

March 12, 1957

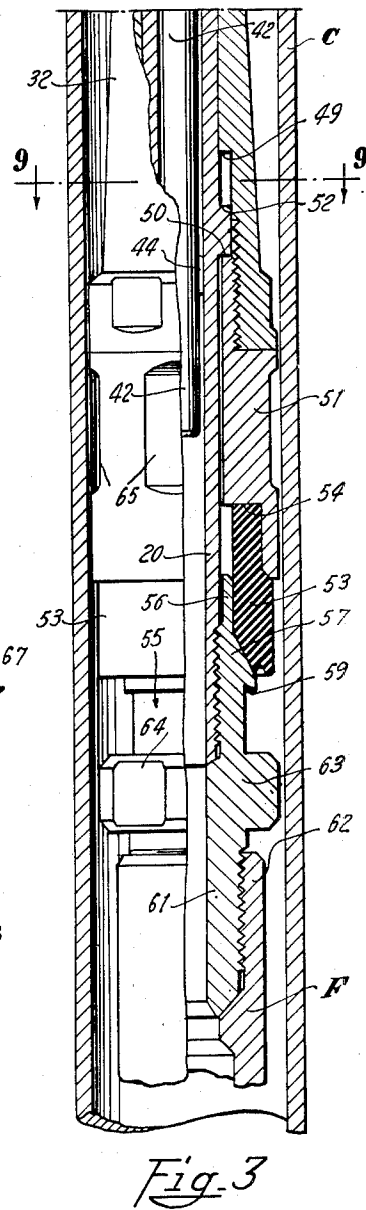
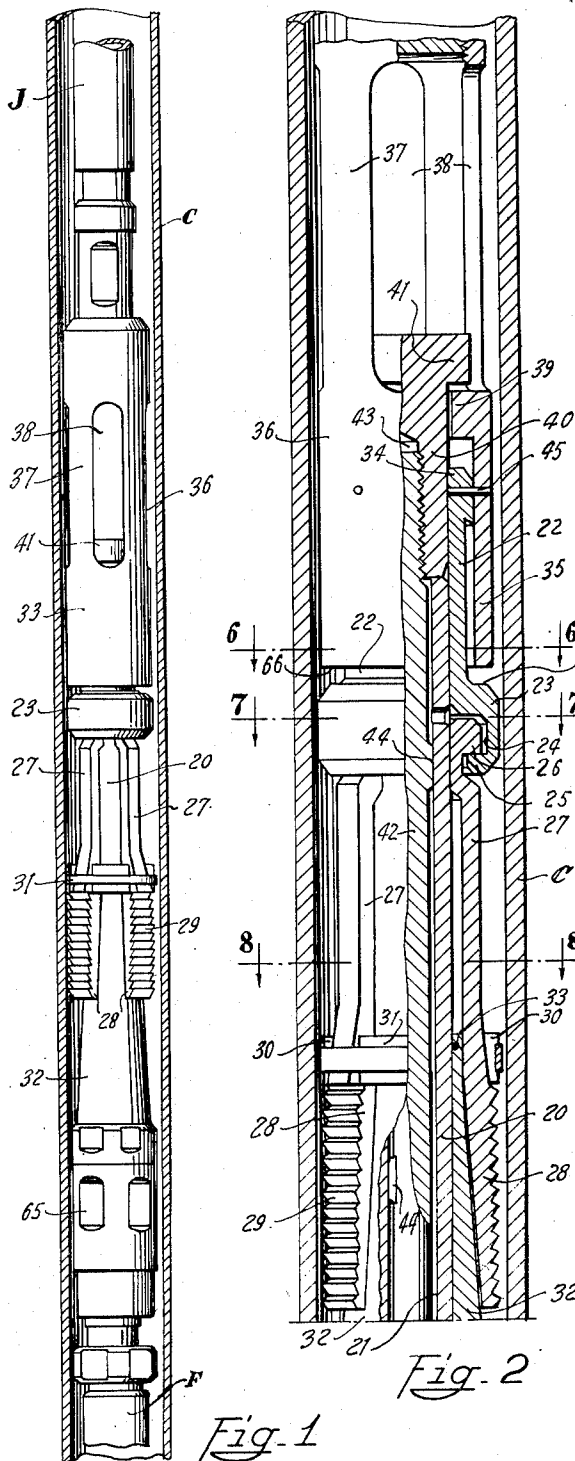
H. C. OTIS

2,784,789

WELL PACKER

Filed Dec. 24, 1951

4 Sheets-Sheet 1



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BY *Herbert C. Otis*
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March 12, 1957

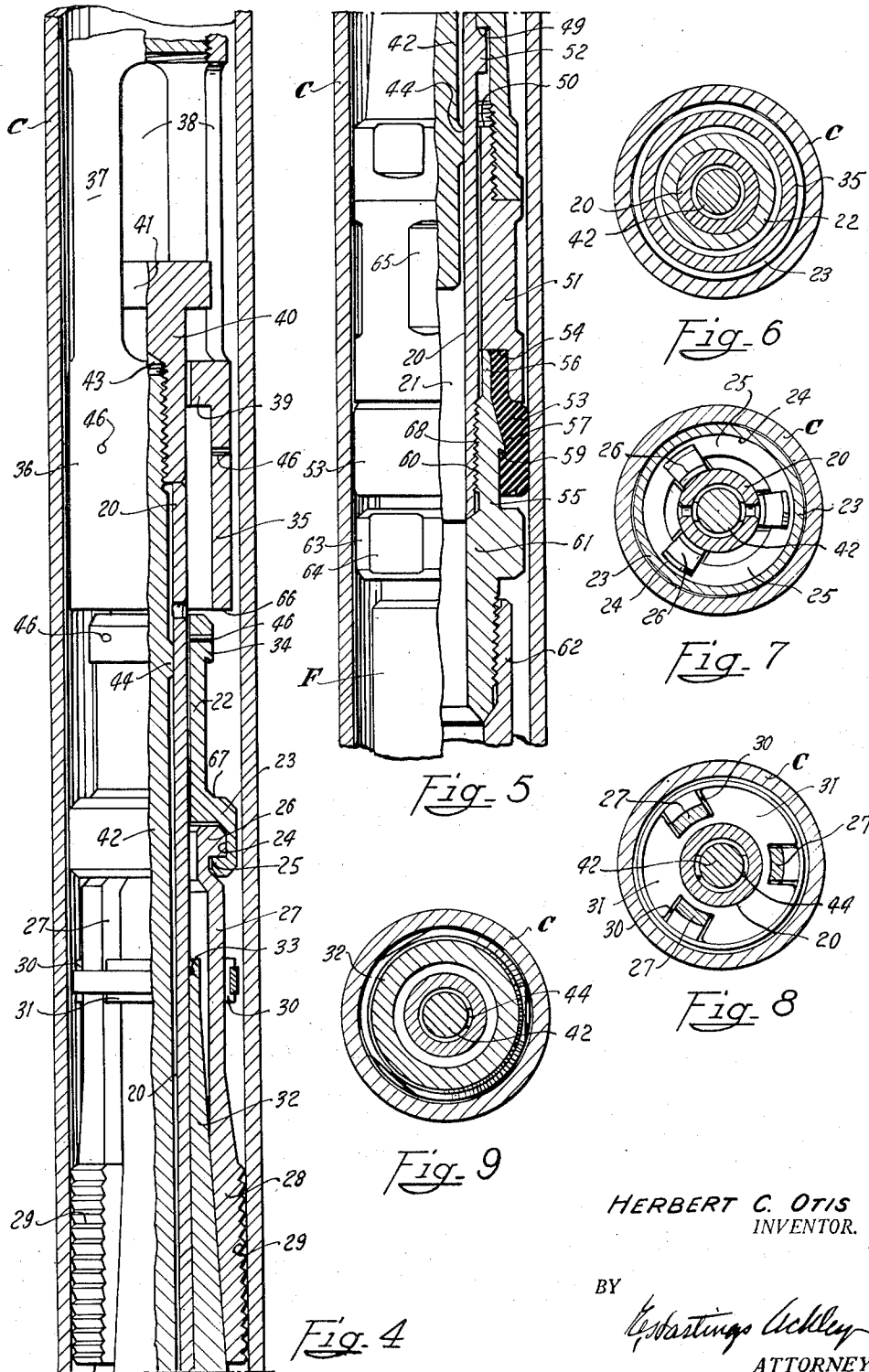
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4 Sheets-Sheet 3

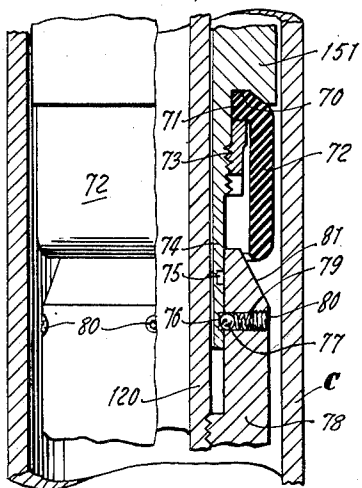


Fig. 10

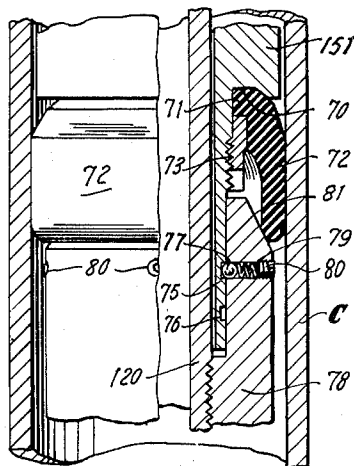


Fig. 11

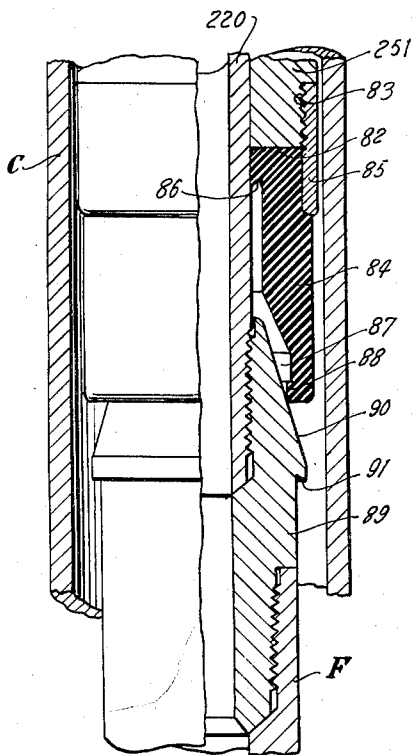


Fig. 12

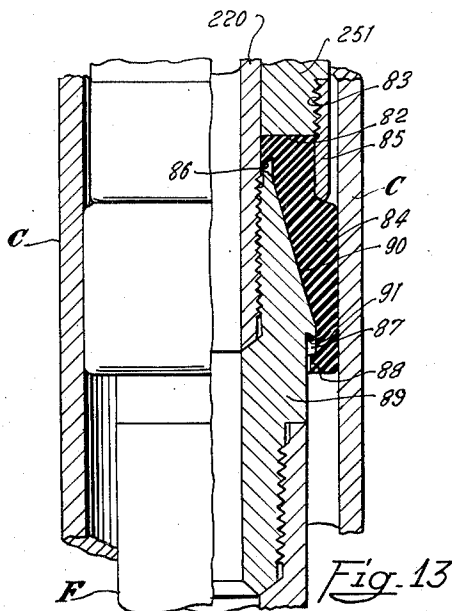


Fig. 13

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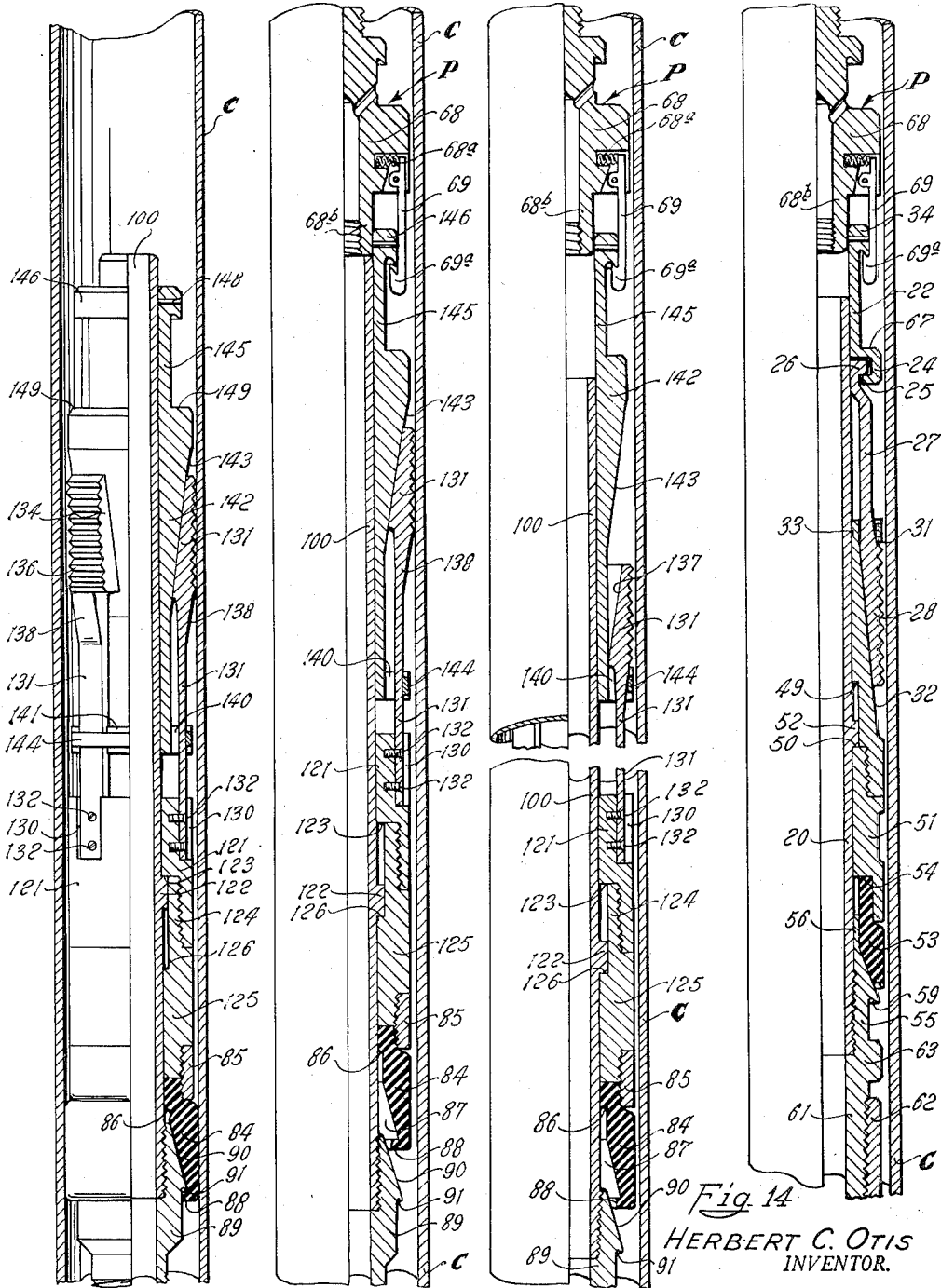
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4 Sheets-Sheet 4



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2,784,789

WELL PACKER

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Application December 24, 1951, Serial No. 263,045

14 Claims. (Cl. 166—125)

This invention relates to new and useful improvements in well packers.

Anchoring and sealing devices for removably supporting flow controlling devices, as well as other well devices, in the flow conductor of wells are usually provided with expansible packing members which are employed to seal the space between the mandrel of the device and the wall of the conductor to prevent passage of well fluids upwardly around the mandrel. The packing members are expanded, after the mandrel has been anchored in the conductor at a desired level, either by the upward pressure exerted on the packing member by the well fluids or by an expanding member which is movable with respect to a packing sleeve for that purpose. It is particularly desirable that the packing member and its expanding member be restrained against movement with respect to each other when in sealing position since such movement might cause them to disengage and thus destroy the seal between the mandrel and the conductor. Such relative movement between the packing member and the expanding member may be caused by accidental jarring of the mandrel by other well devices, by vibrations created by the flow of fluids up the conductor, by variations in the pressure exerted on the packing member and the expanding member by the well fluids, or other reasons. It is desirable, therefore, that means be provided to maintain the packing member and the expanding member against such undesired movement with relation to each other after the packing member has been expanded to seal the space between the mandrel of the anchoring device and the wall of the conductor.

Accordingly, it is one object of the invention to provide a new and improved device for sealing the annular space between a well device and the bore wall of the flow conductor of a well.

It is another object of the invention to provide a new and improved anchoring and packing assembly for releasably anchoring and sealing well devices in place in a well flow conductor.

A further object of the invention is to provide a new and improved anchoring and packing assembly of the character described and operating means for positively operating the same so that each is separately anchored and expanded.

Still another object of the invention is to provide a new and improved expansible packing or sealing sleeve assembly.

It is a further object of the invention to provide a new and improved expansible packing sleeve and packing sleeve expanding member assembly having a means for holding the packing sleeve and the expanding member against undesired movement with relation to each other after the packing sleeve has been expanded.

A particular object of the invention is to provide a well device of the character described which is provided with means for positively anchoring the device in a well flow conductor against upward displacement there-

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in, and which is also provided with a packing assembly and means for positively expanding the packing member of said packing assembly into sealing engagement with the bore wall of the conductor; and more especially wherein the anchoring means is first positively set, and the packing member then separately actuated to sealing position.

A still further object of the invention is to provide a device of the character described wherein the packing expanding means is movable from packing expanding position to non-expanding position separately and independently of movement of the anchoring means, and wherein such movement of the packing expanding means to non-expanding position may be effected prior to releasing the anchoring means; and it is still another object of the invention to provide such a device for use with a retrieving tool operable on a flexible line and wherein the locking or anchoring means and the packing expanding means are held out of and prevented from returning to anchored packing expanding position during removal.

Briefly stated, the invention comprises a mandrel assembly having a plurality of gripping members or slips mounted on a mandrel for anchoring the mandrel in the flow conductor of a well and an expansible packing sleeve also mounted on the mandrel for sealing the space between the mandrel and the flow conductor wall after the mandrel has been anchored in the conductor. An expanding member movable with respect to the packing sleeve, is employed to expand said packing sleeve. And, means is provided to restrain the expanding member against movement with respect to the packing sleeve after the latter sleeve has been expanded. In one embodiment of the invention, the restraining means is a flange integral with the expanding member which imbeds in the packing sleeve. In another embodiment, both the expanding member and the packing sleeve are provided with flanges which interlock after the sleeve is expanded by the expanding member. In still another embodiment, the restraining means comprises a detent which releasably latches or locks the expanding member to the mounting for the packing sleeve after the expanding member is moved into its packing sleeve expanding position. Another embodiment of the device is provided with locking means which are arranged to be released upon an upward non-rotative pull or force applied to the device after the packing sleeve expanding means has been moved to non-expanding position. All forms of the invention are designed so that the packing sleeve may be released from expanded position separately from actuation of the locking means for holding the device in place in a flow conductor; and all forms are likewise so constructed that the locking or anchoring means and the packing expanding means are held in unanchored non-expanding position while the device is being removed from the conductor, the mandrel of the device engaging a stop shoulder on the retrieving tool to prevent the locking members expanding means and the packing expanding means from returning to anchored sealing position while the retrieving tool is so engaged with the well device.

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

Figure 1 is an elevation of a mandrel assembly constructed in accordance with the invention, and showing the same suspended in a well tubing by a running tool,

Figure 2 is an enlarged view, partly in elevation and partly in section, of the upper portion of the mandrel assembly and running tool of Figure 1,

Figure 3 is a continuation of Figure 2, partly in eleva-

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tion and partly in section, the lower portion of the mandrel assembly being shown with the packing sleeve unexpanded.

Figure 4 is a view similar to Figure 2, partly in elevation and partly in section, showing the upper portion of the mandrel assembly with the locking mechanism in anchored position.

Figure 5 is a continuation of Figure 4, showing the lower portion of the mandrel assembly with the packing sleeve expanded.

Figures 6 through 8 are horizontal cross-sectional views taken on lines 6—6, 7—7 and 8—8, respectively, of Figure 2.

Figure 9 is a horizontal cross-section view taken on line 9—9 of Figure 3.

Figure 10 is a view, partly in elevation and partly in section, of a portion of a modified form of packing assembly showing a modified embodiment of the packing sleeve and an expander member in unexpanded position.

Figure 11 is a view, partly in elevation and partly in section, of the assembly illustrated in Figure 10, showing the packing sleeve in expanded sealing position.

Figure 12 is a view, partly in elevation and partly in section of a further modification of sealing assembly showing another form of packing sleeve and expander member in unexpanded position.

Figure 13 is a view, partly in elevation and partly in section, of the assembly illustrated in Figure 12 showing the packing sleeve in expanded sealing position.

Figure 14 is a quarter-sectional view similar to Figure 2 showing the mandrel assembly in retrieving position, supported by a retrieving tool.

Figure 15 is a quarter-sectional view of a mandrel assembly having a modified form of locking mechanism, showing the same in running position.

Figure 16 is a view similar to Figure 15, showing the modified form of the invention in the first part of the releasing and removing operation with the packing expanding member moved to non-expanding position, and

Figure 17 is a view similar to Figure 16, showing the mandrel assembly engaged by a retrieving tool in fully released position.

In the drawings, the numeral 20 designates an elongate tubular mandrel having an axial bore 21 extending there-through. The outer upper portion of the mandrel is substantially cylindrical in shape and has a slip supporting carrier or sleeve 22 slidably mounted thereon. The carrier has an enlarged lower portion 23 having an internal annular groove 24 providing an inwardly directed annular flange 25 on which the flanged upper ends 26 of the handles 27 of gripping members 28 are supported. Each of the gripping members has an enlarged slip body portion 29 which is provided with external serrations or gripping teeth. The handles of the gripping members extend through spaced apertures 30 in a retaining flange 31 on the upper end of a frusto-conical expander sleeve 32 which is slidably mounted on the mandrel 20 below the slip carrier 22. The expander sleeve has an inner annular recess at its upper end in which is disposed an O-ring 33 for sealing off the upper end of the space between the expander sleeve and the mandrel to prevent the passage of such foreign matter as sand or the like into such annular space.

The upper end of the slip carrier 22 is formed with an annular flange or retrieving shoulder 34 which has a close sliding fit within the bore of a cylindrical skirt or extension 35 of a running tool 36. The running tool is provided with a cylindrical body sleeve 37 having elongate slots 38 in the wall thereof and an internal annular flange 39 intermediate its ends. A piston 40 having an enlarged head 41 is slidable vertically within the body sleeve 37, downward travel of the piston being limited by engagement of the head with the annular flange 39. A prong 42 is threaded at its upper end into a threaded box 43 formed in the piston and extends downwardly into the axial bore 21 of the mandrel, and

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is provided with a plurality of longitudinally and angularly spaced bosses 44 which tightly engage the inner surface of the mandrel. The bosses being on opposite sides of the prong and having an overall diameter slightly greater than the bore of the mandrel, the prong is bent or sprung between each pair of bosses so that the bosses engage the bore wall of the mandrel in a tight frictional grip, and the mandrel is thus supported by the prong.

The skirt or extension 35 of the running tool is detachably secured to the slip supporting carrier 22 by at least one shear pin 45 which extends through registering apertures 46 in the flange 34 of the carrier and in the skirt of the running tool. The manner in which the gripping members 28 and the expander sleeve 32 coact to anchor the mandrel in the tubing C will be hereinafter described.

The lower end of the bore of the expander sleeve 32 is enlarged to provide an annular ledge 49 and the reduced upper end 50 of a packing supporting ring 51 is threaded into the lower end of the enlarged bore of the sleeve. The mandrel 20 has an external annular stop flange 52 which is movable a limited distance longitudinally between the ledge 49 of the expander sleeve and the upper end 50 of the supporting ring. The expander sleeve and packing supporting ring thus are mounted on and have a limited longitudinal movement on the mandrel of the well device.

A packing sleeve 53 of fabric reinforced rubber, synthetic rubber, or other suitable deformable sealing material, has its upper end fixed within the enlarged lower bore of the supporting ring 51 and abutting the internal annular shoulder or ledge 54 at the upper end of such enlarged bore and has its lower portion extending below the supporting ring. A packing expanding member or sleeve 55 having a reduced cylindrical neck 56 at its upper end with a frusto-conical or wedge packing expander surface 57 immediately therebelow, is threaded onto the lower end of the mandrel. Below the expander surface, the sleeve is formed with an undercut external annular flange 59, whose purpose will be described below. Since the expanding member 56 is screwed onto the lower end of the mandrel 20 and is rigid therewith, it will be moved with the mandrel.

The expanding member may have a downwardly extending portion 61 externally threaded to engage the internally threaded upper portion 62 of a conventional flow control device F. An enlarged external flange 63 having wrench flats 64 thereon is formed centrally of the expanding member in order to provide a means by which the member may be manipulated during assembly or disassembly of the device. The packing supporting ring 51 may also be provided with flat surfaces 65 for this purpose.

In use, the running tool 36 is frictionally secured to the mandrel 20 by inserting the prong 42 into the bore of the mandrel, and the depending skirt 35 is secured to the slip carrier 22 by the shear pin 45. The running tool is suspended on a flexible line lowering and jarring mechanism (not shown) by means of which the running tool and the mandrel assembly are lowered into the tubing or flow conductor C. When the device has been lowered to the desired level in the conductor, the line is suddenly slackened to permit the running tool 36 and the gripping members 28 and their supporting carrier 22 to move downwardly with respect to the expander sleeve 32 and mandrel 20, whereupon the frusto-conical surface of the expander sleeve will move the lower enlarged slip portions 29 of the gripping members outwardly so that the teeth thereon will contact and grip the inner surface of the conductor (see Figure 4). When the teeth grip the conductor, the downward movement of the gripping members and their supporting carrier is halted, and the jarring mechanism may be operated to cause a downward jar to be applied to the skirt to shear the pin 45, whereupon the lower end 66 of the skirt 35 will engage the upper surface 67 of the enlarged portion 23 of the

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slip supporting carrier. Continued downward jarring on the carrier and slip handles will wedge the gripping teeth of the slips more firmly between the expander sleeve and bore wall of the conductor, thus tightly anchoring the well device in the conductor. During this driving or jarring operation, the skirt 35 must not be raised sufficiently to cause the flange 39 to contact the head 41 of the piston 40, since this would cause premature upward movement of the mandrel 20.

After the mandrel assembly has been firmly anchored in the tubing, the running tool 36 is lifted so that the internal flange 39 in the body sleeve engages the lower surface of the head 41 of the piston 40, and the piston and the prong 42 are moved upwardly thereby. Since the bosses 44 of the prong are in tight frictional engagement with the mandrel 20, such upward movement of the prong lifts the mandrel and the packing expanding member 55 at the lower end of said mandrel. The cylindrical neck 56 and the frusto-conical expander surface 57 of the expanding member 55 may slide upwardly into the packing sleeve 53 until the packing sleeve is tightly compacted between the expanding member and the conductor wall or until the upper end of the neck contacts the shoulder 54 of the supporting ring 51. The upward movement of the frustoconical expander surface causes the packing sleeve to expand and tightly press against the bore wall of the conductor. The external undercut flange 59 below the expanding surface is moved intermediate the ends of the packing sleeve and imbeds in the packing sleeve, as shown in Figure 5. Since the undercut flange 59 is imbedded in the packing sleeve, downward movement of the expanding member with respect to the packing sleeve will be resisted or restrained until a relatively great downward force is exerted on the expanding member. The packing sleeve is thus expanded and maintained firmly in its expanded sealing position. Upward movement of the mandrel and the packing expanding member caused by the upward force of fluid pressure from below them and below the flow control device F carried by them is positively limited by the engagement of the annular flange 52 on the mandrel with the downwardly facing ledge 49 in the bore of the slip expander sleeve 32 and by the engagement of the upper end of the neck 56 of the packing expanding member with the internal shoulder 54 in the packing supporting ring. Thus, the slips or gripping members 28 and the expander sleeve 32 positively anchor the assembly against upward displacement in the conductor.

Upon a continued upward pull on the running tool, the prong 42 will slide out of the bore of the mandrel since it was only frictionally held in place in the bore of the mandrel, and since no further upward movement of the mandrel can occur.

When it is desired to remove the mandrel assembly from the conductor, a retrieving tool P is used, which is preferably of the type disclosed in the patent to H. C. Otis, No. 2,508,285, but which may also be of any other suitable type, such as is shown in Figure 14, which has a body 68 carrying a plurality of downwardly extending fingers 69 having inturned hooks 69a at their lower ends. The fingers are pivotally mounted on the body at their upper ends and a spring 68a carried by the body acts on the upper ends of each finger to swing the lower hook end inwardly. Thus, the hooks at the lower ends of the fingers are adapted to engage underneath the annular retrieving flange 34 of the slip supporting carrier 22, and a reduced axial body extension 68b is adapted to engage the upper end of the mandrel 20. As is shown in Figure 4, the upper end of the mandrel is located above the slip supporting carrier when the packing sleeve is in expanded position, so that the reduced extension 68b of the body of the retrieving tool may engage the upper end of the mandrel and be employed to deliver downward blows to said mandrel. The mandrel will thus be driven downwardly with respect to the expander sleeve

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32, and the expanding member 55 carried thereby will be moved downwardly therewith to withdraw the wedge expander surface from within the packing sleeve and permit said sleeve to move to unexpanded non-sealing position. Upon continued downward movement of the mandrel, the external annular flange 52 of the mandrel engages the annular upper end 50 of the packing supporting ring 51, and further blows on the upper end of the mandrel will cause the expander sleeve 32 to be moved downwardly, since the packing supporting ring is secured directly to the expanding sleeve. When the expander sleeve is moved downwardly, as shown in Figure 14, the hooks 69a on the fingers of the retrieving tool engage beneath the flange 34 of the slip supporting carrier 22 to support the same, and upon continued downward movement of the expander sleeve the gripping members may move inwardly and lose contact with the conductor wall. The mandrel assembly is then no longer anchored in the conductor and is supported on the hooks of the fingers 69 of the retrieving tool which are engaged beneath the retrieving flange 34 of the slip supporting carrier, the slip body portion 29 of the gripping members engaging beneath the flange 31 at the upper end of the expander sleeve 32 and so supporting the mandrel 20 by means of its external flange 52 which rests on the upper end 50 of the packing supporting ring carried by the slip expander sleeve. The body extension on the retrieving tool will limit upward movement of the mandrel 20 and thus preclude return of the locking expander sleeve 32 and the packing expanding member 55 to anchoring sealing position during removal of the assembly from the conductor.

A modified form of the packing sleeve and packing expanding member assembly is illustrated in Figures 10 and 11. This form is provided with a supporting ring 151 having a downwardly facing annular undercut shoulder 70 below which is disposed the upper inturned annular flange 71 of a packing sleeve 72. The inturned flange is held in place by a locking ring 73 screwed onto a threaded portion of an axial cylindrical shank 74 depending from the supporting ring 151. The shank of the supporting ring is provided with a pair of vertically spaced annular recesses 75 and 76 in which a ball detent 77 mounted in a bore in a packing expanding member 78 is adapted to engage. The detent is biased toward the skirt by a spring 79 held in place in the bore by a set screw 80 threaded into the outer end of the bore. When the expanding member 78 is in the lower position illustrated in Figure 10 with the ball detent engaged in the lower annular recess 76, the packing sleeve is in its unexpanded position. Upward movement of the expanding member will cause the ball detent to ride out of the recess 76 against the force of the spring, the packing sleeve will be expanded by a frusto-conical expander or wedge surface 81 on the upper end of the expanding member, and the ball detent will finally engage in the upper recess 75 of the skirt. The packing sleeve will now be held in sealing contact with the bore wall of the flow conductor C. The ball detent will hold the expanding member in this position until the retrieving tool delivers a downward blow of relatively great force on the upper end of the mandrel 120, to move the expanding member downwardly with respect to the packing sleeve, in the same manner as in the form previously described.

Another modified form of the packing sleeve and packing expanding member assembly is illustrated in Figures 12 and 13. This form is provided with a packing supporting ring 251 having a downwardly facing shoulder 82 and external screw threads 83 at its lower end. An elongate packing sleeve 84 has its upper end molded to or otherwise fixed in the lower portion of the bore of a reinforcing bushing or sleeve 85 which has its upper end threaded onto the lower end of the packing supporting ring 251. The upper end of the packing sleeve abuts against the shoulder 82 on the supporting ring and the upper end of the bore of said packing sleeve slidably en-

gages the exterior wall of the lower end of the mandrel 220. Spaced below its upper end, the packing sleeve is formed with an internal annular sealing lip 86 whereby fluid pressure from below holds the lip in tight sealing engagement with the mandrel. Below the sealing lip, the bore of the sleeve extends cylindrically downwardly and is then tapered downwardly and outwardly to form an enlarged lower bore 87 which terminates in an internal annular flange 88 at the lower end of the sleeve. A packing expanding member 89 is threaded onto the lower end of the mandrel 220 and has a frusto-conical or wedge packing expanding surface 90 at its upper end which engages the bore of the packing sleeve and expands the same into sealing engagement with the bore wall of the conductor C, as shown in Figure 13, when the mandrel and expanding member are moved upwardly with respect to the packing sleeve. Below the expanding surface, the expanding member is formed with an undercut external annular ledge or shoulder 91 which enters the enlarged bore 87 of the packing sleeve and is disposed above the internal flange 88 of the sleeve when the mandrel and packing expanding member are moved upwardly to expand or deform the sleeve to sealing position. The external diameter of the expanding member immediately above the undercut shoulder 91 is sufficiently great to cause the lower portion of the packing sleeve to initially engage the bore wall of the conductor, and the shoulder will engage the internal flange 88 of the sleeve whereby the expanding member is restrained against downward movement out of the packing sleeve. The shoulders 91 of the expanding member and the flange 88 of the packing sleeve therefore cooperate to maintain the packing sleeve in its expanded position. Upward movement of the mandrel 220 and packing expanding member is limited by engagement of an annular flange, similar to the flange 52 of the first form, on the mandrel with a stop shoulder similar to the shoulder 49 of the first form. As in the other described forms, a strong downward blow must be delivered to the upper end of the mandrel 220 to move the shoulder 91 downward past the flange of the packing sleeve, and the wedge surface 90 downwardly from packing expanding position. However, when the packing expanding member is so moved downwardly, the packing sleeve may retract from sealing position and the well device may be readily removed from the conductor in the same manner as the form first described.

When removing the assembly, in all forms wherein the packing sleeve is secured to the lower end of the slip expander sleeve, the packing sleeve will be positively moved upwardly with respect to the packing expanding member, or the packing expanding member may be moved downwardly with respect to the packing sleeve, so that the packing sleeve and packing expanding member are positively separated to permit the packing sleeve to retract to non-sealing position, whereby the assembly may be readily removed from the flow conductor without sticking.

A modified form of locking mechanism for the mandrel assembly is illustrated in Figures 15 through 17, wherein the gripping elements are expanded by a downwardly tapered expander sleeve and are releasable on a direct upward pull. An elongate tubular mandrel 100 similar to the mandrel 20 previously described has a slip supporting carrier sleeve 121 slidably mounted on the cylindrical portion of the mandrel above an external annular stop flange 122 preferably formed integral with the mid-portion of the mandrel. The lower end of the bore of the slip carrier sleeve 121 is enlarged to provide a downwardly facing annular ledge 123, and the reduced upper end 124 of a packing supporting sleeve 125 is threaded into the lower end of the enlarged bore of the slip carrier sleeve. The upper portion of the bore of the packing supporting sleeve is enlarged to provide an upwardly facing annular shoulder 126 at substantially its mid-portion, whereby the mandrel may undergo a limited movement longitudinally between the downwardly facing

ledge 123 of the slip carrier sleeve and the upwardly facing stop shoulder 126 of the packing supporting sleeve. The slip carrying sleeve and the packing supporting sleeve are thus slidably mounted on and have a limited longitudinal movement on the mandrel of the well device. The lower end of the packing carrying sleeve is provided with a packing sleeve 84 identical with that illustrated in Figures 12 and 13 and bearing the same numbers as the elements there illustrated. Also, the lower end of the mandrel is provided with a packing expanding member 89 which is threaded onto the lower end of the mandrel 120 in the same manner as that illustrated in Figures 12 and 13 and functions in the same manner.

The upper end of the slip carrying the sleeve 121 is provided with a plurality of circumferentially spaced recesses 130 in its exterior surface, and these recesses receive the lower ends of elongate spring arms 131 which are held in place in the recesses by screws 132. The spring arms extend upwardly above the carrying sleeve and have slips or gripping members 133 at their upper end. Each of the gripping members has an enlarged slip body portion 134 which is provided with external serrated gripping teeth 136 and a tapered rear surface 137. The handles 130 extend upwardly through spaced apertures 140 in a retaining flange 141 provided on the lower end of a frusto-conical expander sleeve 142 which is slidably mounted on the mandrel 120 above the slip carrying sleeve. The gripping members 133 are slidable on the frusto-conical expanding surface 143 of the expander member upon downward movement of the expander member with respect to the gripping members. The spring handles 130 are retained in the apertures in the flange at the lower end of the expander member by a retaining ring or band 144 which is mounted in an annular groove formed in the periphery of the flange. The spring arms are provided with wedge surfaces 138 below the serrated gripping faces, and these wedge surfaces engage the band 144 to positively move the gripping members inwardly to retracted position, as clearly shown in Figure 17.

The upper end of the expander sleeve is formed with a reduced cylindrical neck 145 having an external annular retrieving flange or shoulder 146 at its upper end, which is similar to the retrieving shoulder 34 of the slip carrier 22 of the form first described and which served substantially the same purpose, as will be hereinafter more fully explained.

In use, the running tool 36 first described is connected to the well device of this form in the same manner as the running tool was connected to the form first described, the prong extending downwardly through the bore of the mandrel 120, and the skirt 35 of the running tool being detachably secured to the retrieving flange 146 at the upper end of the expander sleeve by at least one shear pin which extends through corresponding apertures 46 in the skirt of the running tool and 148 in the retrieving flange on the expanding sleeve. The mandrel assembly is then lowered into the well in the manner already described until it has reached a desired depth in the flow conductor, and the line is then suddenly slackened to permit the running tool 36 to move the expander sleeve downwardly between the gripping elements or slips to expand the same into contact and gripping engagement with the inner surface of the conductor, in the manner shown in Figure 15. When the teeth of the slips grip the conductor, downward movement of the mandrel assembly is halted and the jarring mechanism may be operated to cause a downward jar to be applied to the skirt of the running tool to shear the pin connecting the skirt to the retrieving flange at the upper end of the expander sleeve, whereupon the lower end 66 of the skirt 35 of the running tool engages the upwardly facing shoulder 149 at the upper end of the expander portion of the expander sleeve. Continued downward jarring on the running tool will wedge the expander member more tightly between the gripping slips and force the slips into a firmer gripping engage-

ment with the wall of the conductor to tightly anchor the device in place in the conductor. After the mandrel has been firmly anchored in the conductor in the manner just described, the running tool is lifted so that the internal flange 39 in the body sleeve engages the head of the piston 40 and lifts the prong 42 upwardly. The tight frictional grip of the prong with the bore wall and the mandrel 100 lifts the mandrel and the packing expanding member 89 at the lower end of the mandrel. Such upward movement of the frusto-conical expander member forces the packing sleeve outwardly into sealing engagement with the wall of the well conductor in the manner previously described.

When it is desired to remove the mandrel assembly from the conductor, a retrieving tool P, similar to that already described and shown in Figure 14, is lowered into the bore of the conductor until the reduced body extension 68b engages the upper end of the mandrel 100. As shown in Figure 15, the upper end of the mandrel is located above the upper end of the slip expander sleeve 142 when the mandrel assembly is locked in place in the conductor, so that the reduced extension 68b of the body of the retrieving tool may be employed to deliver downward blows to the mandrel. The mandrel will thus be driven downwardly with respect to the expander sleeve and the gripping slips, and the expanding member at the lower end of the mandrel will be moved downwardly to withdraw the wedge expander surface from within the packing sleeve and permit the sleeve to move the unexpanded non-sealing position. Upon continued downward movement of the mandrel, the external annular flange 122 on the mandrel engages the upwardly facing shoulder 126 in the packing supporting sleeve and is stopped thereby. At this position, shown in Figure 16, the hooks on the lower end of the fingers of the retrieving tool are disposed beneath the retrieving flange 146 at the upper end of the expander sleeve, whereupon an upward pull may be applied to the expander sleeve to move the sleeve upwardly and withdraw the frusto conical expander surface 143 from between the gripping slips to the position shown in Figure 17. In this position the slips are retracted. The band 144 encircling the flange at the lower end of the expander sleeve engages the wedge surfaces 138 on the slip handles to positively draw the slips inwardly from gripping engagement with the wall of the conductor. The mandrel may then be moved upwardly out of the well conductor.

The body extension 68b on the retrieving tool will limit upward movement of the mandrel 100 and thus preclude movement of the mandrel and locking means which would return the locking means and the packing sleeve 84 to anchored sealing position during removal of the assembly from the conductor.

It will thus be seen that a modified form of the locking mechanism has been disclosed wherein the anchoring mechanism may be released, after the packing expanding member has been moved downwardly from expanding position to release the sealing engagement of the packing sleeve with the conductor. The gripping elements are released upon a simple direct upward pull.

Obviously, any of the packing arrangements shown in Figures 1 through 11 may be employed at the lower end of the packing carrying sleeve of this form of the invention as well as that shown in Figures 15 through 17.

From the foregoing, it will be seen that a new and improved anchoring and sealing assembly has been provided having a packing sleeve which can be expanded in a well flow conductor to seal the space between the mandrel and the conductor wall by upward movement of an expanding member. Furthermore, the expanding member and the packing sleeve are provided with means for holding the packing sleeve and the expanding member firmly and positively in packing sleeve expanding position until a flexible wire line retrieving tool is employed to remove the mandrel assembly from the conductor, the complete

anchoring and sealing assembly being readily removable from within the conductor by means of such retrieving tool.

It will also be seen that the anchoring and sealing assembly is provided with operating means for positively operating the anchoring means and the sealing means separately, so that the anchoring means may first be set to positively anchor the device in place in the conductor and the sealing member may then be separately positively actuated to sealing position; and that the device is provided with means for restraining the packing member and its expanding member against undesired movement toward non-expanding position after the packing member has been initially positively moved to expanded position.

It will further be seen that the retrieving tool used to remove the mandrel assembly from the bore of the conductor may be provided with an extension member engageable with the mandrel of the well device to preclude movement of the mandrel which would return the locking means and the packing to locked sealing position during removal of the device from the conductor. It will also be seen that a locking mechanism has been disclosed which may be removed upon a direct upward pull, after the packing has been moved to non-expanded non-sealing position. In all forms of the invention, the packing is moved to expanded or to non-expanded position separately and independently of movement of the anchoring mechanism to expanded gripping or released position.

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

What I claim and desire to secure by Letters Patent is:

1. A well device including: an elongate tubular mandrel; a plurality of spaced gripping members slidably mounted exteriorly on said mandrel; a tapered expanding sleeve in slidable engagement with said gripping members and slidably mounted on said mandrel for limited longitudinal movement on said mandrel, said expanding sleeve moving said gripping means outwardly of said mandrel to expanded position upon downward movement of one of said members with respect to the other; a tubular packing expanding member secured to said mandrel below said expanding sleeve, said packing expanding member having a downwardly and outwardly inclined surface and an annular horizontal shoulder below and adjacent said tapered portion; and a packing sleeve between said expanding sleeve and said packing expanding member, said packing sleeve having its lower end provided with an inwardly extending annular flange, said packing expanding member telescoping into said packing sleeve when said mandrel is moved upwardly relative to said expanding sleeve after said gripping means has been moved to expanded position, said tapered portion expanding said packing sleeve, said inwardly extending annular flange of said packing sleeve being disposed below the annular shoulder of said expanding member when said packing sleeve and said packing expanding member are in telescoped relation.

2. A well device including: an elongate tubular mandrel, a plurality of spaced gripping members slidably mounted exteriorly on said mandrel; a tapered expanding sleeve in slidable engagement with said gripping members and slidably mounted on said mandrel for limited longitudinal movement on said mandrel, said expanding sleeve moving said gripping members outwardly toward gripping position; an expandable packer sleeve secured to and extending below said expanding sleeve; a tubular packing expanding member secured to said mandrel below said packer sleeve, said expanding member telescoping into said packer sleeve to expand said sleeve when said mandrel is moved to an upper position relative to said expanding sleeve; and a spring biased detent opera-

tively associated with said expanding member for holding said mandrel in said upper position.

3. A well device including: an elongate tubular mandrel; a plurality of spaced gripping means slidably mounted exteriorly on said mandrel; a tapered expanding sleeve in slidable engagement with said gripping means and slidably mounted on said mandrel for limited vertical movement relative to said gripping means for moving said gripping means outwardly of said mandrel to gripping position; a packer sleeve having an inwardly turned upper end extending about and engaging said mandrel and a lower end extending about and spaced from said mandrel; a tubular expanding member secured to said mandrel below said packer sleeve and having a tapered surface for engagement in said lower end of said packer sleeve; means for moving said packer sleeve and expanding member into telescoping relation after the gripping means is moved to gripping position, said tapered surface expanding said lower end of said packer sleeve.

4. A well device including: an elongate tubular mandrel; a plurality of spaced gripping members slidably mounted exteriorly on said mandrel; a tapered expanding sleeve in slidable engagement with said gripping members and slidably mounted on said mandrel for limited longitudinal movement on said mandrel, said expanding sleeve moving said gripping members outwardly from said mandrel to gripping position; a tubular packing expanding member mounted on said mandrel below said expanding sleeve; an expansible packer sleeve between said expanding sleeve and said packing expanding member, said packing expanding member and said packer sleeve being movable into telescoped relation; and means carried by the mandrel and engageable with said packer sleeve and said packing expanding member for positively and firmly restraining said packer sleeve and said packing expanding member in telescoping relation.

5. A well device including: an elongate tubular mandrel; a plurality of spaced gripping members slidably mounted exteriorly on said mandrel; a tapered expanding sleeve in slidable engagement with said gripping members and slidably mounted on said mandrel for limited longitudinal movement relative to said gripping members to expand said gripping members outwardly from said mandrel; a packer sleeve having an inwardly turned upper end extending about and engaging said mandrel and a lower end extending about and spaced from said mandrel; a tubular expanding member secured to said mandrel below said packer sleeve and having a tapered surface for engagement in said lower end of said packer sleeve; means for moving said packer sleeve and expanding member into telescoping relation after the gripping members are expanded, said tapered surface expanding said lower end of said packer sleeve; and means carried by the packer sleeve and engageable with said expanding member for restraining said member and said sleeve in telescoped relation.

6. A well device including: an elongate tubular member; an expansible packing sleeve slidably mounted on said tubular member; an expanding member mounted on said tubular member adjacent said packing sleeve; locking means on said tubular member expansible into locking engagement with the bore wall of a well conductor and having means engageable with the packing sleeve to limit upward movement of said packing sleeve in the conductor; said tubular member being movable with respect to the locking means and said packing sleeve only after the locking means has been expanded to locking position holding such packing sleeve stationary for moving said expanding member and said packing sleeve into telescoping relation to one another to expand said sleeve in directions normal to the longitudinal axis of said tubular member; and means carried by said packing sleeve and engageable with said expanding member for restraining said sleeve and said expanding member firmly and positively in telescoped relation.

7. A well device including: an elongate tubular member; locking means on said tubular member expansible into locking engagement with the bore wall of a well conductor; an expansible packing sleeve mounted on said tubular member adjacent said packing sleeve; means on the locking means engageable with said packing sleeve for limiting upward movement of said packing sleeve in the conductor; said tubular member being movable with respect to the locking means only after the locking means is expanded to locking position holding said packing sleeve stationary to move said expanding member and packing sleeve into telescoping relation to one another to expand said packing sleeve; and means carried by said packing sleeve and engageable with said expanding member for restraining said sleeve and expanding member firmly in telescoped relation.

8. A well device including: an elongate tubular mandrel; gripping means slidably mounted exteriorly on said mandrel; a tapered expanding sleeve slidably mounted on said mandrel for limited vertical movement relative to said gripping means for moving said gripping means outwardly of said mandrel to gripping position; a packing sleeve having an inwardly turned upper end extending about and engaging said mandrel and a lower end extending about and spaced from said mandrel; a tubular expanding member secured to said mandrel below said packing sleeve and having a tapered surface for engagement in said lower end of said packing sleeve; and means for moving said packing sleeve and expanding member into telescoping relation independently of the movement of the gripping means to gripping position, said tapered surface expanding said lower end of said packing sleeve.

9. A well device including: an elongate tubular mandrel; a supporting carrier slidably mounted on said mandrel; a plurality of gripping members carried by said supporting carrier; a tapered expanding sleeve slidably mounted on said mandrel, said expanding sleeve being slidable between the gripping members and the mandrel for moving the gripping members outwardly of said mandrel to gripping position; said expanding sleeve having an annular flange at its smaller end provided with a plurality of spaced apertures, each of said gripping members extending through one of said apertures and being held in spaced relation by said flange; a tubular packing expanding member mounted on said mandrel below said supporting carrier and expanding sleeve; an expansible packing sleeve between said packing expanding member and said supporting carrier and expanding sleeve, said packing expanding member being movable into telescoped relation with said packing sleeve to expand the packing sleeve into sealing position independently of movement of the expanding sleeve to expand the gripping members; and means on the mandrel for firmly restraining said packing sleeve and expanding member in telescoped relation.

10. A well device including: an elongate tubular mandrel; expanding means carried by said tubular mandrel; locking means on said tubular mandrel expansible into locking engagement with the bore wall of a well conductor by said expanding means upon relative movement between said locking means and said expanding means; an expansible packing sleeve mounted on said tubular mandrel adjacent said packing sleeve; and means on the locking means engageable with said packing sleeve for limiting upward movement of said packing sleeve; said tubular mandrel being movable with respect to the locking means to move said expanding member and packing sleeve into telescoping relation to one another to expand said packing sleeve to sealing position independently of relative movement between the expanding means and the locking means after the locking means has been expanded to locking position to hold said packing means stationary.

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11. A well device of the character set forth in claim 10 and a retrieving tool having first means engageable with the locking means for supporting the same; said retrieving tool also having second means engageable with one end of the tubular mandrel for moving the same downwardly with respect to the packing sleeve to move said expanding member out of packing sleeve expanding position, such movement of said tubular member also moving said locking means expanding means out of expanding position with respect to said locking means.

12. A well device including: an elongate tubular mandrel; a supporting carrier slidably mounted on said mandrel; a plurality of gripping members carried by said supporting carrier; a tapered expanding sleeve slidably mounted on said mandrel, said expanding sleeve being slidable between the gripping members and the mandrel for moving the gripping members outwardly of said mandrel to gripping position; said expanding sleeve having an annular flange at its smaller end provided with a plurality of spaced apertures, each of said gripping members extending through one of said apertures and being held in spaced relation by said flange; a tubular packing expanding member mounted on said mandrel below said supporting carrier and expanding sleeve; an expansible packing sleeve between said packing expanding member and said supporting carrier and expanding sleeve, said packing expanding member being movable into telescoped relation with said packing sleeve to expand the packing sleeve into sealing position independently of movement of the expanding sleeve to expand the gripping members; and means on the mandrel for firmly restraining said packing sleeve and expanding member in telescoped relation; and a retrieving tool having catch means engageable with the locking means and having an extension member engageable with one end of the tubular mandrel for moving the tubular mandrel downwardly with respect to the packing sleeve to move the expanding member out of packing sleeve expanding position, said retrieving tool extension member limiting upward movement of said tubular member and thus preventing movement of the locking means and packing expanding member to locked expanding position while the retrieving tool catch means is engaged with the locking means.

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13. A well device including: an elongate tubular mandrel; a locking assembly comprising gripping means slidably mounted exteriorly on said mandrel and an expanding sleeve in slidable engagement with said gripping means and slidably mounted on said mandrel for limited longitudinal movement on said mandrel, said expanding sleeve moving said gripping means outwardly to gripping position upon longitudinal movement of said sleeve and means relative to each other; a tubular packing expander member carried by the mandrel below said locking assembly; a packing assembly comprising a support and a packing sleeve mounted on the mandrel between the locking assembly and said packing expander member, said mandrel being slidable longitudinally relative to said packing assembly; and running tool means detachably secured to said locking assembly and adapted initially to move said locking assembly to gripping position and subsequently to be detached therefrom, and a connecting member having a lost-motion connection with said running tool means and engageable with said tubular mandrel to move said mandrel upwardly relative to said locking assembly and said packing assembly for moving said packer expander member into engagement with the packing sleeve to expand the same to sealing position after said running tool means has been detached from the locking assembly.

14. A well device of the character set forth in claim 13 wherein: the packing expander member has a downwardly and outwardly inclined surface at its upper end and an undercut shoulder below and adjacent said tapered surface, said tapered surface engaging and expanding said packing sleeve and said undercut shoulder engaging said packing sleeve to restrain separating movement therebetween.

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