July 14, 1959 H. B. SCHRAMM ET AL 2,894,586

WELL TOOLS

Filed Feb. 2, 1955 3 Sheets-Sheet 1

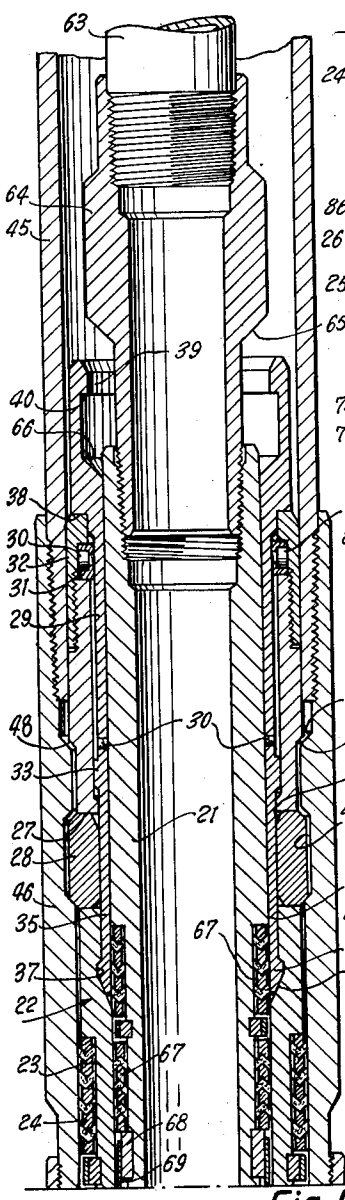


Fig. 1

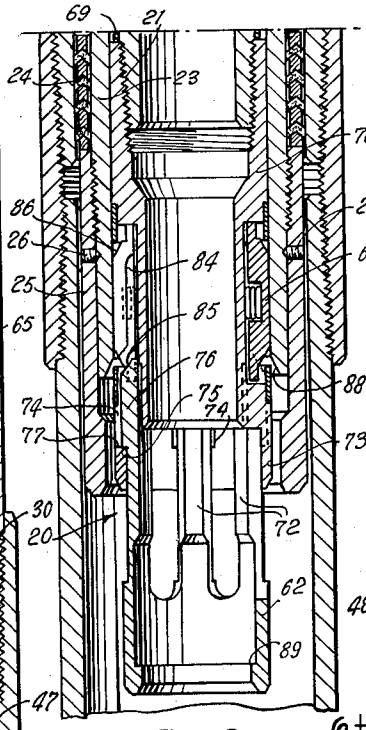


Fig. 2

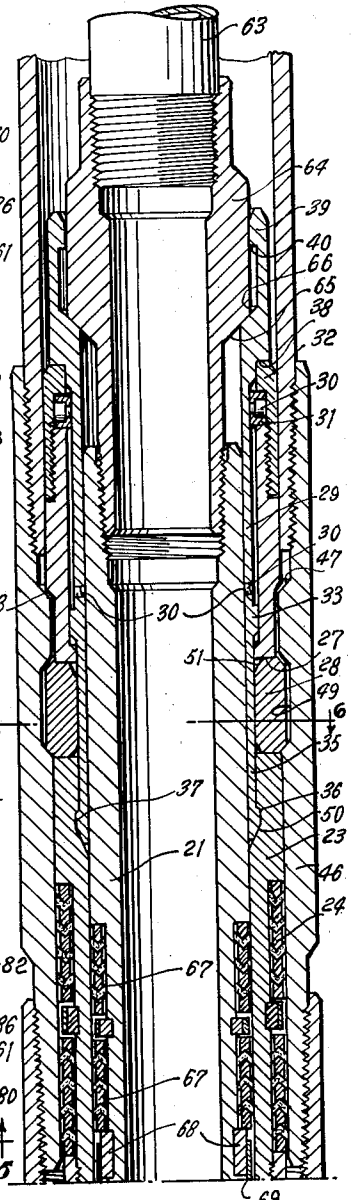


Fig. 3

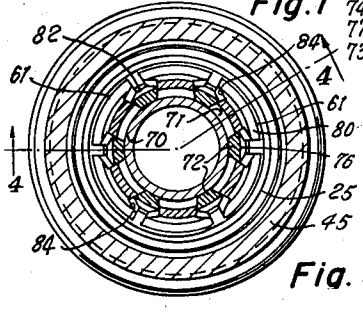


Fig. 5

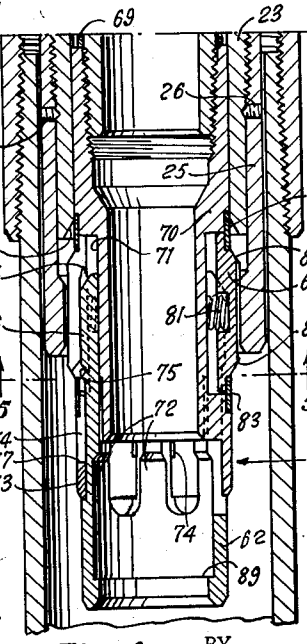


Fig. 4

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WELL TOOLS

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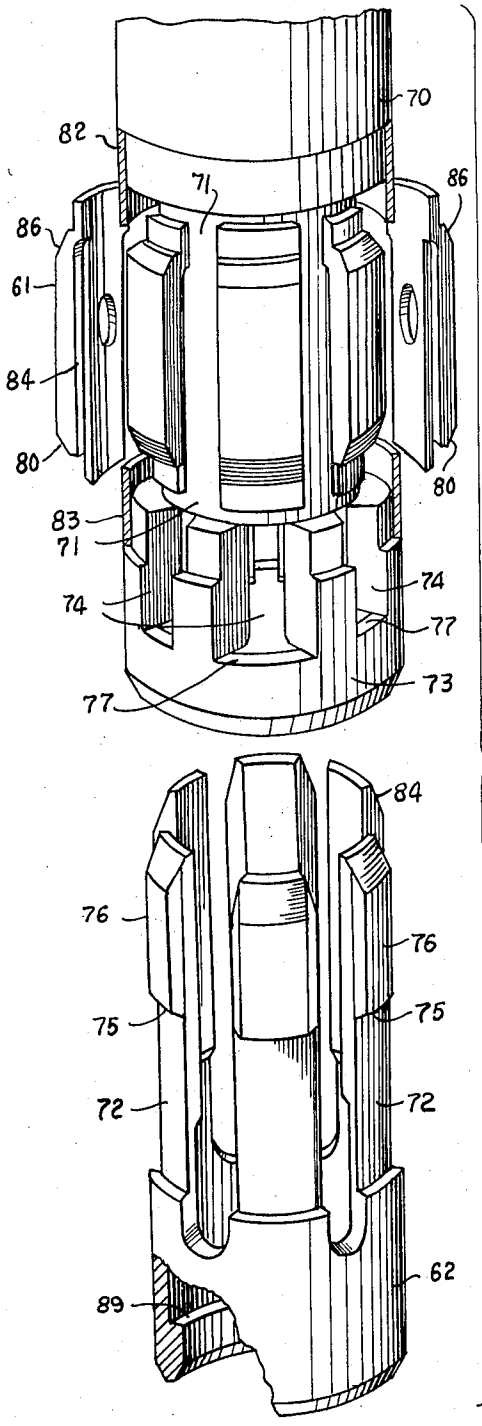


Fig. 7

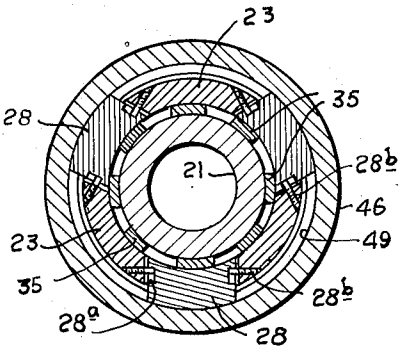


Fig. 6

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July 14, 1959 H. B. SCHRAMM ET AL 2,894,586

WELL TOOLS

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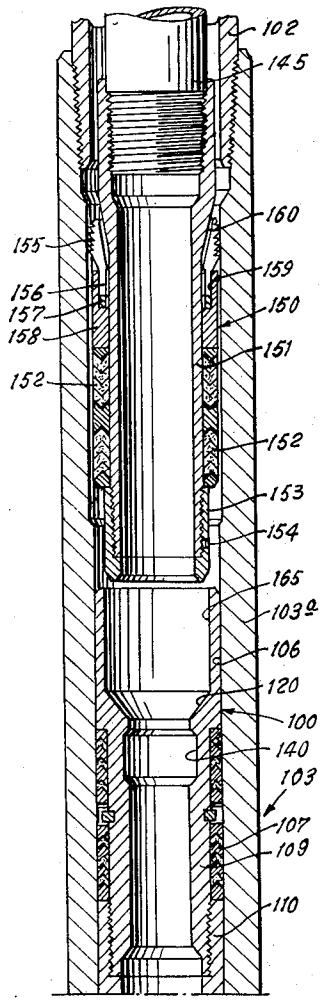


Fig. 8

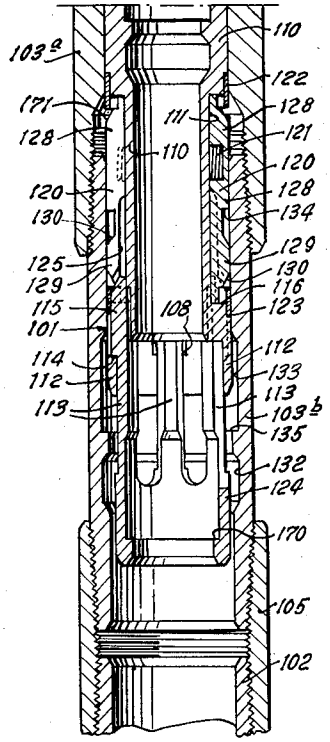


Fig. 9

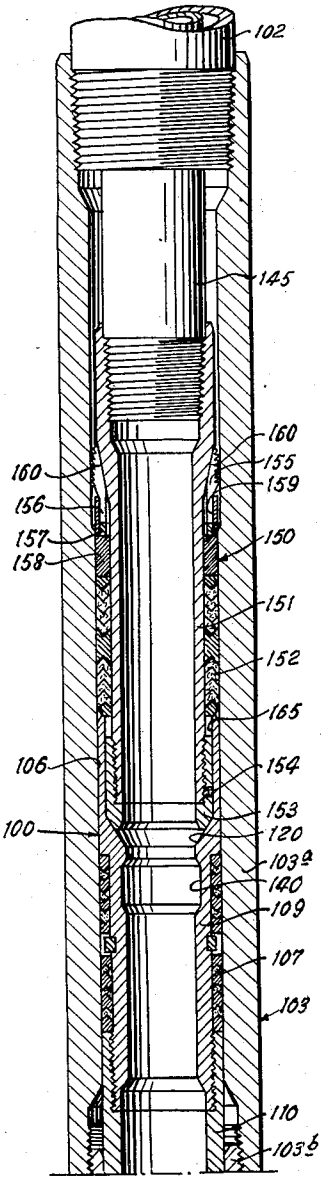


Fig. 10

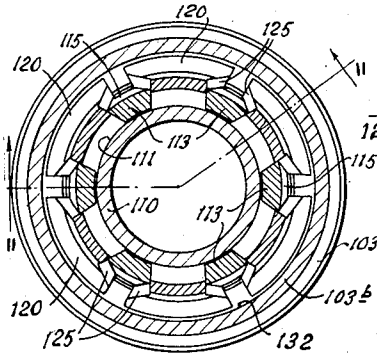


Fig. 12

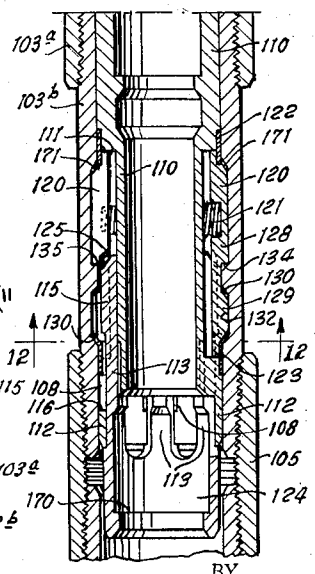


Fig. 11

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United States Patent Office 2,894,586 Patented July 14, 1959

2,894,586

WELL TOOLS

Harry B. Schramm and John V. Fredd, Dallas, Tex., assignors to Otis Engineering Corporation, Dallas, Tex., a corporation of Texas

Application February 2, 1955, Serial No. 485,732

8 Claims. (Cl. 166—125)

This invention relates to well tools and more particularly to a locking means for well tools.

One object of this invention is to provide a new and improved locking means for well tools.

A particular object of the invention is to provide a new and improved locking means for well tools which is especially adapted for locking a well packer in place in a well casing, whereby said packer may be anchored in said casing prior to installation of the well flow tubing and independently of the weight of such well flow tubing.

Another object of the invention is to provide a new and improved locking means of the type described having expansible means for holding the well tool in a selected position in a well, and locking means engageable with said expansible means to hold the expansible means in expanded position.

Still another object of the invention is to provide a new and improved locking means, of the type described, wherein the locking means is a collet member having fingers movable into engagement with the expansible means to lock the expansible means in expanded position.

A further object of the invention is to provide a new and improved locking means, of the type described, for a sealing nipple of a lug type packer, said locking means being adapted for use to lock the sealing nipple in the lug type packer against upward movement with respect thereto.

A still further object of the invention is to provide a new and improved locking device, of the type described, which is particularly adapted for use with a packer to lock the packer in a selected position in a well casing against upward movement with respect thereto.

An important object of the invention is to provide a new and improved locking means for well tools adapted for use with a well packer, whereby the well packer may be run into and locked in place in the well casing under pressure on a flexible line independently of the well flow tubing, and wherein said packer may then be plugged to seal off pressure below the packer, whereby the flow tubing may be inserted in the well without the application of pressure thereagainst and said tubing may be seated in said packer, after which the packer may be unplugged through the flow tubing to permit well fluids to flow upwardly through the packer to the bore of the well flow tubing; said well tool and locking means permitting plugging the packer, removing the tubing without application of pressure thereagainst, unplugging the packer, and then removing the packer from the well casing under pressure by means of a flexible line.

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

Figure 1 is a vertical sectional view, taken substantially along the line 4—4 of Figure 5, of the upper portion of a lug type packer in position in a well casing and having a well flow tubing connected thereto by means of a sealing nipple provided with the new and improved locking means of the invention;

Figure 2 is a continuation of Figure 1 showing the lower portion of the lug type packer, showing the locking means in unlocked position;

Figure 3 is a vertical sectional view, similar to Figure 1, of the upper portion of the lug type packer and sealing nipple;

Figure 4 is a continuation of Figure 3, showing the lower portion of the lug type packer, showing the locking means in locked position;

Figure 5 is a horizontal cross-sectional view taken on line 5—5 of Figure 4;

Figure 6 is a horizontal cross-sectional view taken on the line 6—6 of Figure 3;

Figure 7 is an enlarged exploded view of parts of the locking means of the invention;

Figure 8 is a vertical sectional view, taken substantially along line 11—11 of Figure 12, showing the upper portion of a packer in position in a well casing, said packer having the new and improved locking means of the invention;

Figure 9 is a continuation of Figure 8, showing the lower portion of the packer, and showing the locking means in unlocked position;

Figure 10 is a vertical sectional view, similar to Figure 8, of the upper portion of the packer;

Figure 11 is a continuation of Figure 10 showing the lower portion of the packer, showing the locking means in locked position, and

Figure 12 is a horizontal cross-sectional view taken on the line 12—12 of Figure 11.

Referring now particularly to Figures 1 through 5 of the drawings, the new and improved locking means 20 is shown connected to the lower end of the sealing nipple 21 which is shown used with a lug type packer 22 of the type disclosed in the co-pending application of James H. Bostock, Serial No. 400,444, filed December 28, 1953. Briefly, the lug type packer 22 includes a tubular main mandrel 23 provided with an exterior packing assembly 24, of the pressure seal or chevron type, which is held in position by a packing retaining sleeve or ring 25 threaded on the lower end of the main mandrel and held rigidly against displacement therefrom by set screws 26.

The main mandrel 23 of the packer has a plurality of lateral apertures or windows 27 disposed above the packer assembly, and lugs 28 are slidably positioned in said windows for lateral movement between retracted and expanded positions. Each of the lugs has slots 28*a* formed in its sides which receive the ends of retaining pins 28*b* carried by the main mandrel and engaging in the slots to limit outward movement of the lugs. The lugs are moved outwardly to expanded position by a lock mandrel 29 which is slidable downwardly in the upper end of the main mandrel from an upper position wherein its lower end is disposed above the lugs to the position shown in Figures 1 and 3 wherein it engages the inner side of the lugs to hold said lugs expanded. The lock mandrel is releasably held in its upper position by threaded shear pins 30 which extend from holes in a retainer ring 31 into suitable threaded holes in the side of the lock mandrel. The retainer ring is disposed above the main mandrel and is held in place by a lock collar 32 threaded on the upper end of the main mandrel. The lock mandrel is provided with an external annular flange 33 intermediate its ends which engages the retainer ring 31 to limit upward movement of the lock mandrel in the main mandrel.

The lower portion of the lock mandrel is slitted vertically to form resilient collet fingers 35 having at their lower ends outwardly extending bosses 36, which are

engageable in an internal annular groove 37 formed in the bore of the main mandrel below the windows 27.

The upper end of the lock mandrel is enlarged to provide an external downwardly facing stop shoulder 38 which engages the upper end of the lock collar 32 to limit downward movement of the lock mandrel into the main mandrel. The upper end of the bore of the lock mandrel is also enlarged and an internal annular flange 39 provides a downwardly facing shoulder 40 which may be engaged by a running tool to lower the packer into the well casing 45 having a landing nipple 46 threadedly connected therein to adjacent sections of said well casing. The landing nipple has an upwardly facing internal annular stop shoulder 47 which engages the downwardly facing external annular shoulder 48 of the main mandrel to limit downward movement of the packer in the casing, and to position the lugs 28 opposite the internal annular locking groove 49 of the landing nipple.

The packer 22 is lowered into the well casing by means of a suitable running tool which engages under the shoulder 40 of the lock mandrel, the lock mandrel being rigidly secured in its upper position on the main mandrel 23 by the shear pins 30 so that its lower end is disposed above the lugs 28 which are thus free to move to their retracted position.

When the packer is lowered into the landing nipple to the position shown, the stop shoulder 48 of the main mandrel engages the stop shoulder 47 of the landing nipple and further downward movement of the packer is stopped, and the lugs 28 are then positioned opposite the locking groove or recess 49. Downward blows are then imparted through the running tool to the upper end of the lock mandrel, shearing the shear pins 30 and freeing the lock mandrel to move downwardly in the main mandrel to the position shown in Figures 1 and 3, the collet fingers 35 moving down past the lugs 28 to move the lugs 28 outwardly into the lock recess due to the camming action between the beveled shoulders 50 at the lower ends of the collet fingers and the tapered surfaces 51 at the upper ends of the lugs. The bosses 36 of the collet fingers move into the annular groove 37 in the bore of the main mandrel to lock the lock mandrel in its lower position. The packer is thus positioned and locked in place in the landing nipple, and the lowering operation may be performed under pressure by means of a suitable customary flexible line lowering mechanism (not shown).

The sealing nipple 21 is removably locked in place in the packer 22 by a locking means which includes sealing nipple locking lugs 61 and a collet body 62. The upper end of the sealing nipple is connected to a well tubing 63 by a fitting or sub 64 provided with a downwardly facing external annular stop shoulder 65 which engages an internal annular upwardly facing stop shoulder 66 in the upper end of the lock mandrel 29 of the packer, such engagement limiting downward movement of the sealing nipple in the packer and positioning the sealing nipple locking lugs 61 below the lower end of the main mandrel 23 of the packer. The sealing nipple is provided with an external packer assembly 67 secured in place therein by a split ring 68 fitting in an external annular groove in the sealing nipple, the split ring being positively retained in position by a retaining ring 69 slidable thereover and disposed between the lower end of the packer assembly and the upper end of a tubular body 70 threaded on the lower end of the sealing nipple.

The tubular body is provided with an elongate external annular groove or reduced diameter 71 intermediate the ends of said body, and an annular skirt or sleeve 73 having a bore larger than that of the tubular body depends from the lower end of said tubular body. A plurality of circumferentially spaced slots or openings 74 provide communication between the bore of the skirt and the annular groove 71, whereby upwardly extending resilient fingers 72 of the collet body 62 may be inserted

through said openings to slide along the bottom or inner surface of the groove 71 above the skirt. The collet fingers are sprung inwardly as they pass through the skirt and then frictionally ride on the inner or bottom surface of the reduced central portion of the tubular body. Once the collet body is assembled on the tubular body, its downward movement on the tubular body is limited by the engagement of downwardly facing stop shoulders 75 provided by the outwardly projecting bosses 76 on the upper ends of the collet fingers and upwardly facing stop shoulders 77 at the lower ends of the openings 74 in the skirt portion of the tubular body. The locking lugs 61 are disposed in the external annular groove 71 of the tubular body and are biased laterally outwardly by springs 81 whose opposite ends bear against the bottom of the groove and the inner side of the locking lugs. Outward movement of the locking lugs is limited by upper and lower retainer rings or bands 82 and 83, respectively.

The opposed inner vertical edges of each of the locking lugs are provided with elongate locking grooves or recesses 84 into which the collet bosses 76 are adapted to slide, from the position shown in Figure 2 to the position shown in Figure 4, to lock the locking lugs in the expanded position shown in Figure 4. The collet body is retained in the upper locking position by the frictional engagement of the resilient collet fingers with the surface of the tubular body in the annular groove 71. The collet fingers space the locking lugs 61 circumferentially in the annular groove.

In use, the sealing nipple 21 is connected to the lower end of the well conductor 63 by the fitting or sub 64 and is lowered thereby into the well with the collet body 62 in its lower position on the tubular body, as shown in Figure 2. In this position, the collet fingers are positioned below the locking lugs so that the latter are free to move inwardly and outwardly between expanded and retracted positions as the sealing nipple is moved downwardly, the beveled shoulders 80 at the lower end of the locking lugs camming the lugs inwardly upon meeting obstructions during such downward travel. When the sealing nipple enters into the packer and is properly positioned therein, the stop shoulder 65 of the fitting 64 engages the stop shoulder 66 of the lock mandrel 29, and thus stops further downward movement of the sealing nipple. The sealing nipple is then in the position shown in Figures 3 and 4, with the locking lugs 61 positioned below the lower end of the main mandrel 23 of the packer and biased to expanded position by the springs 81.

The collet body 62 is then moved upwardly to the position shown in Figure 4 by a suitable tool lowered through the well tubing by means of a flexible line to engage the lower end of the collet body so that upward jars or impacts may be delivered thereto. The upper portion of each collet finger is then disposed in the inner recesses 84 of the two adjacent locking lugs, and locks the lugs in expanded position, so that any upward movement of the sealing nipple will cause the beveled upper shoulders 86 of the lugs to engage the beveled shoulder 88 at the lower end of the main mandrel 23 and thus prevent upward movement of the sealing nipple out of the packer. The sealing nipple is thus held locked in position until it is desired to remove it from the packer. In this event, a suitable tool carrying spring-pressed lugs is lowered by means of a flexible line through the well tubing 63 and the sealing nipple so that the spring-pressed lugs engage the internal annular upwardly facing shoulder 89 at the lower end of the collet body, whereby downward jars imparted to the tool will cause the collet body to be moved downwardly to the position shown in Figure 2, wherein the bosses of the collet fingers are below the locking grooves 84 of the locking lugs and the locking lugs are free to move toward retracted position. The sealing nipple can then be raised, the beveled upper

shoulders 86 of the locking lugs camming the lugs inwardly upon encountering obstructions during such upward movement.

It will thus be seen that a new and improved locking means for a well tool, such as a sealing nipple 21, has been illustrated and described. The locking means includes a tubular member 70 rigidly secured to the well tool and carrying expansible means, the locking lugs 61, adapted to contact a downwardly facing stop means or shoulder 88 in a well casing to hold the sealing nipple against upward movement in the well casing. It will also be seen that a locking means, the collet body 62, is slidably mounted on the tubular body and is movable upwardly thereon into engagement with the expansible means to lock the expansible means in expanded position, and is movable downwardly from such position to permit the expansible means to retract.

In Figures 8 through 12, a packer 100 is illustrated as having a locking assembly 101, similar to the locking means 20 already described, employed therewith for locking the packer in place in a well casing. The string of well casing includes the usual casing sections 102 and has a packer landing nipple 103 threaded on the lower end of one casing section, said landing nipple including a sealing nipple 103*a* and a locking nipple 103*b* threaded into the lower end of the sealing nipple, the lower end of the packer landing nipple being connected to the next lower tubing section by a coupling 105 in the usual manner. The sealing nipple has the lower portion of its bore reduced in diameter to provide a sealing surface 106 adapted to be contacted by a packing assembly 107 mounted exteriorly on the packer.

The packer 100 includes a main mandrel 109 having the packing assembly 107 mounted thereon, and is held against upward or downward movement in the packer landing nipple by means of the locking assembly 101 which seats and locks in the locking nipple 103*b*. The locking assembly includes a tubular body 110 threaded on the lower end of the main mandrel and provided in its lower portion with an elongate external annular groove 111. An annular sleeve or skirt 112 having a bore larger than the bore of the tubular body depends from the lower end of said tubular body, and a plurality of circumferentially spaced slots or openings 108 provide vertical and lateral communication between the bore of the skirt and the annular groove 111, whereby upwardly extending resilient fingers 113 of the collet body 124 may be inserted upwardly through said openings to slide along the inner or bottom surface of the groove 111 above the skirt. The collet fingers frictionally engage and ride on the bottom or inner surface of said annular groove in the lower portion of the tubular body. Once the collet body is assembled on the tubular body, its downward movement is limited by the downwardly facing stop shoulders 114 provided at the lower end of the outwardly projecting bosses 115 of the collet fingers engaging the upwardly facing stop shoulders 116 at the lower ends of the openings 108 in the skirt portion of the tubular body. Locking dogs or selector keys 120, corresponding generally to the locking lugs 61 of Figures 2 and 4, are disposed in the annular groove 11 of the tubular body, and such keys are biased outwardly by springs 121 whose opposite ends bear against the bottom of the annular groove and against the inner side of the selector keys. Outward movement of the selector keys is limited by upper and lower retainer rings or bands 122 and 123, respectively.

The opposed inner vertical edges or sides of each of the selector lugs are provided with elongate locking grooves or recesses 125 into which the collet bosses 115 are adapted to slide, from the position shown in Figure 9 to the position shown in Figure 11, to lock the selector keys in the expanded positions shown in Figure 11. The collet body is retained in the upper locking position by the frictional engagement of the resilient collet fingers 113 with inner or bottom surface of the groove 111 in the tubular body. The collet fingers space the locking dogs or selector keys circumferentially in the annular groove.

In use, the packer may be locked in place in the landing nipple 103 before running the casing, or the packer may be secured to the lower end of a suitable running tool (not shown) and lowered through the well casing 102 by means of a flexible line lowering mechanism of the usual type, with the parts of the packer in the positions shown in Figures 8 and 9. The selector keys 120 have two bosses 128 and 129, the lower bosses having outwardly convergent beveled shoulders 130 which cam the selector keys inwardly toward retracted positions upon meeting obstructions, thus permitting the packer to move downwardly in the tubing and through various landing nipples constituting portions thereof, until a landing nipple 103 is reached having a locking nipple 103*b* whose internal configuration corresponds with the external configuration of the selector keys, said locking nipple being provided with a lower annular recess 132 into which the lower boss 129 enters and an upper annular recess 133 into which the upper boss 128 enters. The upper boss has an abrupt outwardly extending substantially horizontal downwardly facing stop shoulder 134 which engages a similar upwardly facing stop shoulder 135 defining the lower edge of the upper annular recess 133, whereby downward movement of the main mandrel in the well casing is stopped by such engagement.

The collet body 124 is then moved upwardly by suitable means carried by the running tool which engages the lower end of the collet body and moves the same upwardly, by upward jars or blows imparted by means of the flexible line to the running tool. The collet body is thus moved upwardly to the position shown in Figure 11, wherein each of the bosses 115 of the collet fingers is in the locking groove 125 of the adjacent selector keys whereby the selector keys are locked in their expanded positions and the packer is firmly and positively locked in position in the landing nipple.

A suitable plugging or obstructive device (not shown), similar to that illustrated in the patent to H. C. Otis, No. 2,144,850, issued January 24, 1939, or that shown in the patent to I. A. Miller, No. 2,673,614, issued March 30, 1954, may then be lowered into the well and locked in place in the bore 140 of the main mandrel 109 of the packer, to close the same against upward flow of fluids therethrough. After this has been done, the well tubing 145 may be lowered into the casing string without sealing between the tubing and the casing, since there is no pressure in the casing above the packer and the obstructive device or plug. A suitable sealing nipple assembly 150 may be connected at the lower end of the tubing string, for sealing between said lower end of the tubing and the bore wall of the packing nipple 103*a* above the packer, whereby fluids flowing upwardly through the packer will be directed into the bore of the tubing. The sealing nipple assembly shown includes an elongate mandrel 151 having mounted thereon a packing assembly 152, preferably comprising a plurality of rings of pressure expansible or chevron type packing held in place on said mandrel by a collar or shoe 153 threaded on the lower end of the mandrel and held against displacement therefrom by a set screw 154.

A ring of locking slips 155, having serrated gripping faces at their upper ends, are provided with resilient depending handles 156 which are connected to a continuous annular base ring 157 at their lower ends. The slip handles and base ring are mounted in a slip carrier sleeve 158 which is slidable on the mandrel 151 above the packing and has in its upper end an internal annular upwardly opening recess 159 for receiving said slip handles and ring and supporting the ring of slips in place on the upper end of the carrier sleeve. The slips may be expanded and retracted laterally, the resilient handles permitting the slips to be moved laterally.

The mandrel 151 is provided with an upwardly and

outwardly inclined frusto-conical expander portion 160 above the slip carrier sleeve, and this expander portion engages the inner surfaces of the slips 155 to move said slips outwardly to expanded positions upon downward movement of the mandrel relative to the slips. Such expansion of the slips moves their serrated faces into gripping engagement with the bore wall of the upper portion of the sealing nipple 103*a* whereby the packing 152 will engage the lower end of the slip carrier 158 and be prevented from moving upwardly when subjected to fluid pressure from below.

The collar 153 at the lower end of the mandrel 151 is adapted to enter the enlarged bore 165 at the upper end of the main mandrel 109, and the lower end of the packing assembly will engage the upper end of the main mandrel of the packer and move the packing upwardly on the mandrel 151 of the seal nipple 150 at the lower end of the tubing strings. Such upward movement of the packing will move the slip carrier and slips upwardly relative to the expander surface 160, whereby the slips are moved outwardly into gripping engagement with the bore wall of the sealing nipple, and the sealing assembly is locked against upward movement because of the fluid pressure therebelow. The weight of the tubing string prevents upward movement of the tubing, and the external diameter of the mandrel 151 of the sealing nipple assembly is preferably no greater than the external diameter of the tubing string, whereby the area subjected to upward pressure will not readily lift the string of tubing.

The collar at the lower end of the sealing nipple assembly 150 may engage the upwardly facing seat 120 in the bore of the main mandrel 109 of the packer to further limit downward movement of the lower end of the tubing.

After the tubing has been installed in the manner described, the obstructive device or plug may be removed from the bore of the main mandrel of the packer, whereupon fluids may flow upwardly through the packer 100 and through the sealing nipple 150 and into the bore of the tubing 145 thereabove, by means of which fluids will be conducted to the surface of the earth.

When it is desired to remove the packer, the bore of the main mandrel 109 is first plugged by the obstructive device (not shown), whereupon the string of tubing 145 and the sealing nipple assembly 150 may be lifted from within the well casing 102 without the necessity of sealing between the casing and tubing, since well fluid pressure is shut off at the packer by the obstructive device. The obstructive device is then removed "under pressure" in the usual manner, and a suitable tool carrying spring-pressed lugs is lowered through the well casing until the spring-pressed lugs engage the upwardly facing internal annular shoulder 170 at the lower end of the collet body, whereby downward jars imparted to the tool will move the collet body downwardly from the position shown in Figure 11 to the position shown in Figure 9, wherein the bosses 115 of the collet fingers are moved below the locking grooves 125 in the selector keys and said selector keys are freed to move inwardly toward retracted positions.

The packer then is free to move upwardly, the downwardly and outwardly beveled shoulders 171 at the upper ends of the upper bosses and the shoulders 130 at the upper ends of the lower bosses of the selector keys camming said selector keys inwardly upon meeting obstructions during such upward movement.

It will thus be seen that a packer 100 has been shown provided with a locking means which includes locking dogs or selector keys engageable with a selected packer landing nipple having a locking nipple of corresponding internal configuration, and a collet body for locking the selector keys in expanded positions in the selected landing nipple. It will also be seen that the sealing nipple at the lower end of the tubing may be provided wtih serrated slips 155 which are moved into engagement with the well casing to serve to prevent upward movement of the sealing means of said sealing nipple.

It will likewise be manifest that the packer may be lowered into and locked in place in the casing by means of a flexible line lowering mechanism, and that the bore of the packer may then be closed by an obstructive device or plug, and a string of well tubing may be lowered into the casing without being subjected to well pressure, and sealed at its lower end in the bore of the sealing nipple of the packer landing nipple, whereupon the obstructive device may be removed and the well flowed through the tubing. It will also be apparent that the procedure may be reversed to permit removal of the tubing without subjecting the same to pressure of the well fluids, and that the obstructive device and the packer 100 may thereafter be removed by means of the flexible line lowering mechanism.

It will be particularly noted that positive locking means has been provided which is not subjected to unlocking force by the pressure of the well fluids and yet which may be readily locked and unlocked by a flexible line lowering mechanism.

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 we claim and desire to secure by Letters Patent is:

1. A locking means for well tools comprising: a packer having means for anchoring it in place in a well flow conductor and having a longitudinal bore; an elongate sealing nipple body adapted to be connected to a well flow conductor, said body being slidably insertable in the bore of said packer; expansible means carried on said body and engageable with a downwardly facing shoulder of said packer when in expanded position to hold said body in place in the bore of said packer against upward movement therefrom; and locking means slidable on said body and movable upwardly between the body and said expansible means into engagement with said expansible means to lock said expansible means in expanded position holding said body in place in the bore of said packer.

2. A locking means of the character set forth in claim 1 wherein the resilient means is provided on the body engaging said expansible means to bias said expansible means toward expanded position.

3. A locking means of the character set forth in claim 1 wherein a landing nipple having a longitudinal bore provided with an internal locking recess is adapted to be connected in a well tubing, and said packer is adapted to land in said landing nipple and the locking means engage in the locking recess in said nipple.

4. A locking means for a well tool comprising: an elongate body connectable to a well tool and having a longitudinal opening therethrough, said body also having an external annular recess; movable means in said recess movable outwardly toward expanded position; means biasing said movable means outwardly toward such expanded position; and a collet body on said elongate body and having fingers extending upwardly into said recess, said collet body being movable upwardly on said elongate body into engagement with said movable means to lock said movable means in expanded position, said collet body having a bore provided at its lower end with an upwardly facing shoulder, whereby said collet body may be moved downwardly to release said collet fingers from locking engagement with said movable means.

5. A locking means for a well comprising: an elongate tubular body connectable to a well tool and having an external annular recess; movable means in said recess movable outwardly toward expanded positions; a collet body on said elongate tubular body and having fingers extending upwardly into said recess, said collet body being movable upwardly on said elongate tubular body into engagement with said movable means to lock said movable means in expanded positions; said collet body having a longitudinal bore therethrough provided at its lower

end with an internal annular upwardly facing shoulder adapted to be engaged by a well tool to force said collet body downwardly to move said collet fingers from position locking said movable means in expanded position; and means biasing said movable means toward expanded position.

6. Means for treating a well having a well casing therein with a landing nipple connected in said well casing, said means including: a tubular packer insertable into said well casing and lockable in said landing nipple, said packer having a tubular body with a locking and seating section in its bore for receiving an insertable and removable flow controlling obstructive device for closing the bore of said packer body, said packer body also having its bore above said locking and seating section enlarged; and a tubular sealing nipple having means for connecting it to a well tubing and having external sealing means thereon insertable in said enlarged bore of said packer body and engageable therewith for sealing therebetween, said sealing nipple having a bore at least as large as the locking and seating section of the packer body bore, whereby the insertable and removable obstructive device may be inserted into and removed from said locking and seating section in the bore of the packer body through the bore of said sealing nipple.

7. A locking assembly for locking a sealing nipple of a well flow conductor within a packer having a body and means for locking it in place in a well, said body having a longitudinal bore and a shoulder on its lower end portion; said sealing nipple being adapted to be connected to a well flow conductor and to enter the bore of said packer body; stop means carried by said sealing nipple and adapted to engage said packer body to limit downward movement of said sealing nipple in the bore of said packer body; a tubular body having a longitudinal opening therein connected to the lower end of said sealing nipple; laterally movable means carried by said tubular body and engageable when in expanded position with said shoulder on the lower end of said packer body when said sealing nipple is in said packer body; and locking means on said tubular body movable longitudinally of said longitudinal opening into engagement with the movable means to lock said movable means in expanded position, said locking means having a portion accessible through said tubular body for engagement from within said tubular body whereby said locking means may be moved into and out of locking engagement with said movable means.

8. A locking assembly for locking a packer in a well tubing having a landing nipple provided with an internal recess, said locking assembly comprising: a packer mandrel having a longitudinal bore therethrough and a downwardly facing stop shoulder in the bore thereof; locking means mounted on said packer mandrel and expansible into position to engage the internal recess of the landing nipple and lock said packer mandrel in said landing nipple against relative longitudinal movement therein; means movable on the mandrel into engagement with the locking means to hold said locking means in such expanded position; a sealing nipple adapted to enter the bore of the packer mandrel and having stop means mounted thereon engageable with the packer mandrel for limiting downward movement of said sealing nipple in said bore; a tubular body having a longitudinal opening therethrough connected to the lower end of the sealing nipple; movable means carried by said tubular body and movable outwardly into expanded position and into engagement with said downwardly facing stop shoulder in the bore of said packer mandrel to hold said sealing nipple against upward movement in the packer mandrel; and locking means on said body movable longitudinally of said longitudinal opening into engagement with the movable means when said movable means is in expanded position in position to engage said stop shoulder in the bore of said packer mandrel to lock said movable means in said expanded position, said locking means having a portion accessible through said tubular body for engagement from within said tubular body whereby a tool may be lowered through the sealing nipple and tubular body to engage and move said locking means longitudinally into and out of engagement with said movable means.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,894,586

July 14, 1959

Harry B. Schramm 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 8, line 66, after "well" insert -- tool --.

Signed and sealed this 12th day of January 1960.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents