

Sept. 3, 1963

P. S. SIZER

3,102,593

ANCHORING AND SEALING DEVICES

Filed Sept. 9, 1959

4 Sheets-Sheet 1

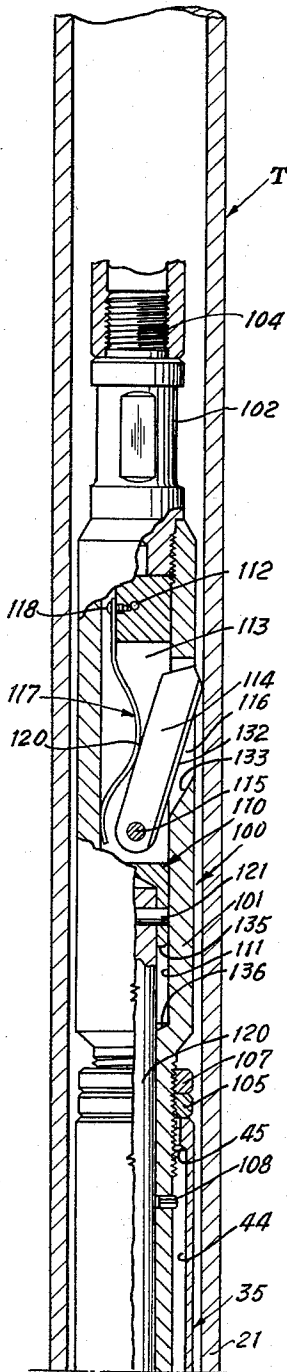


Fig. 1

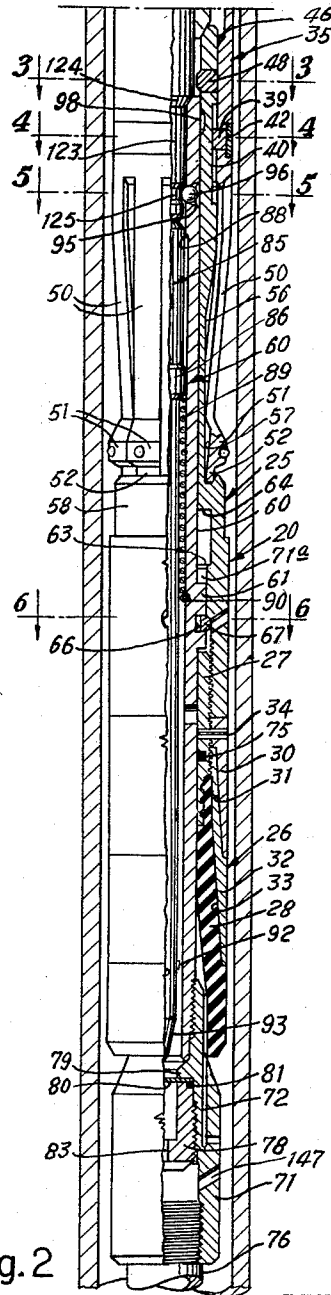


Fig. 2

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4 Sheets-Sheet 2

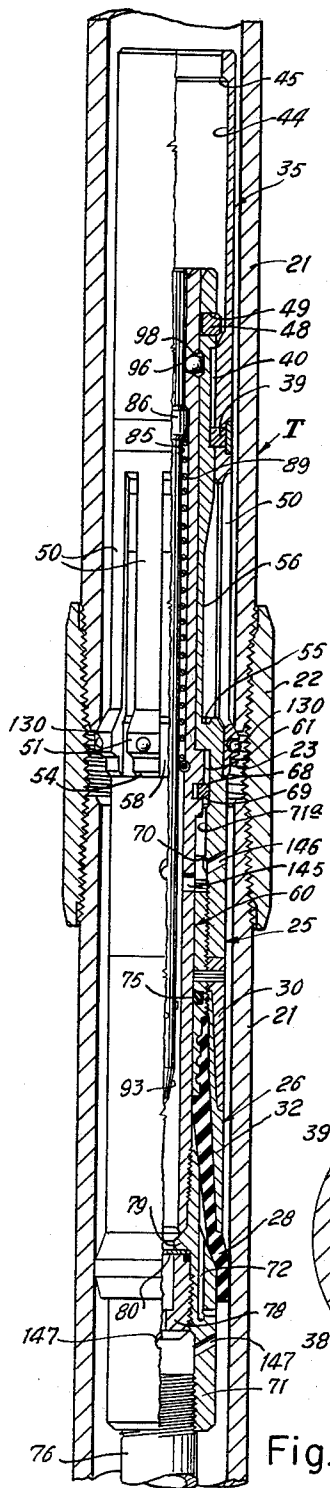


Fig. 9

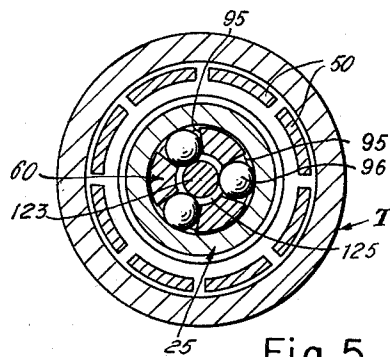


Fig. 5

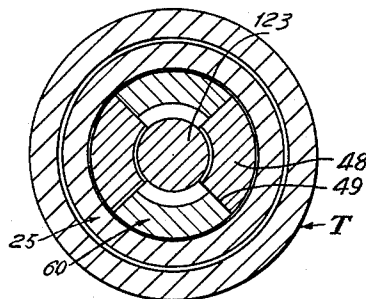


Fig. 3

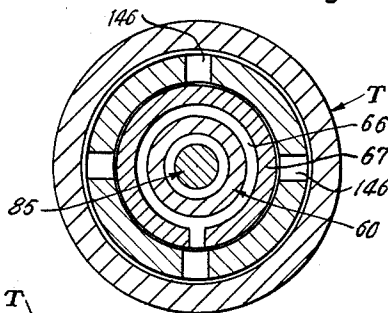


Fig. 6

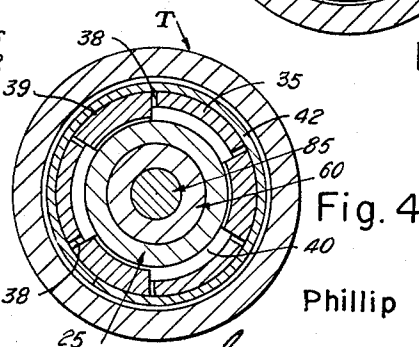


Fig. 4

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ANCHORING AND SEALING DEVICES

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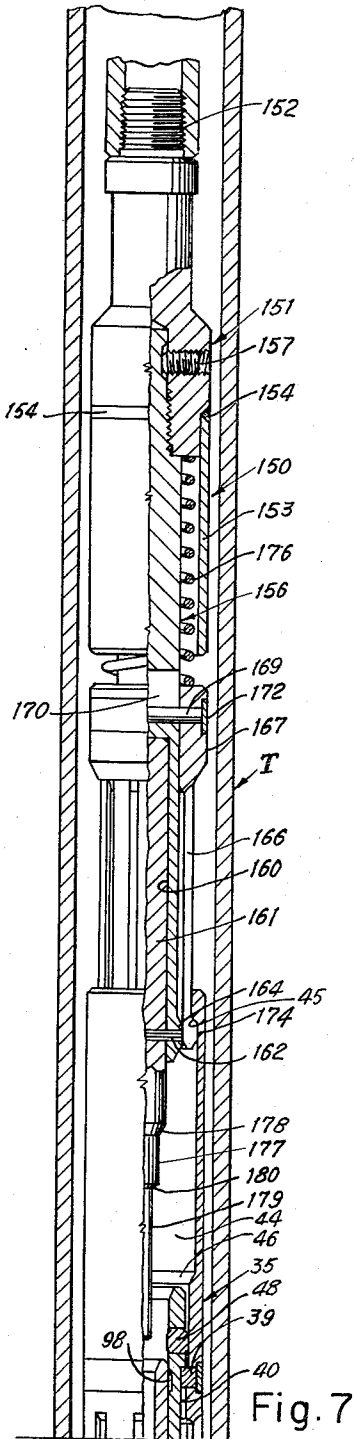


Fig. 7

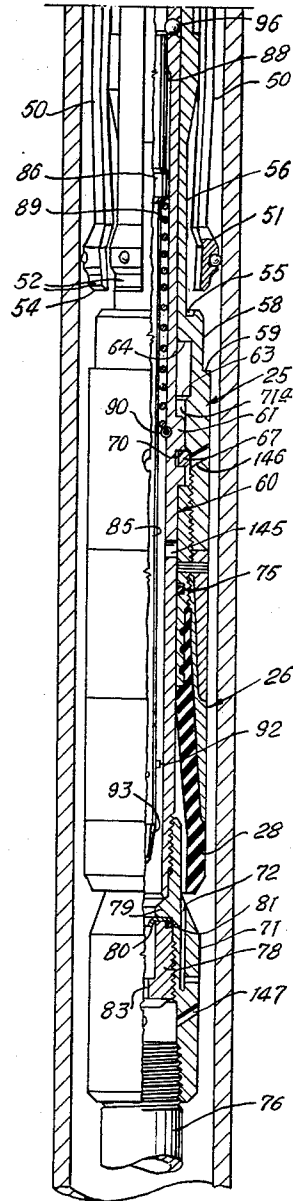


Fig. 8

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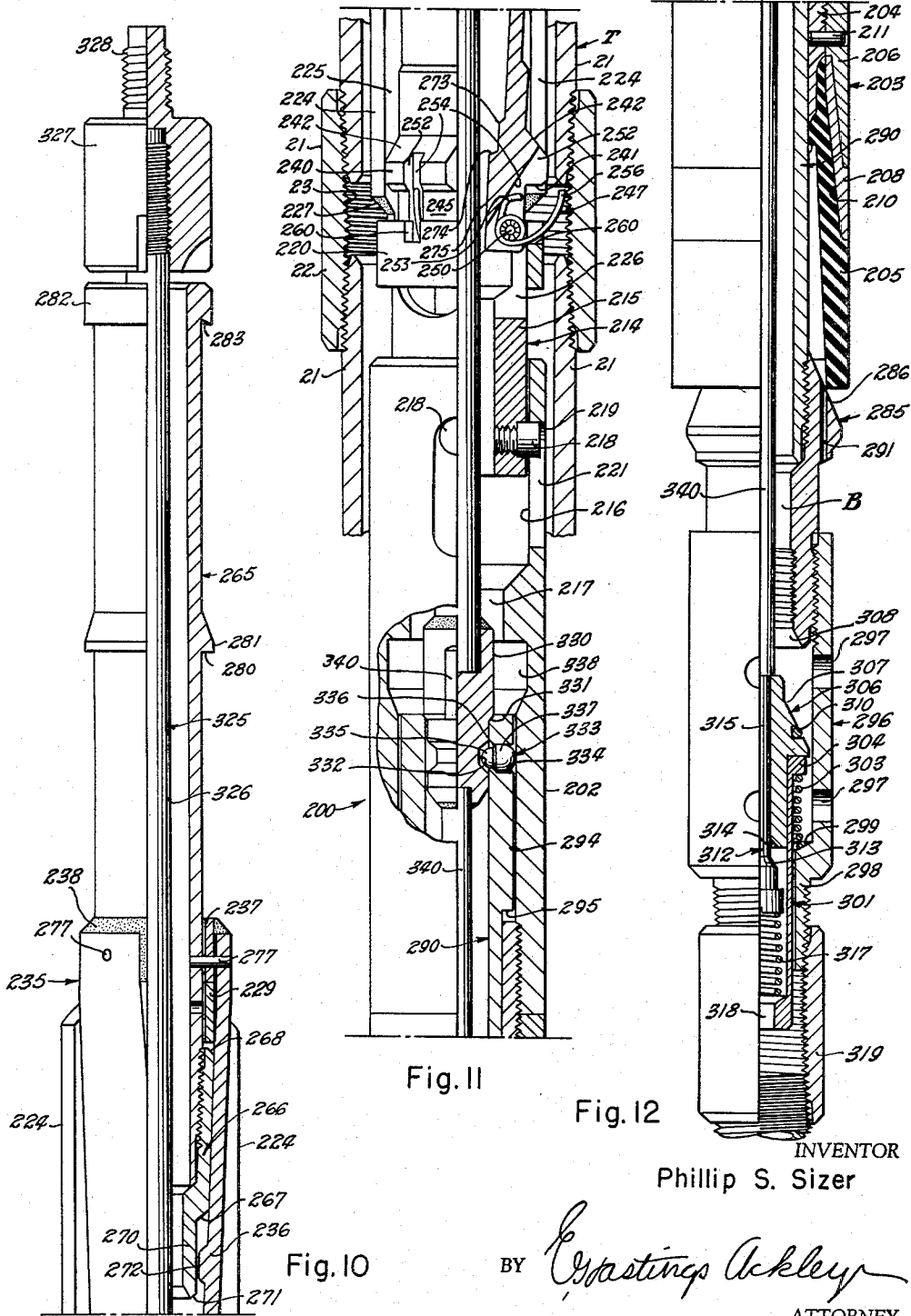


Fig. 11

Fig. 12

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3,102,593

ANCHORING AND SEALING DEVICES

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Filed Sept. 9, 1959, Ser. No. 838,892

22 Claims. (Cl. 166-125)

This invention relates to well tools and more particularly to anchoring and sealing devices releasably securing well devices in a well flow conductor.

An object of the invention is to provide a new and improved anchoring and sealing device for releasably securing well devices in a well flow conductor lowerable into the well flow conductor by a suitable running tool releasable from the anchoring and sealing device only after the anchoring and sealing device has been positively anchored in the well flow conductor and has closed it against fluid flow past the anchoring and sealing device.

Another object is to provide an anchoring and sealing device for supporting a well device at a selected position in a well flow conductor whose anchoring means and sealing means are operable with a minimum of jars being imparted to the supported well device during the anchoring and sealing operations which anchor and anchoring and sealing device in the well flow conductor and close the well flow conductor above the supported well device.

Still another object is to provide an anchoring and sealing device which is lowerable into a well flow conductor by a running tool which is releasable from the anchoring and sealing device only after the anchoring and sealing device has been anchored in the well flow conductor and has fully closed the well flow conductor against flow of fluids therepast.

A further object is to provide an anchoring and sealing device having a seal means engageable with the bore wall of a well flow conductor when the anchoring and sealing device is anchored in the well flow conductor and provided with a pressure equalizing device for permitting flow of well fluids in the well flow conductor past the sealing device which must be operated to permit such pressure equalizing flow before the sealing means is permitted to move out of sealing engagement with the bore wall of the well flow conductor and the anchoring means of the device are released to permit withdrawal of the anchoring and sealing device from the well flow conductor.

A still further object of the invention is to provide an anchoring and sealing device having anchoring means for anchoring the device in a selected position in a well flow conductor, a sealing means expandable into sealing engagement with the bore wall of the well flow conductor after the device is anchored therein to prevent flow of well fluids past the device, expander means engageable with the seal means for expanding the seal means into sealing engagement with the bore wall and a pressure equalizing means for permitting flow of fluids in the well flow conductor past the seal means while the expander means is still in expanding engagement with the seal means, wherein the anchoring means must have anchored the anchoring and sealing device in a well flow conductor before the expander may be moved into expanding engagement with the seal means, the expander means must have been moved into expanding engagement with the seal means before the running tool by means of which the device is lowered to the well flow conductor may be released from the anchoring and sealing device, the pressure equalizing means must be opened by a suitable pulling tool before the expander means

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may again be moved out of expanding engagement with the sealing means and the anchoring means may be operated to release the anchoring and sealing device for removal from the well conductor only after the expander means has been moved out of expanding engagement with the seal means.

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 view, partly in elevation and partly in section, of the upper portions of the anchoring and sealing device embodying the invention showing the device as it appears while being lowered through a well flow conductor by means of a running tool;

FIGURE 2 is a view similar to FIGURE 1, being a continuation thereof, showing the lower portions of the anchoring and sealing device;

FIGURES 3, 4, 5 and 6 are cross-sectional views taken on lines 3-3, 4-4, 5-5 and 6-6, respectively, of FIGURE 2;

FIGURE 7 is a vertical view, partly in elevation and partly in section, showing the upper portion of the anchoring and sealing device as it appears after the pressure equalizing means has been opened by a pulling tool and while the device is being removed upwardly in the well flow conductor by the pulling tool;

FIGURE 8 is a view similar to FIGURE 7, being a continuation thereof, showing the lower portions of the anchoring and sealing device;

FIGURE 9 is a vertical view, partly in elevation and partly in section, showing the anchoring and sealing device anchored in the well flow conductor in sealing relation therewith;

FIGURE 10 is a vertical partly sectional view of the upper portions of a modified form of the anchoring and sealing device;

FIGURE 11 is a view similar to FIGURE 10, being a continuation thereof, showing intermediate portions of the anchoring and sealing device; and

FIGURE 12 is a view similar to FIGURE 11, being a continuation thereof, showing the lower portions of the anchoring and sealing device.

Referring now particularly to FIGURES 1 through 9 of the drawings, the anchoring and sealing device 20 is employed to support well devices in a well flow conductor such as the tubing string T formed of a plurality of longitudinally aligned tubing sections 21 whose adjacent ends are connected together with coupling collars 22, the adjacent ends of each pair of adjacent tubing sections and the coupling collars connecting such adjacent ends forming collar recesses 23 in the tubing string at vertically spaced locations therein. The anchoring and sealing device includes a tubular main mandrel 25 to whose lower end is connected a seal assembly 26 which includes a sub 27 threaded into the lower end of the main mandrel, a tubular seal 28 bonded to the sub and a retainer sleeve 30 threaded on an intermediate portion of the sub 27. The retainer sleeve provides an annular downwardly and outwardly tapered supporting surface 31 for a resilient reinforcing annular member 32 whose upper end is threaded on the sub 27 and whose internal downwardly and outwardly facing surface 33 abuts the upper portions of the outer surface of the tubular seal. The annular reinforcing sleeve 32 is resilient but stiffer than the tubular seal so that the lower non-reinforced portions of the tubular seal flex outwardly more easily than the upper portions thereof. The retainer sleeve is secured to the sub 27 by a pin 34 to prevent rotational movement of one relative to the other.

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A collet 35 is mounted on the upper end portion of the main mandrel for limited longitudinal movement thereon. The collet is provided with a plurality of circumferentially spaced lateral apertures or slots 38 in which are disposed the ring segments 39 which extend inwardly of the collet into an external annular recess 40 of the mandrel. The engagement of the collet ring segments with the upper and lower shoulders defining the external annular recess 40 of the main mandrel limits upward and downward longitudinal movement of the collet on the main mandrel. The ring segments are held in place against movement outward of the collet by a retainer band 42 received in an external annular recess of the collet. The band 42 may be initially split at one or more points and then joined by welding or in any other suitable manner after the ring segments have been inserted in the slots 38 to extend into the upper external recess 40 of the main mandrel.

The collet is provided with an internal annular recess 44 located above the collet ring segments which provides an upper downwardly facing annular shoulder 45 and a lower upwardly facing stop shoulder 46. The lower shoulder is engageable by the ring segments 48 disposed in the lateral slots 49 of the main mandrel above the external annular recess 40 thereof, when the collet is in the lower locked position on the main mandrel illustrated in FIGURE 9, to limit downward movement of the mandrel relative to the collet.

The collet 35 is provided with a plurality of dependent resilient fingers 50 having external bosses 51 at their lower ends and with lower dependent latch portions 52 located below the external bosses. The latch portions have downwardly and inwardly sloping cam shoulders 54 adapted to engage the upwardly and outwardly sloping cam shoulder defining the outer side of an upwardly facing annular latch recess formed in an upwardly facing annular shoulder disposed intermediate the ends of the mandrel and defining the lower end of a lower external collet finger recess 55 of the mandrel disposed below its upper external recess 40. The lower external recess provides space for the inward movement of the lower ends of the collet fingers toward the mandrel into the retracted positions illustrated in FIGURE 2 wherein the external bosses 51 do not extend outwardly of the outer surface of the main mandrel. The collet fingers inherently tend to assume the expanded positions illustrated in FIGURE 8 and are forced inwardly to the position illustrated in FIGURE 2 as the collet is moved downwardly to position the latch end portions 52 of the collet fingers in the latch recess 55 of the mandrel. The resilience of the collet fingers exerts a force moving the upwardly and outwardly extending cam shoulders 54 into engagement with the upwardly and outwardly extending annular shoulder defining one side of the latch groove 55 so that the camming action therebetween tends to move the collet upwardly, when the collet is free to move upward on the main mandrel, until these shoulders disengage, the lower ends of the cam fingers moving outwardly during such upward movement of the collet. The lower ends of the collet fingers have internal recesses which provide the lock surfaces 57 which are adapted to be engaged by the lock surface 58 of the main mandrel when the main mandrel is moved upwardly relative to the collet after the collet fingers have been released from engagement in the latch recess 55. The engagement of the collet ring segments 39 with the upwardly facing shoulder defining the lower side of the upper mandrel recess 40 limits such upward movement of the mandrel relative to the collet.

An inner mandrel 60, slidably disposed in the mandrel 25 for limited longitudinal movement relative thereto, is provided intermediate its ends with an external annular flange 61 disposed in the lower enlarged bore portion of the main mandrel. The engagement of the upper shoulder of the external annular flange with the downwardly facing shoulder 64 of the main mandrel limits up-

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ward movement of the inner mandrel in the main mandrel and the engagement of the downwardly facing shoulder of the external annular flange with the upper end of the sub 27 limits its downward movement in the main mandrel. The external flange is provided with an external annular recess 66 in which is disposed a split latch ring 67 whose inherent diameter is greater than the diameter of the enlarged lower bore section of the main mandrel so that the outer portions of the split latch ring tend to protrude outwardly of the external annular flange. The ring has external upper and lower outwardly converging cam shoulders 68 and 69. The engagement of the upper cam shoulder 68 of the latch ring with the upwardly and inwardly inclined shoulder 70 of the main mandrel cams the latch ring inwardly into the recess 66 to permit upward movement of the inner mandrel in the main mandrel when a predetermined upward force is exerted on the inner mandrel. The engagement of the lower cam shoulder 69 with the upwardly and inwardly extending shoulder 63 of the main mandrel cams the latch ring inwardly into the recess when a predetermined downward force is exerted on the inner mandrel to permit downward movement of the inner mandrel in the main mandrel from its upper position illustrated in FIGURE 9. The upper and lower internal shoulders of the main mandrel are provided by the internal flange 71a thereof. It will thus be apparent that when the inner mandrel is in the lower position in the main mandrel illustrated in FIGURES 2 and 8, the split latch ring 67 tends to hold the inner mandrel against upward movement in the main mandrel until a predetermined upward force of sufficient strength to cam the ring inwardly is exerted thereon and that when the inner mandrel is in the upper position illustrated in FIGURE 9, the split latch ring 67 tends to maintain the inner mandrel in the upper position until a predetermined downwardly acting force of sufficient strength to cam the ring resiliently inwardly is exerted thereon.

A tubular expander 71 is secured on the lower end of the inner mandrel and has an outwardly and downwardly extending expander surface which is adapted to enter into and engage the lower end of the tubular seal upon upward movement of the inner mandrel in the main mandrel from the lower position as illustrated in FIGURE 2 to the upper position illustrated in FIGURE 9 to expand the tubular seal into sealing engagement with the internal wall surfaces of the tubing string. The expander 71 is provided with a flow passage 72 which communicates with the tubing string below the tubular seal and with the interior of the tubular seal when the inner mandrel is in the upper position illustrated in FIGURE 9 so that the fluid pressure below the tubular seal is effective to aid in holding the tubular seal in sealing engagement with the tubing string. The sub 27 is provided with an internal annular recess above the tubular seal in which an O-ring or other suitable sealing means 75 is disposed for sealing between the inner mandrel and the sub above the tubular seal so that flow of fluid therebetween is prevented.

The bore of the expander is enlarged along its lower portion and internally threaded so that any suitable well device may be connected thereto by means of a connecting member 76. A bean 78 is threaded in the expander below an annular internal flange 79 thereof and a plug disk 80 is held between the upper end of the bean and the lower annular shoulder provided by the internal flange of the expander to close the bore of the inner mandrel. The upper end of the bean 78 is provided with an annular recess in which an O-ring 81 or other suitable sealing element is disposed to seal between the bean and the expander. The bean has a reduced orifice 83 which regulates the rate of flow of fluids through the bean, and therefore through the inner mandrel, when the plug disk is ruptured.

A prong 85 mounted for limited longitudinal movement in the inner mandrel has an external annular flange

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36 spaced from its upper end whose upper shoulder is adapted to engage the downwardly facing shoulder 88 of the inner mandrel to limit upward movement of the prong therein. A spring 89 in the inner mandrel disposed about the prong biases the prong upwardly relative to the inner mandrel. The upper end of the spring engages the downwardly facing shoulder of the external flange of the prong and the lower end of the spring engages a pair of spaced transverse pins 90 which extend parallel to one another through the bore of the inner mandrel on opposite sides of the prong. The opposite ends of each pin 90 are received in aligned transverse apertures or bores of the inner mandrel. It will thus be apparent that the pins 90 and the spring 89 cooperate to yieldingly urge the prong upwardly and also to limit downward movement thereof in the mandrel.

The prong adjacent its lower end is provided with a plurality of circumferentially spaced centering lugs 92 which engage the inner surfaces of the inner mandrel to maintain the prong in properly aligned axial position in the inner mandrel. The lower end portion of the prong is tapered as at 93 to form a point at its lower end whereby the plug disk 80 may be pierced or ruptured when the prong is moved downwardly from the position illustrated in FIGURE 2 in the inner mandrel into engagement with the plug disk 80.

The inner mandrel is provided adjacent its upper end with a plurality of latch ball recesses 95 of substantially conical configuration in which are disposed the latch balls 96. The outer portions of the latch balls 96 extend outwardly into the internal annular latch recess 98 of the main mandrel when the inner mandrel and the prong 85 are in the upper position illustrated in FIGURE 9. The prong 85 then holds the balls locked in such outward positions. The latch balls are moved to their inner positions wherein inner portions thereof protrude inwardly into the bore of the inner mandrel when the inner mandrel is moved to the lower position illustrated in FIGURES 2 and 8. The downwardly and inwardly extending lower shoulder defining the lower side of the internal latch recess 98 of the main mandrel cams the balls inwardly upon such downward movement of the inner mandrel relative to the main mandrel.

When it is desired to anchor a suitable well device, which may be a pressure sensing and recording device, in the tubing string T and seal the tubing string above such well device, the well device is connected to the expander 71 by means of the connecting member 76 and a running tool 100 is connected to the anchoring and sealing device 20 whereby the assembly of the well device and the anchoring and sealing device may be lowered into the tubing string and anchored thereby by operation of the running tool at a selected collar recess 23 of the tubing string.

The running tool 100 includes a tubular housing 101 in whose upper end is threaded the reduced lower end of a connecting sub 102 by means of whose threaded upper neck 104 the running tool may be connected to the usual set of line equipment and thus to a flexible line.

The reduced lower end portion of the tubular housing 101 is adapted to telescope into the collet 35 until the nut 105 threaded on the tubular housing engages the upper end of the collet. A lock nut 107 is also threaded on the tubular housing to prevent accidental displacement of the nut 105 on the tubular housing from its desired set position. A pin 108 secured in a suitable lateral aperture in the reduced lower end portion of the tubular housing projects outwardly thereof to prevent the nuts 105 and 107 from slipping downwardly in the event that the nuts are sheared from or accidentally moved out of engagement with the threads of the tubular housing. The pin 108 does not extend outwardly far enough to prevent the passage thereof into the upper end of the collet. The lower end of the tubular housing is adapted to engage the upper end of the main mandrel.

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A latch carrier 110 is slidably disposed in the bore 111 of the tubular housing and is held in the upper position in the tubing housing illustrated in FIGURE 1 by a shear pin 112 which extends through suitable aligned apertures in the latch carrier and in the tubular housing. The latch carrier is provided with a longitudinal slot 113 in which is disposed a latch 114 pivoted at its lower end on a pin 115 extending through suitable aligned apertures in the latch carrier and the latch. The slot 113 is aligned with a lateral longitudinal window 116 of the tubular housing so that the upper end of the latch may extend outwardly of the tubular housing through the window. The latch is biased for such outward movement by a leaf spring 117 whose upper end is rigidly secured to the latch carrier by any suitable means, such as the screw 118, and whose lower end engages the internal wall of the tubular housing opposite the longitudinal window 116. The intermediate curved portion 120a of the leaf spring bears against the side of the latch carrier opposite the window 116 to urge the latch outwardly of the housing through the window.

The latch carrier has an elongate extension 120 received in a downwardly opening bore of the latch carrier which is secured to the latch carrier by a shear pin 121. The latch carrier extension has a reduced lower end portion 123 which provides a downwardly facing annular shoulder 124 adapted to engage the upper end of the inner mandrel. The reduced lower end portion is provided with an external annular latch recess 125 in which are receivable the latch balls 96 of the inner mandrel when the reduced lower end portion is telescoped in the upper end of the inner mandrel.

The running tool is secured to the anchoring and sealing device 20 when the running tool is in engagement with the anchoring and sealing device as illustrated in FIGURES 1 and 2 since the inner portions of the latch balls 96 of the inner mandrel extend inwardly into the external latch recess 125 of the latch carrier extension and are prevented from moving outwardly therefrom by their engagement with the inner wall surface of the main mandrel. The main mandrel is held against downward movement by the engagement of the upper shoulder 68 of the latch ring 67 with the downwardly facing shoulder 70 of the internal flange 71a of the main mandrel. The collet 35 in turn is held against upward movement on the main mandrel by the engagement of its upper end with the stop nut 105 on the tubular housing of the running tool even though the resilient force exerted by the inwardly bent collet fingers, due to the camming engagement of the cam surfaces 54 thereof with the outwardly and upwardly extending cam shoulder defining one side of the upwardly facing recess 55 of the main mandrel, tends to move the collet upwardly on the main mandrel. The collet fingers are now held out of engagement with the internal wall surfaces of the tubing string.

The anchoring and sealing device is lowered with all of its operative elements in the positions illustrated in FIGURES 1 through 6 until the anchoring and sealing device, together with the well device which is attached to its lower end, reaches a desired level in the tubing string. An upward pull is then imparted to the sub 102 through the flexible line to move the running tool and the anchoring and sealing device upwardly in the tubing string until the upper end of the latch 114 enters into the first collar recess which it encounters during such upward movement of the running tool. The upper end of the latch then engages the lower end of the upper tubing section 21 at such collar recess so that a further continued upward pull imparted to the tubular housing 101 of the running tool through the sub 102 will cause the shear pin 112, which secures the latch carrier 110 in its upper position in the tubular body illustrated in FIGURE 1, to shear so that further upward force applied to the sub 102 will then cause the tubular housing 101 to move upwardly relative to the latch carrier and its ex-

tension 120. Such upward movement of the tubular housing moves the stop nut 105 thereof upwardly and permits the collet 35 to move upwardly, the collet 35 being biased toward such upward movement on the main mandrel by the resilient force of the collet fingers 50 and the camming action of the cam shoulders 54 on the upwardly and outwardly extending annular shoulder of the latch recess 55 of the main mandrel. As a result of such upward movement of the collet on the main mandrel, the lower latch end portions of the collet fingers move upwardly out of the latch recess 55 and the hardened balls 130 of the collet fingers engage the internal wall surface of the tubing string. The hardened balls are provided to reduce the wear on the bosses due to their engagement with the tubing string. At this time the split ring 67 still engages the downwardly facing shoulder of the internal flange 71a of the main mandrel and the inner mandrel is still maintained in the lower position on the main mandrel illustrated in FIGURE 2.

A continued upward pull or force exerted on the sub 102, and therefore on the tubular housing of the running tool, now causes the side surface 132 of the latch 114 to engage the upwardly and outwardly extending shoulder 133 defining the lower edge of the window 116 so that the continued upward movement of the tubular housing will now cause the latch 114 to be cammed inwardly into the tubular housing until its upper end finally disengages from the lower end of the tubing section at the collar recess. The tubular housing continues to move upwardly relative to the latch carrier until the downwardly facing shoulder 135 of the latch carrier engages the upwardly facing shoulder 136 of the tubular housing. A continued upward pull or force exerted on the housing will now be transmitted through the latch carrier and its extension to the inner mandrel 60 due to the engagement of the latch balls 96 of the inner mandrel in the external annular recess 125 of the latch carrier extension. Since the split latch ring 67 still engages the downwardly facing shoulder of the internal flange 71a of the main mandrel, this upward force is also imparted to the main mandrel. The collet moves with the main mandrel since the lower ends of the collet fingers engage the upwardly facing shoulder containing the annular latch recess 55 of the mandrel. As a result, the running tool and the anchoring and sealing device moves as a unit upwardly in the tubing string until the bosses 51 become aligned with the collar recess 23 in which the upper end of the latch 114 had previously been received. At this time the collet fingers move into their expanded positions wherein their bosses extend into the collar recess. The upper downwardly and outwardly extending shoulders of the bosses then engage the lower end of the upper tubing section at the collar recess and prevent further upward movement of the collet in the tubing string.

A continued upward force exerted on the running tool will now cause the inner mandrel and the main mandrel to move upward relative to the collet to move the lock surface 58 of the main mandrel into engagement with the lock surface 57 of the collet fingers until the ring segments 39 of the collet engage the upwardly facing lower shoulder of the external recess 40 of the main mandrel whereupon further upward movement of the main mandrel is prevented since the collet can no longer move upwardly in the tubing string. At this time the main mandrel ring segments 48 are disposed above the lower shoulder 46 of the internal recess 44 of the upper end of the collet mandrel and are free to move outwardly when their inner upwardly and inwardly sloping inner lower shoulders are engaged by the upper end of the inner mandrel.

Further upward movement of the running tool then causes the inner mandrel to move upwardly camming the ring segments 48 of the main mandrel outwardly to the position illustrated in FIGURE 9 and then moving the latch balls 96 of the inner mandrel into alignment with the internal annular latch recess 98 of the main mandrel.

As the inner mandrel moves upwardly relative to the main mandrel, the split ring 67 is cammed inwardly into the recess 66 by the engagement of its upper downwardly and outwardly extending shoulder 68 with the downwardly and outwardly extending shoulder of the internal flange 71a of the main mandrel to release the inner mandrel for such upward movement. The split ring flexes outwardly again upon moving upwardly of the upper shoulder of the internal flange of the main mandrel. At this time the upper shoulder of the external flange 61 of the inner mandrel engages the downwardly facing shoulder 64 of the main mandrel to prevent further upward movement of the inner mandrel relative to the main mandrel. During this upward movement of the inner mandrel relative to the main mandrel, the expander surface of the expander 71 has moved into the lower end of the tubular seal 28 and has expanded it into sealing engagement with the internal wall surface of the tubing string.

Continued upward movement of the running tool now causes the downwardly and outwardly extending lower shoulder defining the lower end of the external latch recess 125 of the latch carrier extension 120 of the running tool to cam the latch balls outwardly into the internal latch recess 98 of the main mandrel and release the latch carrier extension from the inner mandrel and for upward movement therefrom whereupon the running tool is freed from the anchoring and sealing device and may be removed from the tubing string. During upward movement of the latch carrier relative to the inner mandrel, the prong 85 is moved upwardly by the force exerted by the spring 89 until the upper shoulder of its external flange 86 engages the downwardly facing shoulder 88 of the inner mandrel. At this time the upper portion of the prong is disposed inwardly of the latch balls 96 and prevents their movement out of latching engagement in the internal recess 98 of the main mandrel.

The anchoring and sealing device is then anchored in the tubing string T as illustrated in FIGURE 9 and seals the tubing string above any well device supported by means of the connector 76. The inner mandrel is then locked in an upper position relative to the main mandrel so that the expander 71 may not move out of expanding engagement with the tubular seal, the collet 35 is locked against movement in the tubing string since the bosses 51 of the collet fingers are held in expanded position in the collar recess, and the main mandrel is held against movement relative to the collet by the ring segments 48 and the ring segments 39.

A pulling tool 150 is employed to remove the anchoring and sealing device from the tubing string T and includes a top sub 151 having a threaded pin 152 at its upper end by means of which the running tool may be connected through suitable line equipment to a flexible line. A sleeve 153 extends downwardly from the top sub and is secured thereto by any suitable means, such as the weld 154. An elongate body 156 extends upwardly through the sleeve 153 into an internal bore in the lower end of the sub 151 and is secured therein against rotation by a set screw 157.

The lower end portion of the elongate body is provided with a bore 160 in which is received the upper end portion of a rod 161 rigidly secured therein by a pin 162 extending through aligned apertures in the body 156 and the rod 161.

The elongate body 156 adjacent its lower end is provided with an external lock flange 164 which is adapted to engage the internal surfaces of the resilient collet fingers 166 of a collet 167. The collet is slidably mounted on the elongate body and its longitudinal movement thereon is limited by a shear pin 169 which extends through a transverse slot 170 of the body located above the bore 160 thereof. The shear pin is retained in place by a ring or band 172 disposed in a suitable external annular recess of the collet.

The collet fingers are provided with external bosses

174 which have downwardly and outwardly extending upper shoulders which are adapted to engage the upper downwardly facing shoulder 45 of the anchoring and sealing device collet 35 when the bosses of the collet fingers of the pulling tool are disposed in the internal recess 44 of the collet 35. The bosses 174 also have upwardly and outwardly extending lower shoulders which cam the lower free ends of the collet fingers inwardly upon meeting such upwardly facing obstructions as the upper end of the collet 35 of the anchoring and sealing device during downward movement of the pulling tool in the tubing string, the collet moving upwardly on the body upon engaging such upwardly facing obstructions whereby the lower ends of the collet fingers are moved above the annular lock flange 164 of the body upon meeting such upwardly facing obstructions. Such upward movement of the collet on the body is yieldingly resisted by a spring 176 disposed about the body between the collet and the top sub 151 whose opposite ends abut the lower end of the sub and the upper end of the collet.

The rod 161 has a reduced intermediate portion 177 which provides a downwardly facing shoulder 178 and a further reduced lower end portion 179 which provides a second downwardly facing lower shoulder 180 spaced below the upper shoulder 178.

The pulling tool 150 is lowered into the tubing string with its elements in the relative positions illustrated in FIGURE 7 until the lower ends of its collet fingers 166 engage the upper end of the collet 35 of the anchoring and sealing device. The pulling tool collet 167 then remains stationary as the elongate body 156 is moved further downwardly until the lock flange 164 of the body is disposed below the collet fingers whereupon the engagement of the lower shoulders of the bosses 174 with the upper end of the collet 35 cams the lower ends of the cam fingers inwardly when downward movement of the body 156 relative to the pulling tool collet is prevented by the engagement of the lower end of the sleeve 153 with the upper end of the collet. The collet then moves downwardly with the body until the bosses 174 move downwardly of the upper shoulder 45 of the internal recess 44 on the collet 35 whereupon the lower ends of the collet fingers move outwardly and the bosses enter into the recess. The spring 176 is then effective to move the collet 167 again downwardly on the running tool body so that the lock flange 164 is again positioned behind the bosses 174 and prevents subsequent inward flexing of the lower ends of the collet fingers and thus locks the bosses 174 of the collet fingers in the recess 44 of the collet 35.

During such downward movement of the pulling tool which places the collet bosses 174 in the recess 44, the lower reduced end of the rod engages the top end of the prong 35 of the anchoring and sealing device and as the pulling tool is moved or forced downwardly, the lower pointed end of the prong 35 engages the plug disk 30 and penetrates it. The pulling tool is then pulled upwardly to move the prong out of engagement with the ruptured disk to permit the prong to move back to its original position where its upper end is flush with the ends of the inner and main mandrels. The rupturing disk permits the pressure above and below the tubular seal 28 to equalize at a rate controlled by the orifice of the bean 73 since a flow passage through the anchoring and sealing device is now open which communicates with the bore of the tubing string above and below the tubular seal. This flow passage includes the port 146 of the main mandrel, the lateral port 145 of the inner mandrel, the central bore of the inner mandrel, the aperture in the plug disk caused by the penetration of the prong through the disk, the orifice 83 of the bean and the upwardly extending lateral port 147 of the expander.

When the pressure above and below the tubular seal has been equalized, the pulling tool is again moved downwardly to move the prong 35 downwardly until the down-

wardly facing shoulder 180 of the rod 161 of the pulling tool engages the upper end of the inner mandrel and moves it downwardly against the resistance of the split ring 67 which is now moved inwardly into the recess 66 of the inner mandrel due to the camming engagement of its lower cam shoulder 69 of the split ring with the shoulder 63 of the main mandrel to thus permit downward movement of the inner mandrel relative to the main mandrel. The reduced lower end portion 179 of the pulling tool is of smaller diameter than the prong 85 above its external flange 86 so that the latch balls may simultaneously move inwardly out of the internal latch recess 98 of the main mandrel due to the action of the downwardly and inwardly sloping lower shoulder of the latch recess 98. The inner mandrel continues to move downwardly until the lower shoulder of the annular flange 61 engages the upper end of the sub 27. During this downward movement of the inner mandrel relative to the main mandrel, the expander is moved out of expanding engagement with the tubular seal 28 which thereupon moves out of sealing engagement with the tubing string. At the same time the split ring 67 moves below the internal annular flange 71a of the main mandrel so that its upper shoulder 63 now engages the downwardly facing shoulder 70 of the internal flange of the main mandrel and holds the inner mandrel in the lower position illustrated in FIGURES 7 and 8. The expander 71 is thus held out of expanding engagement with the tubular seal 28.

Further downward movement imparted to the pulling tool then causes the anchoring and sealing device to move as a unit downwardly in the tubing string T until the lower downwardly facing shoulders of the bosses 51 of the anchoring and sealing device contact the upper end of the lower tubing section 21 at the collar recess 23. Further continued downward movement of the pulling tool will then cause the main mandrel to move downwardly relative to the collet 35 until the split ring segments 39 of the collet 35 engage the downwardly facing shoulder of the external recess 40 of the main mandrel. The downward force of the pulling tool is imparted during such further downward movement of the pulling tool to the main mandrel through the inner mandrel due to the engagement of the downwardly facing shoulder of its external flange 61 with the upper end of the sub 27.

During such downward movement of the main mandrel relative to the collet 35, the locking surface 58 of the main mandrel moves downwardly out of engagement with the locking surfaces 57 of the collet fingers whereby the collet fingers are now freed to move inwardly toward retracted positions into the external recess 56 of the main mandrel.

An upward pull is then imparted to the pulling tool to cause it to move upwardly to the position illustrated in FIGURE 7 wherein the upwardly facing shoulders of the bosses 174 of its collet fingers 166 engage the downwardly facing shoulder 45 of the internal recess of the collet 35 whereupon further movement of the pulling tool causes the anchoring and sealing device, and whatever well device is connected thereto by the means of the connecting member 76, to move upwardly in the tubing string for removal therefrom. During such upward movement of the anchoring and sealing device the downwardly and outwardly extending upper shoulders of the bosses 51 of the collet 35 of the anchoring and sealing device cam the lower ends of the fingers inwardly upon engaging such downwardly facing obstructions of the tubing string as the lower ends of the tubing sections 21. The hardened steel balls 130 engage the inner surfaces of the tubing string during such upward movement of the anchoring and sealing device. The balls 130 are hardened to resist wear.

It will now be apparent that an anchoring and sealing device has been illustrated and described which includes a main mandrel 25 having a collet 35 mounted thereon for limited longitudinal movement and having an inner mandrel 60 which is provided with an expander 71 for ex-

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panding a tubular seal 28 of the main mandrel into sealing engagement with the internal wall surfaces of a tubing string.

It will further be seen that the inner mandrel may not move upwardly in the main mandrel to cause the expander to engage the tubular seal 28 and move it into expanded sealing engagement with the tubing string until the bosses 31 have moved into engagement with a downwardly facing obstruction of the tubing string to prevent further upward movement of the collet in the tubing string and the main mandrel has moved upwardly in the collet 35 to lock the collet bosses in such expanded locking positions before the inner mandrel may be moved upwardly relative to the main mandrel due to the provision of the ring segments 48 which are held in their inner positions preventing upward movement of the inner mandrel in the main mandrel until the main mandrel has moved upwardly relative to the collet 35 and moved the ring segments 48 into alignment with the internal annular recess 44 of the collet 35. It will therefore be seen that the anchoring and sealing device cannot be moved into sealing engagement with the tubing string until it is anchored against movement therein.

It will further be seen that the running tool 100 by means of which the anchoring and sealing device is lowered through the tubing string to the desired location at which the anchoring and sealing means is to be anchored and then moved into sealing engagement with the tubing string cannot be released from the anchoring and sealing device until the inner mandrel has been moved to its upper position wherein the expander 71 thereof has moved the tubular seal 28 into sealing engagement with the tubing string since the latch balls 96 cannot move out of engagement from the external recess 125 of the prong 120 of the running tool until the inner mandrel has been moved upwardly in the main mandrel and the latch balls 96 are in alignment with the internal annular recess 98 of the main mandrel.

It will further be seen that the collet 35 and the main mandrel 25 have coengageable means, the downwardly beveled shoulders 54, the lower ends of the collet fingers and the upwardly and outwardly extending outer shoulder of the latch recess 55 of the main mandrel, which are effective to move the collet fingers from the retracted positions illustrated in FIGURE 2 to the expanded positions illustrated in FIGURE 9 when the collet 35 is freed to move upwardly on the main mandrel due to the resilient force exerted by the inwardly flexed collet fingers 50.

It will further be seen that the collet is free to move upwardly on the main mandrel when the running tool is moved upwardly in the tubing string after the latch 114 engages a downwardly facing obstruction of the tubing string whereby the stop nut 105 permits upward movement of the collet 35 on the main mandrel while the prong 120 of the running tool still holds the inner mandrel in its lower position in the main mandrel.

It will further be seen that the anchoring and sealing device includes a prong 85 which is movable downwardly in the inner mandrel to rupture a plug disk 80 and open a flow passage communicating with the tubing string above and below the tubular seal after the tubular seal has been moved to expanded position whereby the pressure above and below the anchoring device may be equalized prior to the movement of the inner mandrel downwardly relative to the main mandrel and the consequent movement of the expander 71 of the tubular seal.

It will further be seen that the inner and main mandrels are provided with coengageable means, the split latch ring 67 and the upper and lower shoulders 63 and 70 of the internal flange 71a of the main mandrel, which releasably hold the inner mandrel in either of two extreme longitudinal positions relative to the main mandrel, in the upper extreme position the expander 71 of the main mandrel holding the tubular seal 28 in expanding sealing position

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and in the lower extreme position the expander 71 being held out of expanding engagement with the tubular seal.

It will further be seen that a pulling tool has been provided having a rod 161 which moves the prong 85 downwardly and ruptures the disk 80 in order to equalize the pressures above and below the tubular seal 28 before the inner mandrel may be moved downwardly by the pulling tool to cause the expander to move out of expanding engagement with the tubular seal 28.

It will further be seen that the main mandrel 25 may be moved downwardly by the pulling tool relative to the collet 35 only after the inner mandrel has been moved downwardly relative thereto and the tubular seal 28 has been freed to move out of sealing engagement with the tubing string to free the collet fingers for movement towards retracted position.

It will further be seen that a running tool for use with an anchoring and sealing device has been illustrated and described which includes rod 120 which is releasably secured to the inner mandrel and which holds the prong of the anchoring and sealing device in a lower position in the inner mandrel.

It will further be seen that the inner mandrel is provided with a latch means, the latch balls 96, which locks the inner mandrel in its upper position in the main mandrel, the latch means being held in such locking position by the prong 35 so that the inner mandrel may not be moved downwardly to permit downward movement of the expander 71 out of expanding engagement with the tubular seal 28 until the prong 35 has been moved downwardly to rupture the plug disk 80.

It will further be seen that a pulling tool 150 has been illustrated and described which has means for successively engaging the prong of the anchoring and sealing device to move it into engagement with the disk 80 and to rupture the disk and equalize the pressure above and below the tubular sealing means, moving the inner mandrel downwardly relative to the tubular seal 28 and the main mandrel whereby the tubular seal is allowed to move out of sealing engagement with the internal wall surfaces of the tubing string, moving the anchoring and sealing device as a unit downwardly in the tubing string to permit and then cause the main mandrel to move downwardly relative to the collet 35 whereby the collet fingers are unlocked to move inwardly into retracted position, and then moving the unlocked anchoring and sealing device upwardly through the tubing string.

Referring now particularly to FIGURES 10, 11 and 12 of the drawings, the anchoring and sealing device 200 includes a main mandrel 202 to whose lower end is connected a seal assembly 203. The seal assembly includes a sub 204 threaded into the lower end of the main mandrel, a tubular seal 205 bonded to the sub and a retainer sleeve 206 threaded on the sub 204. The retainer sleeve provides an annularly downwardly and outwardly tapered supporting service for a resilient reinforcing annular member 208 whose upper end portion is secured to the retainer sleeve in any suitable manner, as by an adhesive or bonding agent, and whose internal downwardly and outwardly facing surface 210 abuts the upper portions of the outer surface of the tubular seal. The annular reinforcing sleeve 208 is resilient but stiffer than the tubular seal so that the lower non-reinforced portions of the tubular seal flex outwardly more easily than the upper portions thereof. The retainer sleeve is secured to the sub by a pin 211 to prevent rotation of one relative to the other.

The main mandrel 202 comprises an extension 214 whose lower end portion 215 telescopes downwardly into the enlarged upper portion of the bore 216 of the main mandrel above the internal flange 217 thereof. The main mandrel extension 214 is capable of limited longitudinal movement relative to the main mandrel 202. Upward movement of the extension relative to the mandrel is limited by the engagement of the screw 218 of the man-

drel extension with the downwardly facing shoulder 219. When the collet fingers are in their expanded positions upward movement of the main mandrel relative to the extension is limited by the engagement of the upper and lower shoulders of the retainer ring 220 with the lower ends of the collet fingers and the upper end of the main mandrel, respectively. The upper section of the main mandrel extension 214 includes a plurality of elongate bars 224 circumferentially spaced with respect to each other to form a plurality of longitudinal slots 225 communicating with longitudinal slots 226 in the upper end of the lower section 215 of the main mandrel extension. The lower ends of the bars 224 are secured to the lower section 215 in any suitable manner, as by welds 227, and their upper ends are similarly connected to an annular member or ring 229.

A collet member 235 is slidably mounted on the extension and includes a plurality of collet fingers 236 whose upper ends are rigidly secured to a collet ring 237 of the same dimensions as the main mandrel extension ring 229 by any suitable means as by a weld 238. The collet fingers 236 extend downwardly over the main mandrel ring 229 and into the slots 225 between the extension bars 224 and into the slots 226 of the lower section of the main mandrel extension.

The collet fingers are provided at their lower ends with bosses 240 having lower shoulders 241 adapted to engage the upwardly facing shoulders provided by the upper ends of the tubing sections 21 at collar recesses 23 to limit downward movement of the anchoring and sealing device in the tubing string or well flow conductor. When the lower ends of the collet fingers are in expanded positions, the upper downwardly and outwardly sloping shoulders 242 of the collet bosses are adapted to cam the collet fingers inwardly into retracted positions upon engaging such downwardly facing obstructions as the lower ends of the upper tubing sections 21 at each collar recess during upward movement of the anchoring and sealing device through the tubing string T.

The collet retainer ring 220 is slidably disposed on the lower section 215 of the main mandrel extension 214 and is adapted to engage the outer surfaces 245 of the collet fingers below the downwardly facing shoulders 241 thereof to releasably hold the collet fingers in the retracted positions illustrated in FIGURES 10 and 11 when the collet retainer ring is in the upper position on the main mandrel extension illustrated in FIGURE 11. The resilient force being exerted by the collet fingers holds the collet retainer ring in this upper position until the collet retainer ring is moved downwardly on the main mandrel extension by the spring catches 247.

The spring catches 247 are pivotally secured to the collet fingers below the collet bosses 240 by means of pins 250 which extend transversely through the longitudinal slots 252 of the collet fingers and the coil portions of the spring catches. Each of the spring catches 247 includes an inner spring portion 253 which bears against the shoulder 254 defining the inner end of each recess 252 and an outwardly projecting free end portion 256 which tends to project outwardly of the main mandrel extension through the slots 224 and 226 thereof and through aligned upwardly facing slots 260 of the collet retainer ring. The free ends of the spring catches bear resiliently against the inner wall surfaces of the tubing sections as the anchoring and sealing device 200 is lowered through the tubing string T and expand outwardly into each collar recess as they pass each collar recess and then are again biased inwardly upon the engagement of their lower surfaces with the upper ends of the tubing sections at such collar recesses as the downward movement is continued. When the anchoring and sealing device 200 is moved upwardly through the tubing string T, however, the free ends 256 of the spring catches engage the downwardly facing end of the upper tubing section 21 at the first collar recess 23 into which they

extend during such upward movement of the anchoring and sealing device so that further upward movement imparted to the collet now causes the free ends 256 to pivot downwardly and since the free ends 256 of the spring catches engage the upwardly facing shoulder of the collet retainer ring, the spring catches move the collet retainer ring downwardly on the lower extension section 215 and out of engagement with the outer surfaces 245 of the collet fingers which are then free to move outwardly toward expanded position. The free ends of the spring catches then move downwardly into the slots 226 of the lower section 215 of the main mandrel extension where they are no longer effective to engage the tubing string.

The collet fingers are locked in their expanded positions by a tubular lock member 265 on whose lower end is threaded a tubular collar expander 266 which provides an outwardly and upwardly extending lower cam shoulder 267 and a downwardly and outwardly extending upper annular cam shoulder 268. The lower reduced end portion 270 of the expander 266 is provided with an upwardly and outwardly extending annular shoulder 271.

The collet fingers are provided with intermediate internal flanges 272 having inwardly convergent upper and lower shoulders and are also provided adjacent their lower ends with downwardly and inwardly extending cam shoulders 273 and 274. The internal surfaces 275 of the lower ends of the collet fingers are adapted to be engaged by the external surface of the reduced portion 270 of the expander 266 when the lock sleeve is in a lower position relative to the collet fingers to lock or hold the lower ends of the collet fingers, and therefore the bosses 240 thereof, in expanded positions in a collar recess as will be explained below.

The collet 235 is releasably secured to the lock member 265 in the lower position thereon illustrated in FIGURES 10 and 11 by means of shear pins 277 which extend through aligned apertures in the collet fingers, the collet ring 237 and the lock sleeve 265. Downward movement of the lock sleeve relative to the collet is limited by the engagement of the downwardly facing shoulder 280 provided by the external annular flange 281 of the lock member 265 with the upper end of the collet ring 237. The lock member is also provided with an annular external flange 282 at its upper end which provides an annular downwardly facing undercut shoulder 283 which is engageable by running and pulling tools as will be explained below.

The tubular seal 205 is moved into expanded position and into engagement with internal wall surfaces of the tubing string, after the movement of the main mandrel in the tubing string T is prevented by the engagement of the bosses 240 of the collet fingers in a selected collar recess 23, by an expander 285 having downwardly and outwardly extending annular surface 286 which telescopes into the tubular seal to expand it on upward movement of the inner mandrel 290 to which the expander 285 is secured. The expander is provided with a plurality of flow passages 291 which provide for the introduction of fluid pressure between the tubular seal and the inner mandrel when the expander 285 is telescoped into the lower end of the tubular seal whereby the fluid pressure below the tubular seal aids in holding the tubular seal in expanded sealing engagement with the internal wall surfaces of the tubing string.

The inner mandrel 290 is provided with an upper external flange 294 whose lower shoulder 295 is engageable with the upper end of the sub 204 of the main mandrel to limit downward movement of the inner mandrel in the main mandrel.

A valve cage 296 is threaded on the lower end of the expander 285 and is provided with a plurality of lateral ports 297 through which fluids may flow into the bore B of the inner mandrel. The lower end of the valve cage 296 is reduced to provide an internal annular upwardly

facing shoulder 299. A valve sleeve 301 is disposed in the valve cage with its lower end extending through the reduced lower portion of the valve cage. The valve sleeve 301 is biased upwardly by a spring 303 which extends about the valve sleeve and whose opposite ends bear against the upwardly facing shoulder 299 of the valve cage and the downwardly facing shoulder provided by the external flange 304 on the upper end of the valve sleeve. The valve 306 has a lower reduced portion which telescopes into the upper end of the valve sleeve and a downwardly and outwardly extending surface 307 which is adapted to abut the downwardly and outwardly extending annular shoulder or valve seat 308 at the lower end of the expander 285. The valve is provided with an external annular recess in which is disposed an O-ring or other sealing means 310 which engages the valve seat 308 when the valve 306 is in an upper position in the valve cage to seal therebetween.

The secondary valve 312 extends through a longitudinal bore of the valve 306 and is provided with an outwardly and downwardly extending seal surface 313 which is engageable with the downwardly and outwardly extending valve seat 314 provided at the lower end of the valve 306. The valve stem 315 of the valve 312 is greater in length than the valve member so that its upper end projects above the upper end of the valve member when the secondary valve is in its upper closed position in the valve member with its seal surface 313 engaging the valve seat 314. The valve stem is smaller in diameter than the bore of the valve 306 so that fluids may flow through the bore when the secondary valve is in a lower position on the main valve with its seal surface spaced below the valve seat 314. The secondary valve is biased upwardly toward closed position by a spring 317 whose opposite ends engage the lower end of the secondary valve and the upwardly facing internal shoulder provided by the internal flange 318 of the valve sleeve.

The inner mandrel and the valves may be held in the lower positions illustrated in FIGURES 10 and 11 during the installation and the removal of the anchoring and sealing device by a prong 325 having an upper section 326 provided with a prong extension 327 threaded thereon. The prong extension has an upwardly extending externally threaded pin 328 by means of which the prong may be secured to a suitable running tool, such as the running tool illustrated in FIGURE 63 on page 4158 of the Composite Catalog of Oil Field Equipment and Services, 1947 Edition, or to a pulling tool such as the pulling tool illustrated in FIGURE 66 of page 4159 of the Composite Catalog of Oil Field Equipment and Services, 1957 Edition. Such running and pulling tools as illustrated in the Composite Catalog are provided with dogs having hooks at their lower ends for engaging the undercut shoulder 283 of the external flange 282 of the tubular lock member 265 to hold the lock member in the upper position on the prong illustrated in FIGURES 10, 11 and 12 during installation and removal operations of the anchoring and sealing device 200.

The lower end of the upper section 326 of the prong 325 extends into an upwardly opening bore in a weldment 330 and is rigidly secured thereto by any suitable means, as by a weld. The weldment 330 is provided with a downwardly facing external shoulder 331 which is adapted to engage the upper end of the inner mandrel 290 when the lower reduced portion of the weldment portion telescopes into the upper end of the inner mandrel.

The weldment 330 has an external annular recess 332 which is aligned with the latch buttons 333 of the inner mandrel when the stop shoulder of the weldment is in engagement with the upper end of the inner mandrel. The buttons 333 are disposed in lateral apertures 334 adjacent the upper end of the inner mandrel and have reduced portions 335 which are adapted to extend into the external recess of the weldment. The lateral apertures have reduced inner portions which provide a stop shoulder

engageable by the shoulders 336 of the latch buttons which limits inward movement of the latch buttons in the lateral apertures 334. The enlarged portions 337 of the latch buttons are adapted to extend into an internal recess 338 of the main mandrel when the inner mandrel is in an upper position in the main mandrel.

The lowermost section 340 of the prong has its upper end extending into a downwardly facing bore of the intermediate section or weldment 330 of the prong and its lower end extends through the inner mandrel to engage the valve stem 315 of the secondary valve 312 and the upper end of the valve 306 to hold the valves in an open position when the prong is in the position illustrated in FIGURES 10 through 12.

In use, when it is desired to install the anchoring and sealing device in a well flow conductor to support any suitable well device and seal thereabove, such well device being connected to the lower end of the valve cage 296 by a coupling 319, the anchoring and sealing device is attached to a suitable running tool, such as the Otis running tool illustrated in FIGURE 63 on page 4158 of the Composite Catalog of Oil Field Equipment and Services, 1957 Edition. The upper end of the prong 328 is rigidly secured to the core of such running tool and the tubular lock member 265 is held in an upper position relative to the prong and to the collet 235 due to the engagement of the dogs of the running tool with the undercut shoulder 283 of the tubular lock member. The inner mandrel 290 is now held locked in the lower position illustrated by the engagement of the downwardly facing shoulder 331 of the weldment 330 of the prong with the upper end of the inner mandrel so that the expander 285 is held out of expanding engagement with the tubular seal 205. The lower ends of the collet fingers are now held in the retracted positions illustrated in FIGURE 11 by the collet retainer ring 220 and the free ends 256 of the spring catches 247 extend outwardly of the main mandrel and into resilient engagement with the internal wall surfaces of the tubing string T in which the anchoring and sealing device 200 is to be installed.

The anchoring and sealing tool is then lowered through the tubing string T, the free ends 256 of the spring catches moving into each collar recess 23 of the tubing section as they pass the recesses. Since the valve 306 is now in its lowermost position, fluids which may be in the tubing string may flow past the tubular seal internally through the anchoring and sealing device through the ports 297 of the valve cage, the bore B of the inner mandrel past the flats 340a provided on the weldment and through the windows or slots 221 of the main mandrel. When the anchoring and sealing device has been lowered to a position in which it is to be anchored, an upward pull is imparted to the anchoring and sealing tool until the free ends 256 of the spring catches 247 enter into a collar recess 23 whereupon these ends engage the downwardly facing end shoulder or the upper tubing section 21 at such collar recess. A further upward movement imparted to the anchoring and sealing device through the running tool now causes the spring catches 247 to pivot downwardly and move the collet retainer ring 220 downwardly on the main mandrel extension 214 and out of engagement with the collet fingers which are then free to move outwardly toward expanded positions. The anchoring and sealing device is then moved downwardly until the bosses 240 of the collet fingers move into alignment with the collar recess in which the spring catches had been disposed immediately prior thereto and the resilient force of the collet fingers then moves the lower ends of the collet fingers outwardly to position the collet bosses 240 in the collar recess. Further downward movement of the collet 235 is then arrested by the engagement of the downwardly facing shoulders 241 of the collet bosses with the upper end of the lower tubing section 21 at such collar recess.

Downward jars are then imparted to the running tool which cause the dogs of the running tool to disengage

from the undercut shoulder 283 of the tubular lock member 265 and at the same time cause the tubular lock member to move downwardly relative to the collet 235, the shear pins 277 being sheared by the force of such downward jars. The tubular lock member 265 then moves downwardly, the cam shoulder 267 camming the collet fingers further outwardly, if they are not in fully expanded positions, by its engagement with first the upper shoulders of the internal flanges 272 of the collet fingers and then with the downwardly and inwardly extending shoulders 273 of the collet fingers until the shoulder 267 engages the shoulders 274 of the collet fingers and the reduced lower locking portion 270 of the expander 266 engages the internal surfaces 275 of the collet fingers. The collet fingers are then held or locked against inward movement from expanded positions toward retracted positions. The downwardly and inwardly extending shoulder 271 on the lower end of the expander also tends to cam the collet fingers outwardly if they are not in fully expanded position upon engaging the shoulders 273 or 274 thereof. The internal flanges 272 of the collet fingers are now disposed between the lower end of the extension ring 229 and the upper shoulder 268 of the expander. The main mandrel and therefore the tubular seal 205 are now locked in the tubing string.

An upward pull is then imparted to the prong 325 by means of the running tool which no longer engages the tubular member so that upward movement of the prong may take place without any upward movement of the tubular lock member. Such upward movement of the prong now causes the inner mandrel to move upwardly until the latch buttons 333 are aligned with the internal recess 338 of the main mandrel. Such upward movement of the inner mandrel causes the expander surface 286 to engage the lower end of the tubular seal 205 and expand it outwardly into sealing engagement with the internal wall surfaces of the tubing string. When the latch buttons 333 are moved into alignment with the internal recess 338 of the main mandrel, upward movement of the inner mandrel is stopped by the engagement of its upper end with the internal flange 217 of the main mandrel and the camming action of the lower downwardly and outwardly expanding shoulder of the external recess 332 of the weldment 330 of the prong 325 cams the latch buttons outwardly and into the internal recess 338. The prong is thus released from engagement with the inner mandrel and may be removed by the running tool.

The anchoring and sealing device is left anchored in the tubing string T, the reduced locking portion 270 of the expander 266 holding the collet fingers against movement from expanded into retracted positions. The expander 285 is held in expanding engagement with the tubular seal 205 by the pressure of the well fluids which tend to move the inner mandrel upwardly since the valves 306 and 312 are now closed.

When it is desired to remove the anchoring and sealing device and the well device which it supports from the tubing string, the prong 325 is attached to a suitable pulling tool, such as the Otis pulling tool which is illustrated in FIGURE 66, page 4159 of the Composite Catalog of Oil Field Equipment and Services, 1957 Edition. The pulling tool with the prong 325 is then lowered by means of a flexible line through the tubing string until the prong 325 enters into the anchoring and sealing device and moves downwardly toward the position illustrated in FIGURES 10, 11 and 12. The lower end of the prong 325 first contacts the valve stem 315 of the secondary valve 312 and moves it downwardly whereupon the pressure across the valve 306 is equalized since fluids may flow through the central bore of the valve 306 past the valve stem 315. When the pressure across the valve 306 is at least partially equalized, further downward movement of the pulling tool and the prong 325 moves the valve 306 downwardly permitting equalization of the fluid pressure across the tubular seal 205. During such

further downward movement of the pulling tool and the prong 325, the weldment 330 of the prong enters into the upper end of the inner mandrel 290 and its downwardly facing shoulder 331 engages the inner mandrel so that further downward movement of the prong causes the inner mandrel to move downwardly also. Since the external recess 332 of the weldment is now in alignment with the latch buttons 333, upon such further downward movement of the inner mandrel 290 the camming engagement of the downwardly and inwardly extending lower shoulder defining the internal recess 338 of the main mandrel with the enlarged portions 337 of the latch buttons causes the latch buttons to be cammed inwardly so that their inner reduced end portions 335 extend into the internal recess 332, such movement of the latch buttons permitting downward movement of the inner mandrel in the main mandrel.

During such downward movement of the inner mandrel, the expander 285 is moved out of expanding engagement with the tubular seal 205 which thereupon is free to move out of sealing engagement with the internal wall surfaces of the tubing string. The dogs of the pulling tool then engage the undercut shoulder 283 of the lock member so that an upward pull now imparted to the pulling tool causes the dogs of the pulling tool to impart an upward movement to the lock member 265. The main mandrel however remains stationary due to the engagement of the upper shoulders 242 of the bosses with the lower end of the tubing section 21 at the collar recess 23 so that the tubular lock member moves upwardly relative to the main mandrel and to the collet until the upper shoulder 268 of the expander of the tubular lock member engages the lower end of the ring 229 of the main mandrel extension.

Further upward movement of the pulling tool and the lock member results in upward movement also of the collet and of the main mandrel extension 214 since the upper shoulder 268 of the expander 266 now engages the ring 229 of the main mandrel extension which in turn engages the collet ring 237. When the extension moves upwardly to a position wherein the screw 218 engages the upper shoulders 219 of the slots 221, further upward movement of the pulling tool results in upward movement of the main mandrel. The lower reduced portion 270 of the expander is now in the position illustrated in FIGURE 10 and out of engagement with the internal surfaces 275 at the lower ends of the collet fingers so that the collet fingers are now free to move inwardly to retracted positions and are moved to such retracted positions by the camming engagement of the downwardly and outwardly sloping upper shoulders 242 of the bosses with such downwardly facing obstructions in the well flow conductor as the lower ends of the tubing sections at the collar recesses. The inner mandrel is held during such upward removal of the anchoring and sealing device in the lower position illustrated in FIGURES 11 and 12 since its latch buttons 333 are in the positions illustrated in FIGURE 11 with the inner ends engaged in the external recess 332 of the weldment 330 of the prong 325.

It will now be apparent that the anchoring and sealing device 200 includes a main mandrel having locking means engageable with a well flow conductor to lock the main mandrel in any desired position in a well flow conductor and that the main mandrel is provided with a tubular seal 205.

It will further be seen that the anchoring and sealing device is provided with an inner mandrel which has expander means for expanding the tubular seal into sealing engagement with the well flow conductor after the main mandrel has been anchored against movement therein.

It will further be seen that the inner mandrel is provided with pressure equalizing means for equalizing the pressure across the tubular seal after it has been moved

to expanded position which equalizing means close upon upward movement of the inner mandrel to expand the tubular seal into sealing engagement with the well flow conductor.

It will further be seen that the anchoring and sealing device includes a prong 325 which may be connected either to a running or a pulling tool and which holds the inner mandrel in a lower position wherein its expander does not expand the tubular seal and also holds the pressure equalizing means, the valve 306, in open position during installation and removal operations.

It will further be seen that the means for locking the main mandrel in predetermined position in a well flow conductor includes a tubular locking member 265 which must be moved to locking position, wherein it locks the locking means or collet fingers in expanded locking position, before the prong may be moved to move the inner mandrel upwardly toward the tubular seal expanding position.

It will further be noted that the anchoring and sealing device may also be used as a bottom hole choke merely by removing the prong 85 and the plug disk 80, such modification resulting in the loss of the pressure equalizing function but opening the bore of the inner mandrel for fluid flow. The latch balls 96 of course would then have no function and could also be removed.

It will further be seen that the anchoring and sealing device can be used to suspend a variety of other well devices, such as tubing safety valves, regulators and the like by removing the bean 78, and closing or plugging the ports 147 of the expander 71 so that all flow through the tubing string would be controlled by such well devices secured to the expander 71 by means of the connecting member 76 or directly to the expander itself. In this modification also the prong 85 and the plug disk 80 may be removed to open the bore of the inner mandrel.

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

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

1. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial retracted position adjacent the main mandrel to expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions, said inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; and operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of the operator means in the inner mandrel.

2. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial retracted position adjacent the main mandrel to an upper expanded position wherein said locking means extends

outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of the operator means in the inner mandrel; and a second coengageable means on the mandrels for locking the inner mandrel in said upper position in the main mandrel when the operator means is in said upper position in the main mandrel, the operator means engaging said second coengageable means when in said upper position to prevent movement of the inner mandrel relative to the main mandrel.

3. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial retracted position adjacent the main mandrel to an expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, said mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel for closing said flow passage; and operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of the operator means in the inner mandrel, said locking means being mounted on the main mandrel for limited longitudinal movement thereon between a lower initial retracted position and an upper position wherein said locking means is free to move between said retracted and expanded positions, the locking means and the main mandrel having third coengageable means for releasably holding said locking means in a retracted position on the main mandrel intermediate said upper and lower positions.

4. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel movable upwardly relative to the main mandrel from an initial retracted position adjacent the main mandrel to an upper expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions, said inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on

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the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; and operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of the operator means in said inner mandrel, said locking means being mounted on the main mandrel for limited longitudinal movement thereon between a lower initial retracted position, an upper position wherein the locking means is free to move between retracted and expanded positions and a subsequent lower expanded position wherein said locking means is locked against movement from expanded position toward retracted position, the main mandrel and the locking means having coengageable means for releasably holding the locking means in said lower locked expanded position.

5. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel movable upwardly relative to the main mandrel from an initial lower retracted position adjacent the main mandrel to an expanded position outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding said inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel for closing said flow passage; and operator means longitudinally movable in the inner mandrel between upper and lower positions for opening said closing means upon downward movement of said operator means in the inner mandrel, the locking means being mounted on the main mandrel for limited longitudinal movement thereon between an initial lower retracted position, an upper position wherein said locking means is free to move between said retracted position and said expanded position and a subsequent lower expanded position wherein said locking means is locked against movement from expanded position toward retracted position, the locking means and the main mandrel having first coengageable means for releasably holding said locking means in said initial lower retracted position on the main mandrel, said main mandrel and said locking means having second coengageable means for releasably holding the locking means in said lower locked expanded position.

6. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial lower retracted position adjacent the main mandrel to an expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by said locking means; coengageable means on the mandrels for releasably holding the inner

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mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; and operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of said operator means in the inner mandrel, said locking means being mounted on the main mandrel for limited longitudinal movement thereon between said initial lower retracted position, an upper position wherein the locking means is free to move between retracted and expanded positions and a subsequent lower expanded position wherein said locking means is locked against movement from expanded position toward retracted position, the main mandrel and the locking means having second coengageable means for releasably holding the locking means in said lower locked expanded position, the inner mandrel being engageable with said last mentioned coengageable means for preventing release of the locking means for movement from said lower expanded position when the inner mandrel is in said upper position relative to the main mandrel.

7. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial lower retracted position adjacent the main mandrel to an expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of said operator means in the inner mandrel; latch means carried by the inner mandrel engageable with the main mandrel for locking the inner mandrel in said upper position in the main mandrel when the operator means is in said upper position in the inner mandrel.

8. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial lower retracted position adjacent the main mandrel to an expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the

closing means upon downward movement of said operator means in the inner mandrel; latch means carried by said inner mandrel engageable with the main mandrel for locking the inner mandrel in said upper position in the main mandrel when the operator means is in said upper position in the inner mandrel, said latch means holding the operator means in intermediate position in the inner mandrel when the inner mandrel is in said lower position.

9. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial lower retracted position adjacent the main mandrel to an expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; co-engageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of said operator means in the inner mandrel; latch means carried by the inner mandrel and engageable with the main mandrel for locking the inner mandrel in said upper position in the main mandrel when the operator means is in said upper position in the inner mandrel, the latch means holding the operator means in an intermediate position in the inner mandrel when the inner mandrel is in said lower position; and means biasing said operator means upwardly in the inner mandrel toward said upper position.

10. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial lower retracted position adjacent the main mandrel to an expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of the operator means in said inner mandrel; and latch means carried by the inner mandrel and engageable with the main mandrel for locking the inner mandrel in said upper position in the main mandrel when the operator means is in said upper position in the inner mandrel, said locking means being mounted on the main mandrel for limited longitudinal movement thereon between said initial lower retracted position and an upper

position wherein said locking means is free to move between retracted and expanded positions relative to the main mandrel, the locking means and the main mandrel having coengageable means for releasably holding the locking means in said initial lower retracted position on the main mandrel.

11. In combination with the device of claim 10, a running tool including: a body; an elongate member carried by the body and movable relative to the body between an upper position and a lower position, the elongate member telescoping into the inner mandrel and being releasably secured thereto by the latch means, the elongate member and the body having means engageable with the inner mandrel, the main mandrel and the locking means for holding the locking means in said initial lower retracted position on the main mandrel and for holding the inner mandrel in said lower position relative to the main mandrel.

12. In combination with the device of claim 10, a running tool including: a body; an elongate member carried by the body and movable relative to the body between an upper position and a lower position, the elongate member telescoping into the inner mandrel and being releasably secured thereto by the latch means, said elongate member and said body having means engageable with the inner mandrel, the main mandrel and the locking means for holding the locking means in said initial lower retracted position on the main mandrel and for holding the inner mandrel in said lower position relative to the main mandrel, said running tool having means engageable with the well flow conductor to permit the body to move upwardly relative to the elongate member when an upward force is exerted on the body to free the locking means for movement upwardly on the main mandrel and toward expanded position to engage the well flow conductor and lock the main mandrel against longitudinal movement therein, said elongate member being releasable from the inner mandrel when the main mandrel has moved upwardly relative to the locking means and the inner mandrel has moved to its upper position relative to the main mandrel.

13. In combination with the anchoring and sealing device of claim 1, a pulling tool including: an elongate body having a lower end telescopable into the inner mandrel to move the opening means downwardly into opening engagement with the closing means; means on the elongate member engageable with the inner mandrel for moving the inner mandrel downwardly relative to the main mandrel after the said flow passage has been opened to move the inner mandrel to its lower position relative to the main mandrel.

14. In combination with the anchoring and sealing device of claim 6, a pulling tool including: an elongate body having a lower end telescopable into the inner mandrel to move the operator means downwardly into opening engagement with the closing means; means on the elongate member engageable with the inner mandrel for moving the inner mandrel downwardly relative to the main mandrel after the said flow passage has been opened to move the inner mandrel to its lower position relative to the main mandrel, said elongate body having means engageable with said second coengageable holding means on said mandrel and said lock means for releasably holding the locking means in said lower locked expanded position for preventing movement of the locking means to said upper position whereby the main mandrel cannot be unlocked from its anchored position in the well flow conductor until the inner mandrel has been moved downwardly and the expander means has been moved out of engagement with the seal means.

15. An anchoring and sealing device for use in a well flow conductor including: an outer tubular main mandrel having anchoring means movable relative to the main mandrel between a lower position wherein said anchoring means is held in retracted position adjacent the main

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mandrel and an upper position wherein said locking means is free to move outwardly toward expanded position for anchoring the main mandrel against longitudinal movement in the well flow conductor; expansible sealing means carried by the main mandrel; an inner mandrel carried by the main mandrel and movable between an upper position relative to the main mandrel wherein the inner mandrel holds the seal means in expanded position and in sealing engagement with the well flow conductor and a lower position wherein said inner mandrel permits movement of the sealing means out of sealing engagement with the well flow conductor; means for releasably holding the inner mandrel in said upper position, the inner and main mandrels providing a flow passage past said seal means; means closing said passage; and means insertable through said inner and main mandrels for first moving said closing means to open position to equalize the fluid pressure across the seal means and then moving the inner mandrel toward said lower position relative to the main mandrel.

16. An anchoring and sealing device for use in a well flow conductor including: an outer tubular main mandrel having anchoring means movable relative to the main mandrel between a lower retracted position and an upper position wherein said anchoring means is movable to expanded position outwardly of the main mandrel to engage with a well flow conductor for anchoring the main mandrel against longitudinal movement in the well flow conductor; expansible sealing means carried by the main mandrel; an inner mandrel carried by the main mandrel and movable between an upper position relative to the main mandrel wherein the inner mandrel holds the seal means in expanded position and in sealing engagement with the well flow conductor and a lower position wherein said inner mandrel permits movement of the seal means out of sealing engagement with the well flow conductor; means for releasably holding the inner mandrel in said upper position, the inner and main mandrels providing a flow passage past said seal means; means closing said passage; and means insertable through said inner and main mandrels for first moving said closing means to open position to equalize the fluid pressure across the seal means and then moving the inner mandrel toward said lower position relative to the main mandrel, said insertable means including a prong; and coengageable means on said prong and said inner mandrel for releasably securing said inner mandrel to said prong.

17. An anchoring and sealing device for use in a well flow conductor including: an outer tubular main mandrel having anchoring means engageable with a well flow conductor for anchoring the main mandrel against longitudinal movement in the well flow conductor; expansible sealing means carried by the main mandrel; an inner mandrel carried by the main mandrel and movable between an upper position relative to the main mandrel wherein the inner mandrel holds the seal means in expanded position and in sealing engagement with the well flow conductor and a lower position wherein said inner mandrel permits movement of the seal means out of sealing engagement with the well flow conductor; means for releasably holding the inner mandrel in said upper position, the inner and main mandrels providing a flow passage past said seal means; means closing said passage; and means insertable through said inner and main mandrels for first moving said closing means to open position to equalize the fluid pressure across the seal means and then moving the inner mandrel toward said lower position relative to the main mandrel; and locking means releasably engageable with said anchoring means for holding said anchoring means in expanded positions upon downward movement of the locking means relative to said anchoring means, said insertable means including a prong; and coengageable means on said prong and said inner mandrel for releasably securing said inner mandrel to said prong.

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18. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel engageable with a well flow conductor when in expanded position to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; and coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means, said locking means being mounted on the main mandrel for limited longitudinal movement thereon between an upper expanded position and a lower retracted position wherein said locking means is free to move between retracted and expanded positions relative to the main mandrel.

19. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel engageable with a well flow conductor when in expanded position to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; and coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, said mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means, said locking means being mounted on the main mandrel for limited longitudinal movement thereon between an initial lower retracted position and an upper position wherein said locking means is free to move between a retracted position and an expanded position relative to the main mandrel, the locking means and the main mandrel having coengageable means for releasably holding said locking means in said initial lower retracted position on the main mandrel.

20. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel engageable with a well flow conductor when in expanded position to anchor the well device in a well flow conductor against longitudinally movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions, said inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; and coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means, said locking means being mounted on the main mandrel for limited longitudinal movement thereon between an initial lower retracted position and an upper position wherein the locking means is free to move between retracted position and expanded position relative to the main mandrel and a subsequent lower locked position wherein said locking means is in expanded position, the main mandrel and the locking means having coengageable

means for releasably holding the locking means in said lower locked position.

21. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial retracted position adjacent the main mandrel to an expanded position outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel; an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; and operator means longitudinally movable in the inner mandrel between upper and lower positions for opening the closing means upon downward movement of the operator means in the inner mandrel, said locking means being mounted on the main mandrel for limited longitudinal movement relative thereto between an initial lower position wherein said locking means is in retracted position, an upper position wherein said locking means is free to move between said retracted and expanded positions, and a subsequent lower expanded position when said locking means is held against movement toward retracted position.

22. An anchoring and sealing device for use in a well flow conductor including: a tubular main mandrel; locking means carried by the main mandrel and movable upwardly relative to the main mandrel from an initial retracted position adjacent the main mandrel to an upper expanded position wherein said locking means extends outwardly of the main mandrel to anchor the well device in a well flow conductor against longitudinal movement therein; seal means carried by the main mandrel;

an inner mandrel disposed in the main mandrel for limited longitudinal movement between upper and lower positions relative thereto, the inner mandrel being provided with an expander means engageable with the seal means to expand the seal means into sealing engagement with the well flow conductor after the main mandrel has been anchored therein by the locking means; coengageable means on the mandrels for releasably holding the inner mandrel in said upper and lower positions, the mandrels providing a flow passage for communicating with the well flow conductor above and below the sealing means; means carried by the inner mandrel closing said flow passage; operator means longitudinally movable in said inner mandrel between upper and lower positions for opening the closing means upon downward movement of the operator means in the inner mandrel; and a second coengageable means on the mandrels for releasably locking the inner mandrel in said upper position in the main mandrel when the operator means is in said upper position in the main mandrel, the operator means engaging the second coengageable means when in said upper position to prevent release of the inner mandrel for movement from said upper position in the main mandrel, said locking means being mounted on the main mandrel for limited longitudinal movement relative thereto between a lower initial position wherein said locking means is in retracted position and an upper position wherein said locking means is free to move between said retracted and expanded positions, and a subsequent lower expanded position wherein said locking means is held against movement toward retracted position.

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