

June 3, 1958

N. T. BREAUX

2,837,166

WELL PACKER

Filed April 2, 1951

4 Sheets-Sheet 1

FIG. 1

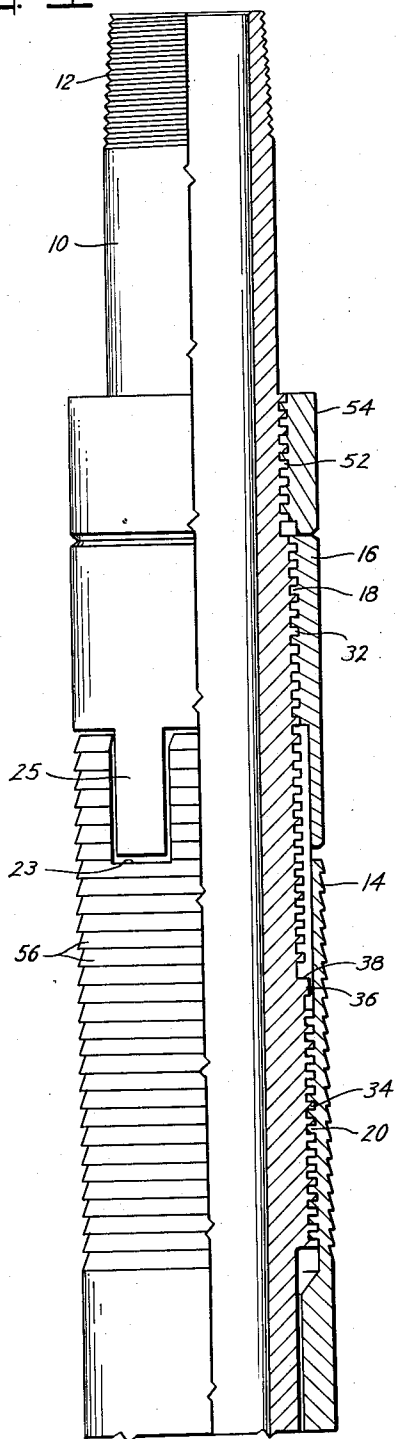
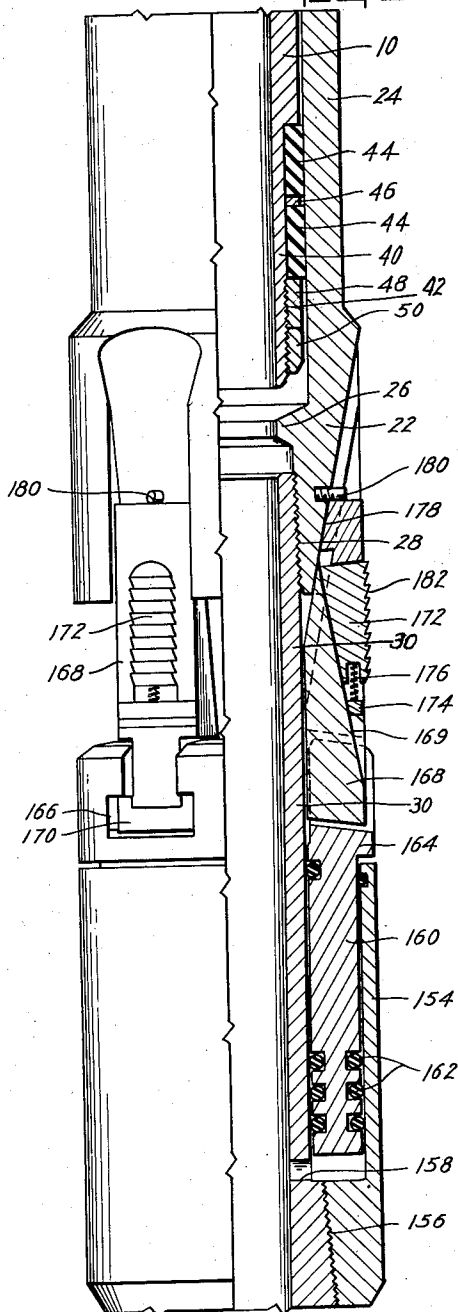


FIG. 1A



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4 Sheets-Sheet 2

Fig. 18

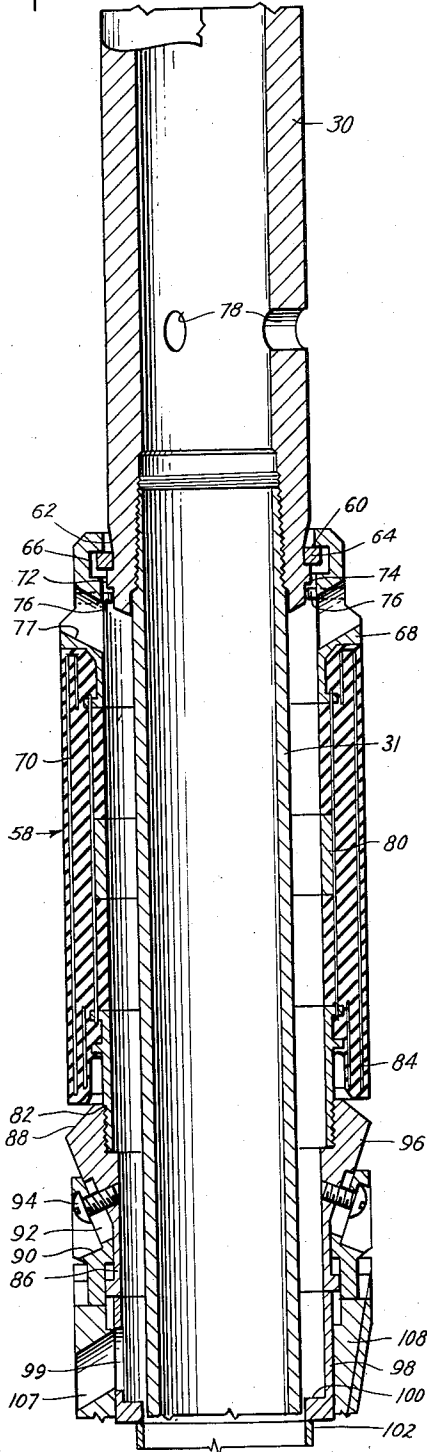
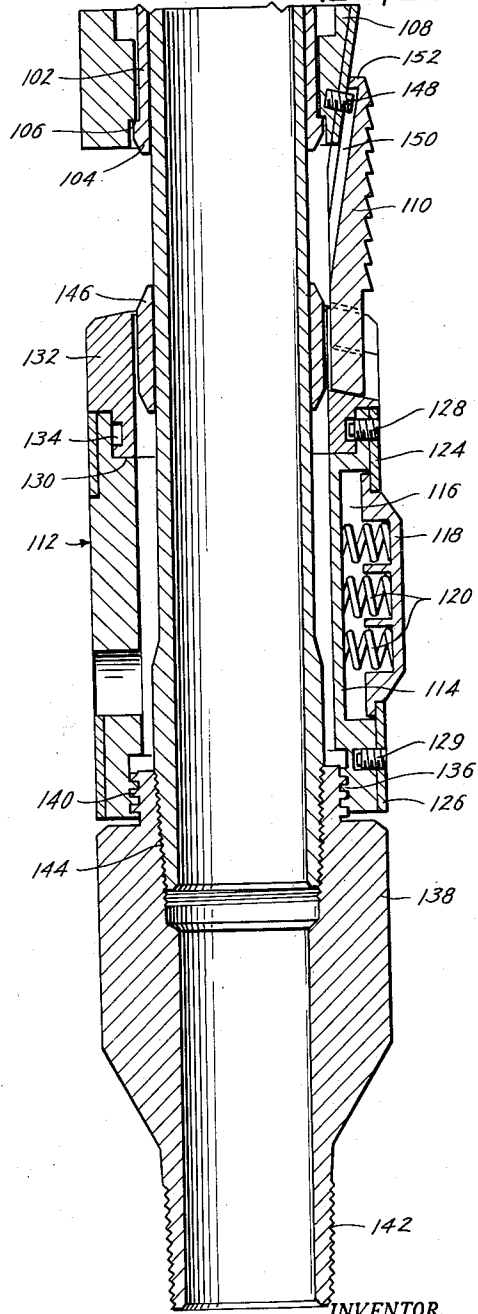


Fig. 12c



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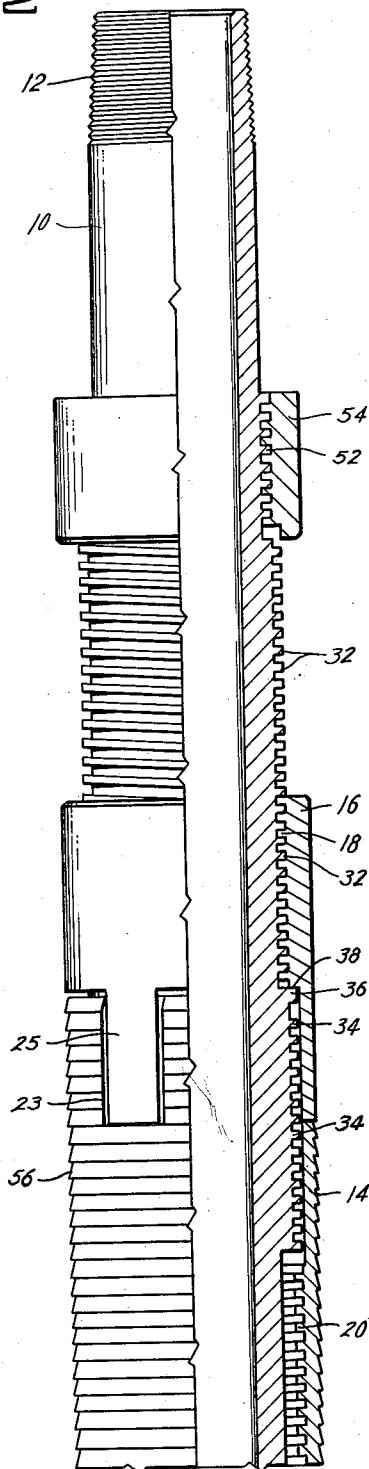
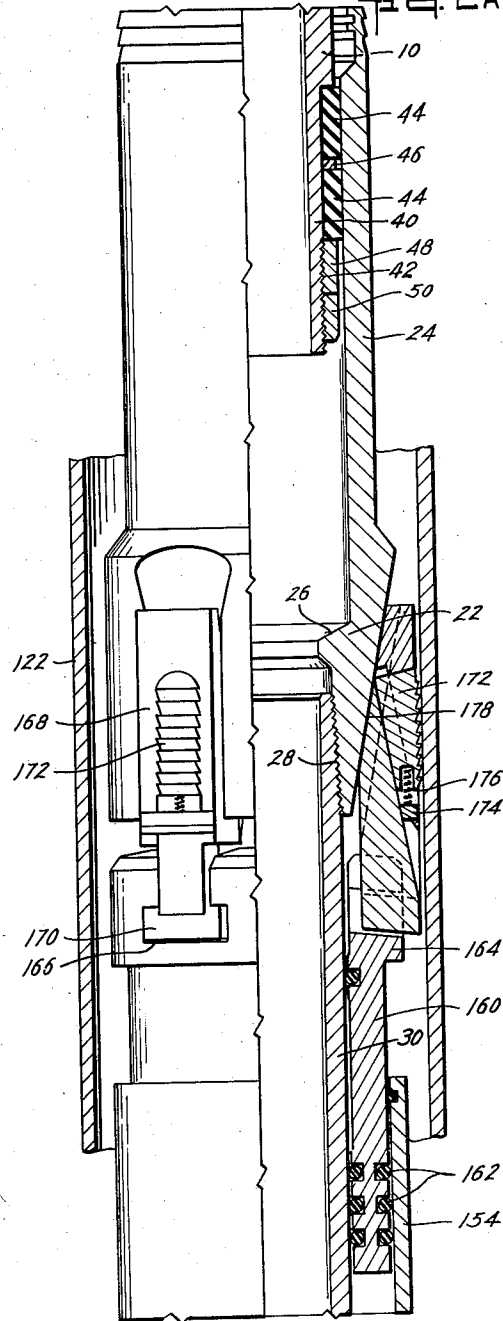
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4 Sheets-Sheet 3

FIG. 2

FIG. 2A



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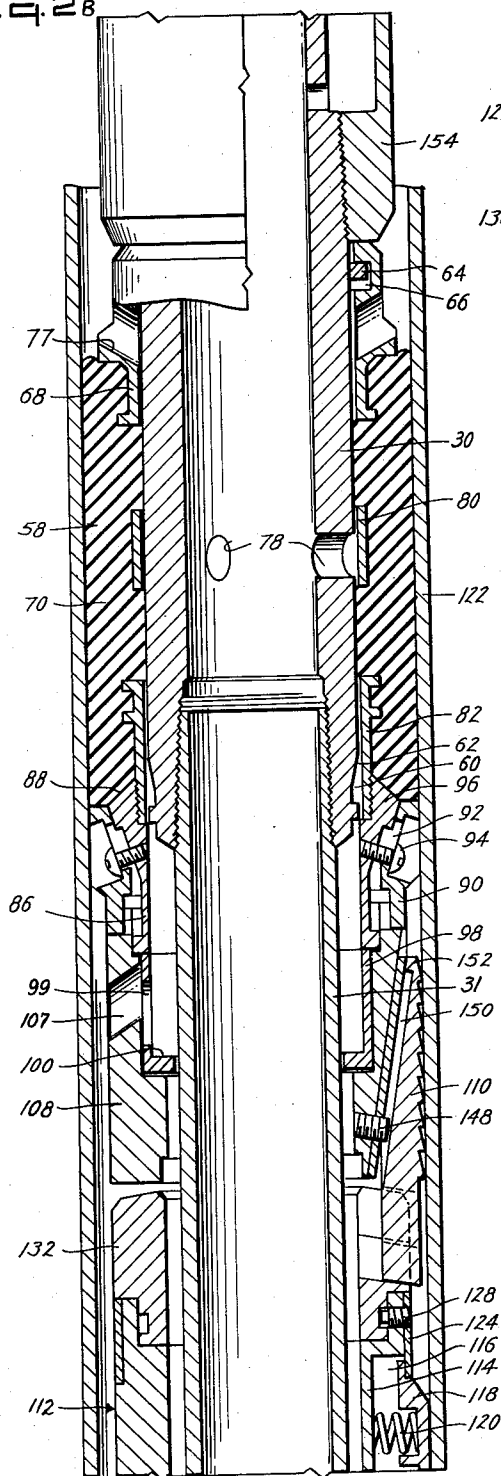
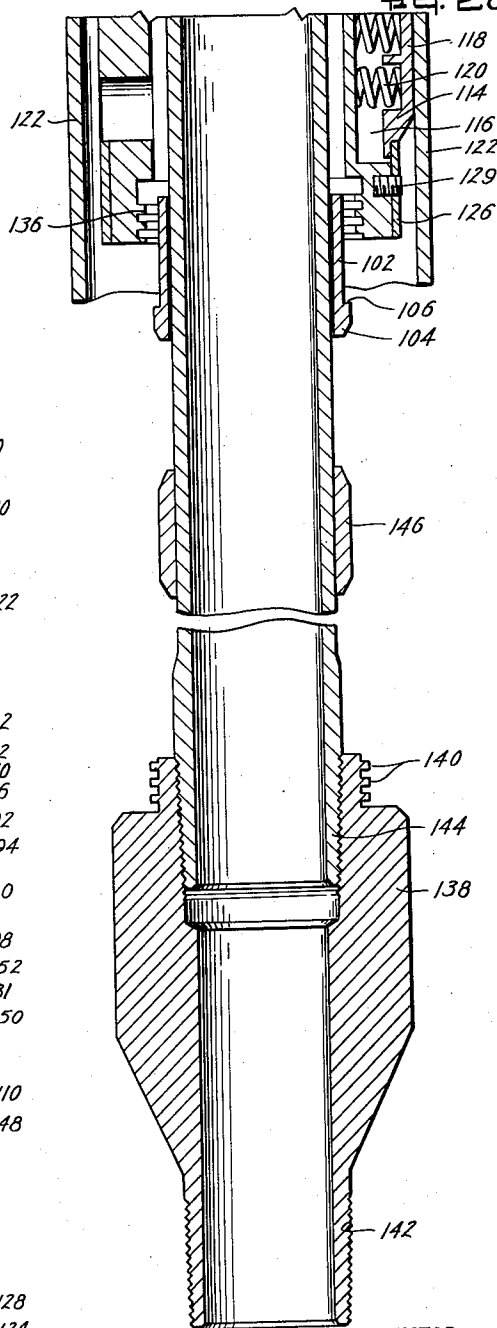
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4 Sheets-Sheet 4

Fig. 28

Fig. 2c



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1

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WELL PACKER

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Application April 2, 1951, Serial No. 218,785

6 Claims. (Cl. 166—134)

This invention relates to a well packer of the general type known as a hook wall packer, and more particularly to a packer structure embodying improved hold down and safety joint means by which the positioning and operation of the packer is greatly facilitated.

An important object of the invention is to provide a well packer adapted to be set in a well casing by manipulation of the operation string, and which also has independently operable hold down means, whereby upward movement of the packer due to increased pressure below the same may be effectively prevented.

Another object of the invention is the provision of a well packer embodying independently operable hold down means adapted to be operated by fluid pressure in the operating string.

A further object of the invention is to provide a well packer which is easily released and reset, when it is desirable to change the location of the packer in the well.

A still further object of the invention is the provision in a well packer of the kind referred to of means for releasing the operating string in the event that the packer becomes stuck in the well or under conditions in which it is desired to leave the packer in position in the well and remove the operating string.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation and arrangement of parts, an example of which is given in this specification, and illustrated in the accompanying drawings, wherein—

Figures 1, 1A, 1B and 1C are longitudinal sectional views showing upper, intermediate and lower portions of the invention in assembled condition preparatory to lowering the same into a well;

Figures 2, 2A, 2B and 2C are similar views of the invention showing the same in set condition in the well.

Referring now to the drawings in greater detail, wherein like numerals of reference designate the same parts throughout the several views, 10 indicates a safety joint mandrel, externally threaded at its upper end as at 12 for connection to an operating string, and threadably received in an outer tubular member 14, known as a fishing neck.

The fishing neck 14 has internal, left-hand threads 20 which are engageable with external, left-hand threads 34 provided on the safety joint mandrel whereby the fishing neck is removably secured to the safety joint mandrel. At its lower end the fishing neck is formed with an external, tapered, slip-expander 22, and above the slip-expander there is a portion 24 of reduced internal diameter. An internal, annular projection 26 is formed within the slip-expander 22, which serves to reenforce and strengthen the same, and the lower end of the fishing neck is internally threaded, as seen at 28, for connection to the upper end of an upper inner mandrel section 30.

Safety joint mandrel 10 also has a portion spaced

2

above the threads 34, which is of somewhat reduced diameter and is provided with external, left-hand threads 32.

Circumferentially spaced, vertical slots 23 are provided at the upper end of the fishing neck, and an operating nut 16 having left-hand threads is threaded onto the threads 32 of the fishing neck, said nut 16 having downwardly projecting tangs 25 which extend into the slots and prevent independent rotation of the nut and the fishing neck relative to each other.

The threaded portion 34 is of somewhat greater diameter than the portion 32, and between the threads 32 and 34 there is an annular projection 36 forming an upwardly-facing shoulder 38, which is adapted to engage the lower end of the nut 16 to limit the distance to which the mandrel may be threaded out of the fishing neck upon rotation of the mandrel to the right.

The lower end of the safety joint mandrel has a reduced portion 40, provided with external threads 42. Annular packing elements 44 are positioned on the portion 40, separated by a washer 46, or the like, and are retained in place by lock nuts 48 and 50, or other suitable means. The packing elements 44 form a fluid tight seal between the fishing neck and the safety-joint mandrel.

The safety joint mandrel also has a somewhat reduced upper portion which is provided with external, right-hand threads, as indicated at 52, upon which a lock nut 54 is threaded, which nut engages the upper end of the operating nut 16, when the safety mandrel reaches its innermost position relative to the fishing neck. External annular serrations 56 are also provided on the fishing neck for engagement by a grapple in the event that it should become necessary to recover the packer by such means.

Upper inner mandrel section 30 is connected at its lower end to a packer assembly, indicated generally at 58.

For this purpose the upper inner mandrel section 30 has an external annular groove 60 formed with an inwardly and downwardly tapering upper wall 62, in which groove an expansible pick-up ring 64 is received. The pick-up ring also fits into an internal annular groove 66 in a back-up ring 68, secured to the upper end of an expansible packer element 70, whereby the packer assembly is suspended from the upper inner mandrel section.

Below the groove 60, the upper inner mandrel section has an annular projection 72, forming a downwardly facing shoulder 74 with which shear pins 76 carried by the back-up ring engage, whereby the upper inner mandrel section is prevented from moving downwardly into the packer assembly until the pins are sheared. Passageways 77 extend through the back-up ring to permit fluid flow into or out of the packer assembly when desired. The upper inner mandrel section also has circulation holes 78 therethrough mediate its ends, and the expansible packing element 70 carries an internal ring 80 mediate its ends, which is adapted to cover the circulation holes when the upper inner mandrel section has been moved into the packer assembly as seen in Figure 2B. The lower end of the upper inner mandrel section is internally threaded for attachment thereto of a lower inner mandrel section 31.

The packer element 70 carries at its lower end a latch ring 82, and the packer element has a downwardly extending annular lip 84 spaced outwardly of the latch ring. A packer expander member 86 is threadably secured to the latch ring and has a tapered upper surface 88 adapted to engage the inner surface of the lip 84 to expand the lip outwardly upon movement of the expander member toward the packer element.

Packoff segments 90 having elongated slots 92 therein are carried by the expander member 86 and connected

thereto by bolts 94 extending through the slots. These segments 90 are slidably positioned on an exterior outwardly and upwardly tapering surface 96 on the expander member, and are adapted to engage the lower end of the packer element 70 to back the same when the packer element is in expanded condition.

A jack ring 98, is positioned below the expander in engagement at its upper end with the lower end of the expander. This jack ring has an inwardly extending annular flange 100 at its lower end, which engages a collar 102 on the lower mandrel section 31.

The collar 102 has at its lower end an exterior annular projection 104 forming an upwardly facing shoulder 106 upon which a slip expander 108 having downwardly and inwardly tapering slip engaging faces is adapted to seat. The jack ring 98 engages the lower end of the expander member 86 to hold the expander member in an upper position, out of engagement with the slip expander 108 when the packer element 70 is in contracted condition, as seen in Figure 1B, and moves downwardly upon downward movement of the mandrel section 30 to permit the expander member 86 to engage the expander 108, to support the expander member 86 against downward movement when the slips are set.

The slip expander 108 has an opening 107 therethrough which registers with an opening 99 through the jack ring 98 to permit fluid to flow into and out of the packer assembly.

Below the packer assembly 58 there is a friction block assembly indicated generally at 112. The friction block assembly has a tubular body member 114 provided with friction block recesses 116, in which friction blocks 118 are disposed for inward and outward radial movement. Resilient means, such as the coil springs 120 are positioned in the recesses 116 beneath the friction blocks and urging the blocks outwardly into engagement with a surrounding well casing 122, as shown in Fig. 2A. The blocks are retained in the recesses by means of rings 124 and 126 carried by the body member and secured thereto in any suitable manner as by the screws 128 and 129. The retainer rings 124 and 126 extend beyond the walls of the recesses in overlapping relation to corresponding marginal portions of the friction blocks.

At its upper end the body member has an enlarged bore 130 adapted to receive a slip holder 132, secured within the body member by the screws 128 which extend into an external, annular recess 134 in the holder.

At its lower end the body member 114 has internal, left-hand releasing threads 136 for connection thereto of a lower connector 138 having external, left-hand releasing threads 140. The connector 138 is externally threaded at its lower end, as indicated at 142 for connection to any desired implement below the packer, and at its upper end is internally threaded, as seen at 144 for connection to the lower end of the lower mandrel section 31.

The lower mandrel section also has a collar 146 fixed thereon, which enters the slip holder 132 and serves to guide the lower mandrel section and maintain the same centered with respect to the friction block assembly.

The slips 110 are mounted for radial movement in the slip holder 132 and are slidably interconnected with the slip expander 108 for movement into engagement with the well casing upon downward movement of the expander. Relative movement between the expander and the slips 110 in a direction to release the slips is limited by pins 148 secured to the expander and extending into grooves 150 in the slips. The grooves 150 terminate in shouldered portions 152 at the upper ends of the slips which engage the pins to limit relative movement between the expander and the slips in one direction.

Surrounding the upper, inner mandrel section 30 above the packer assembly 58, there is a hold-down cylinder 154, which is threadably secured to the mandrel section 31 at its lower end as indicated at 156, and which is open at its upper end. There is a passageway 158 through

the wall of the mandrel section leading from the interior of the section 31 into the cylinder adjacent its closed lower end.

A tubular piston 160 works in the cylinder 154, and is provided with external grooves to receive suitable packing as indicated at 162, forming a fluid tight seal between the piston and cylinder. This piston has an enlarged outer end portion 164, provided with key-hole slots 166. Slip carriers 168 are disposed on the portion 164 of the piston for radial movement thereon, each of the carriers having a T-head 170 at its lower end which is interengageable with the corresponding key-hole slot in the piston. The slip carriers have downwardly and outwardly inclined outer surfaces 169. Each of the slip carriers has an auxiliary hold-down slip 172 slidably positioned on the inclined surface 169 thereof, and interlockingly connected thereto. A cross-piece 174 is attached to each slip carrier below the auxiliary slip, and resilient means, such as, a coil spring 176 is disposed between the lower end of the slip and the cross-piece adapted to yieldingly urge the slip upwardly on the slip carrier.

The slip carriers are also formed with downwardly and inwardly inclined surfaces 178 which are slidably engageable with the expander 22 to move the carriers radially outwardly to engage the auxiliary slips with the surrounding well casing. Shear pins 180 are secured to the expander 22 which engage the upper ends of the carriers 168 to hold the same in slip releasing position until the pins are sheared and the expander is moved downwardly relative to the slip carriers. The auxiliary hold-down slips 172 are provided with upwardly directed casing engaging teeth 182, for the purpose of restraining upward movement of the packer assembly, while the slips 110 are provided with downwardly directed teeth adapted to prevent downward movement of the assembly in the casing when the device has been set in the well.

The releasing threads 136 of the body member 114 and the releasing threads 140 of the lower connector 138 are relatively loosely fitted together as compared with the threads 18 and 32 of the safety joint mandrel and the fishing neck so that upon rotation of the string to the right the releasing threads 136 and 140 will be released before the safety joint mandrel begins to rotate out of the fishing neck.

The device is inserted in a well casing attached to an operating string in the condition shown in Figures 1, 1A, 1B and 1C, wherein the slips 110 and the auxiliary hold-down slips 172 are in fully retracted position, the threads 136 and 140 are in engagement connecting the inner mandrel to the packer assembly, and the safety joint mandrel 10 is fully inserted in the fishing neck 14.

When the device has reached the desired location in the casing the string is then rotated to the right, and due to the frictional engagement of the blocks 118 with the surrounding casing the packer assembly 58 and block assembly 112 will remain stationary, while the inner mandrel will be rotated to unscrew the releasing threads 136 and 140. The string is then lowered, which causes the ring 64 to be expanded into the internal groove of the back-up ring 68 to release the section 30 from the back-up ring and permit the fishing neck and inner upper mandrel section to move downwardly relative to the packer assembly 58 and block assembly 112, whereupon the lower end of the cylinder 154 engages the back-up ring of the packer assembly to move the assembly downwardly with the slip expander 108 relative to the slips 110 to expand the latter into gripping engagement with the surrounding casing. Further downward movement of the inner upper mandrel section then results in corresponding downward movement of the back-up ring 68 to expand the packer element into sealing engagement with the casing. During such expansion of the packer element 70 the packer element is moved downwardly against

5

expander member 86 to expand the lip 84 into tight contact with the casing.

In the condition of the device just described the packer is in sealing engagement with the casing, but the openings 78 in the upper inner mandrel section are still above the packer element, so that circulation through the string and above the packer may take place if desired.

Still further downward movement of the inner mandrel results in shearing the pins 76 and the upper inner mandrel section 30 then moves downwardly into the packer element 70 until the openings 78 are brought within the packer element and closed thereby. The lower end of the hold-down cylinder 154 is then in contact with the upper end of the back-up ring 68 and further movement of the upper inner mandrel section into the packer assembly is arrested.

With the openings 78 thus closed, it will be seen that the pressure of fluid in the string cannot escape into the casing and fluid under pressure may enter the passageway 158 into the cylinder 154 and move the piston 160 upwardly, carrying with it the slip carriers 168 and moving the same upwardly relative to the expander 22 to expand the auxiliary hold-down slips 172 into gripping engagement with the casing. It will thus be apparent that any increase in the fluid pressure in the string will result in more securely setting the auxiliary hold-down slips so that the packer assembly cannot be displaced by increased pressure from below.

To release the device in order to remove the same from the well as to a new location therein, the pressure is released from the cylinder 154 to allow the auxiliary slips to be released, and the inner mandrel is then moved upwardly until the releasing threads 136 and 140 are in contact, whereupon the releasing threads may be reengaged by rotation of the string to the left. In this condition of the mechanism the slips 110 are released and the entire device may be moved with the string out of the well. The device may be reset in a new location by repetition of the above described setting operation if desired.

In the event that it should become necessary or desirable to release the device and recover the string, the string may be further rotated to the right to unscrew the threads 32 of the safety joint mandrel from the fishing neck, until the shoulder 38 contacts the operating nut 16, whereupon the safety joint mandrel may be lifted from the fishing neck and recovered with the string, leaving the packer set in the well.

Should it be necessary to recover the device after the safety joint has been released and the string has been removed, a suitable grappling means may be lowered over the fishing neck into gripping engagement with the serrations 56 on the neck, whereby the device may be pulled from the well.

It will be seen that the invention as described above provides a well packer by which a number of different well operations can be carried out with great facility, and which is certain and secure in its sealing action.

While the invention has been disclosed in connection with a particular embodiment of the same, it will be understood that this is intended by way of illustration only, and that numerous modifications can be made in the construction and arrangement of the various parts without departing from the spirit of the invention, or the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. In a well packer of the type having a tubular mandrel and an expansible packer element around the mandrel adapted to form a fluid-tight seal with a surrounding well casing, casing gripping means mounted on the mandrel for relative movement longitudinally thereof beneath the packer element and engageable with the casing to form an abutment against which the ele-

6

ment is engageable to support the element against downward movement in the casing to allow the mandrel to move downwardly relative to said element, means on the mandrel above the element and movable downwardly with the mandrel relative to the abutment to expand the element, said mandrel having an opening leading from the interior of the mandrel to the exterior thereof and positioned to be closed by said element upon such downward movement of said mandrel, and fluid pressure operable means around the mandrel above the packer element and including means operable under the influence of the pressure of fluid in said mandrel when said opening is in closed position to anchor the mandrel against upward movement in the casing.

2. In a well packer of the type having a tubular mandrel and an expansible packer element around the mandrel adapted to form a fluid tight seal with a surrounding well casing, casing gripping means mounted on the mandrel for relative movement longitudinally thereof beneath the packer element and engageable with the casing to form an abutment against which the element is engageable to support the element against downward movement in the casing to allow the mandrel to move downwardly relative to the element, means on the mandrel above the element and movable downwardly with the mandrel relative to the abutment to expand the element, said mandrel having an opening leading from the interior to the exterior of the mandrel positioned to communicate with the interior of the casing above said element and movable to a closed position within said element upon such downward movement of the mandrel, fluid pressure operable means on the mandrel above the packer element and including means operable under the influence of the pressure of fluid in the mandrel when said opening is in closed position to anchor the mandrel against upward movement in the casing and means releasably connecting the mandrel to an operating string.

3. A well packer comprising a tubular mandrel adapted to be connected to an operating string, an expansible packer element around and movable longitudinally relative to the mandrel, a lower slip expander around the mandrel beneath the packer element, expansible casing engaging slips on the lower expander, friction means around the mandrel in frictional engagement with a surrounding well casing in position to support said lower slips, releasable means connecting the friction means and mandrel and releasable upon rotation of the mandrel to allow the mandrel to move downwardly relative to the friction means, means on the mandrel positioned for engagement with the packer element upon such downward movement of the mandrel to move the element and lower expander downwardly to expand the lower slips into gripping engagement with the casing to anchor the lower slip expander against downward movement in the casing and to thereafter expand the element into sealing engagement with the casing upon further downward movement of the mandrel, said mandrel having an opening leading from the interior to the exterior thereof positioned to communicate with the interior of the casing above said element and movable to a closed position within the element upon such downward movement of the mandrel, and upper slip expander on the mandrel above the element, upper expansible casing engaging slips on the upper expander, and fluid pressure operable means on the mandrel positioned for coaction with the upper slip expander to expand the upper slips under the influence of the pressure of fluid in the mandrel when said opening is in closed position to anchor the mandrel against upward movement in the casing.

4. A well packer comprising a tubular mandrel adapted to be connected to an operating string, an expansible packer element around and movable longitudinally on the mandrel, a lower slip expander around

and movable longitudinally on the mandrel beneath the packer element, lower expansible casing engaging slips on the lower expander, friction means around the mandrel positioned for frictional engagement with a surrounding well casing in position to engage the lower slips to resist downward movement of the lower slips in the casing, releasable means connecting the friction means to the mandrel and releasable upon rotation of the mandrel to allow the mandrel to move downwardly relative to the packer element and lower expander, means on the mandrel positioned for engagement with the packer element upon downward movement of the mandrel relative thereto to move the element and lower expander downwardly relative to the lower slips to expand the lower slips into gripping engagement with the casing to anchor the packer element in the casing and expand the packer element into sealing engagement with the casing, said mandrel having an opening leading from the interior of the mandrel to the exterior thereof positioned to communicate with the interior of the casing above said element and movable to a closed position within said element upon such downward movement of the mandrel, an upper slip expander, expansible casing engaging slips on the upper expander and an independently operable member on the mandrel positioned for coaction with the upper slips and upper expander and operable by the pressure of fluid in the string when said opening is closed to expand the upper slips to anchor the element in the casing.

5. A well packer comprising a tubular mandrel adapted to be connected to an operating string, an expansible packer element around and movable longitudinally on the mandrel, a lower slip expander around and movable longitudinally on the mandrel beneath the packer element, lower expansible casing engaging slips around the mandrel engageable with the lower expander, friction means around the mandrel positioned for frictional engagement with a surrounding well casing and engageable with the lower slips to support the slips against downward movement in the casing, releasable means connecting the friction means and mandrel and releasable upon rotation of the mandrel to allow the mandrel to move downwardly relative to the packer element and expander, stop means above the packer element on and movable with the mandrel and engageable with the packer element and lower slips to move the lower slips downwardly with the mandrel relative to the lower expander to expand the lower slips into gripping engagement with the casing to anchor the packer element against downward movement in the casing and thereafter to expand the packer element upon further downward movement of the mandrel, said mandrel having an opening leading from the interior of the mandrel to the exterior thereof positioned in communication with the interior of the casing above the packer element and movable to a closed position within the

element upon such downward movement of the mandrel, an upper expander on the mandrel above said packer element, expansible casing engaging slips on the upper expander, and means on the mandrel operable by the pressure of fluid in the mandrel when said opening is closed to engage said upper slips to hold said packer element against upward movement in the casing.

6. A well packer comprising a tubular mandrel adapted to be connected to an operating string, an expansible packer element around and movable longitudinally on the mandrel, a lower slip expander around and movable longitudinally on the mandrel beneath the packer element, lower expansible casing engaging slips on the lower expander, friction means around the mandrel positioned for frictional engagement with a surrounding well casing in position to engage the lower slips to resist downward movement of the lower slips in the casing, releasable means connecting the friction means to the mandrel and releasable upon rotation of the mandrel to allow the mandrel to move downwardly relative to the packer element and lower expander, means on the mandrel positioned for engagement with the packer element upon downward movement of the mandrel relative thereto to move the element and lower expander downwardly relative to the lower slips to expand the lower slips into gripping engagement with the casing to anchor the packer element in the casing and expand the packer element into sealing engagement with the casing, said mandrel having an opening leading from the interior to the exterior thereof positioned to communicate with the interior of the casing above said element and movable to a closed position within said element upon such downward movement of the mandrel, an upper slip expander on the mandrel above the packer element, upper expansible casing engaging slips on the upper expander and means mounted on the mandrel for longitudinal movement thereon in position for coaction with said upper expander and upper slips and operable by the pressure of fluid in the mandrel when said opening is closed to expand the upper slips to anchor said packer element against upward movement in the casing.

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