiting downward movement of said tubular member through said landing nipple; lugs movably mounted in said ports for movement between retracted position and expanded position; an expander sleeve slidably mounted in said tubular member for limited longitudinal movement therein between an upper position and a lower position, said expander sleeve moving said lugs from retracted to expanded positions when said expander sleeve is moved from the upper position to the lower position after downward movement of the tubular member through the landing nipple has been stopped by engagement of said shoulders; said expander sleeve having a collet section provided with bosses, and said tubular member having an internal groove therein, said bosses being movable into said internal groove of said tubular member when said expander sleeve is moved to said lower position to hold said expander sleeve in said lower position.

17. A well tool adapted to be moved into and out of a landing nipple of a well casing provided with a stop shoulder and a locking groove, said well tool including: an elongate tubular packer having a body provided with a plurality of lateral ports; an outwardly extending stop shoulder on said packer engageable with said stop shoulder of said landing nipple for limiting downward movement of said tubular packer member through said landing nipple; lugs movably mounted in said ports for movement between retracted position and expanded position; an expander sleeve slidably mounted in said packer body for limited longitudinal movement therein between an upper position and a lower position, said expander sleeve engaging and moving said lugs from retracted to expanded positions when said expander sleeve is moved from the upper position to the lower position by downward force applied to the expander sleeve when the downward movement of the packer through the landing nipple has been stopped by engagement of said shoulders; said expander sleeve having a collet section provided with bosses and said packer body having an internal annular restraining groove, said bosses being movable into said restraining groove in said packer body when said expander sleeve is moved to said lower position to hold said expander sleeve in said lower position; and an inner nipple extendable into said expander sleeve and said packer body and engaging the collet section of said expander sleeve to prevent inward movement thereof, whereby said bosses are not retractable from said restraining groove in said packer body while said inner nipple is disposed in said packer. a landing nipple of a well casing provided with a plurality

18. A well tool adapted to be moved into and out of a landing nipple of a well casing provided with a plurality of landing nipples each having an internal selective locking groove provided with an upwardly facing stop shoulder, said tool including: an elongate tubular packer having a body provided with a plurality of lateral ports; a selector key mounted on said packer body in one of said ports and biased toward an expanded position, said selector key having an external configuration conforming to the configuration of the selective locking groove of a selected landing nipple and provided with a downwardly facing stop shoulder engageable with the stop shoulder of the selective locking groove of said selected landing nipple when said selector key is moved to expanded position, such engagement limiting downward movement of said packer through said landing nipple; a lug movably mounted in one of said ports for movement between retracted position and expanded position; an expander sleeve slidably mounted in said packer body for limited longitudinal movement therein between an upper position and a lower position, said expander sleeve moving said lug from retracted to expanded positions when said expander sleeve is moved in one direction when the downward movement of the packer through the landing nipple has been stopped by said selector key stop shoulder engaging with the stop shoulder of said locking groove, said expander sleeve having means on its upper end whereby said expander sleeve may be attached to a raising and lowering mechanism; said expander sleeve having a resilient collet finger member at its lower end provided with a laterally outwardly extending boss; said tubular packer body having an internal restraining groove provided therein below the lateral ports and receiving the boss of the collet finger of the expander sleeve for releasably restraining said expander sleeve in position holding the lug in expanded position.

19. A well tool adapted to be lowered by means of a flexible line into and out of a landing nipple of a well casing provided with a locking groove and an upwardly facing stop shoulder, said well tool including: an elongate tubular body provided with a plurality of lateral ports; an outwardly extending stop shoulder on said body engageable with the stop shoulder of said landing nipple for limiting downward movement of said tubular member through said landing nipple; lugs movably mounted in said ports for movement between retracted position and expanded position; and an expander sleeve slidably mounted in said packer for limited longitudinal movement therein between an upper position and a lower position, said tubular body having an internal restraining recess therein, said expander sleeve having a collet section provided with resilient finger members having outwardly projecting bosses which are movable into said restraining recess of said body when said expander sleeve is moved to said lower position to hold said expander sleeve in said lower position.

20. A well tool adapted to be moved into and out of a selected landing nipple of a well conductor provided with a plurality of landing nipples each having a selective locking groove of a different configuration from the groove of the other landing nipples, said well tool including: an elongate tubular packer mandrel provided with a lateral port; a locking member having a selector key face corresponding to the configuration of the locking groove of said selected landing nipple, said locking member being movably mounted on said mandrel in said lateral port for movement between retracted and expanded positions, said locking member selector key face being engageable with the selective locking groove of said selected landing nipple to limit downward movement of said packer mandrel through said landing nipple; and a sleeve slidably mounted in said packer mandrel for limited longitudinal movement therein between an upper position and a lower position, said sleeve locking said locking member in expanded position when said sleeve is moved from one position to the other position after the downward movement of the packer mandrel through the landing nipple has been stopped by said locking member engaging said locking groove.

21. In combination with the well tool of claim 20, a running tool detachably connectable to said sleeve and having means engageable with said locking member for biasing said locking member outwardly toward expanded position.

22. The device of claim 20 wherein: said packer mandrel is provided with another lateral port; a locking lug is mounted in said port for movement between retracted and expanded positions, said locking lug engaging in said locking groove when in expanded position, said sleeve when in position holding said locking member expanded also engaging and holding said locking lug in expanded position.

23. The device of claim 20 wherein: said sleeve and said packer mandrel are provided with cooperating means for releasably holding said sleeve in said other position wherein the locking member is held in expanded position.

24. A well tool comprising: an elongate tubular member; a locking member mounted on said tubular member for free lateral movement between projecting locking and retracted non-locking positions thereon; a sleeve member slidable longitudinally within said tubular member between upper and lower positions thereon and when in one of said positions being engageable with said locking member to hold said locking member in locking position; shoulder means on said tubular member and said sleeve member engageable with each other for limiting movement of said sleeve member longitudinally of said tubular member; a pair of longitudinally spaced oppositely facing internal annular shoulders in said tubular member, and a resilient member on said sleeve member having a projecting member thereon engageable with said shoulders in the tubular member to restrain the sleeve member in either of said upper and lower positions when engaged with the corresponding shoulder.

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# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

December 2, 1958

Patent No. 2,862,560

James H. Bostock et al.

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

Column 2, line 29, for "net" read -- set --; column 3, line 14, for "picker" read -- packer --; column 11, line 66, for "sad" read -- said --; column 13, line 31, strike out "a landing nipple of a well casing provided with a plurality".

Signed and sealed this 10th day of March 1959.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON

Commissioner of Patents