Aug. 16, 1955 C. C. BROWN 2,715,442

WELL PACKERS

Filed Nov. 26, 1951 3 Sheets-Sheet 1

Fig. 1

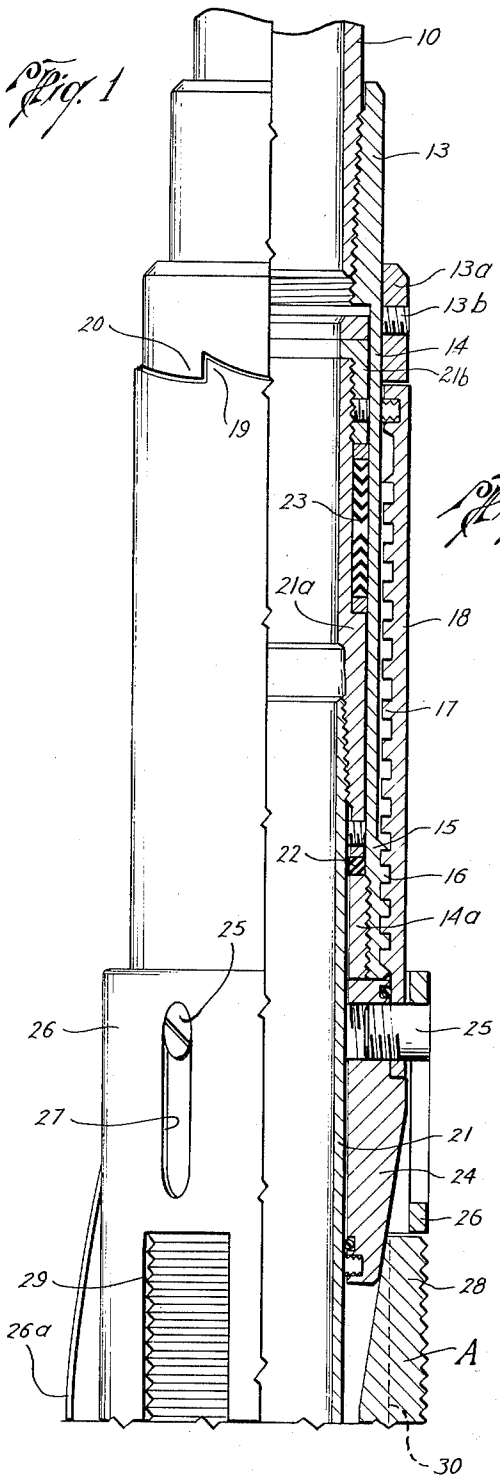
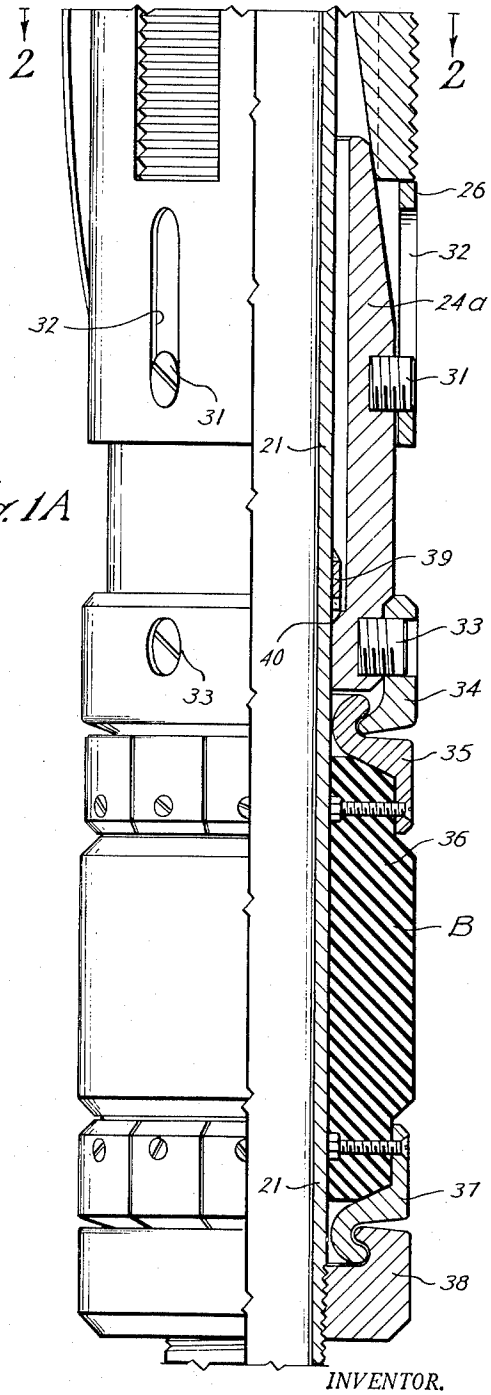


Fig. 1A



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Aug. 16, 1955 C. C. BROWN 2,715,442

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Filed Nov. 26, 1951 3 Sheets-Sheet 2

Fig. 3

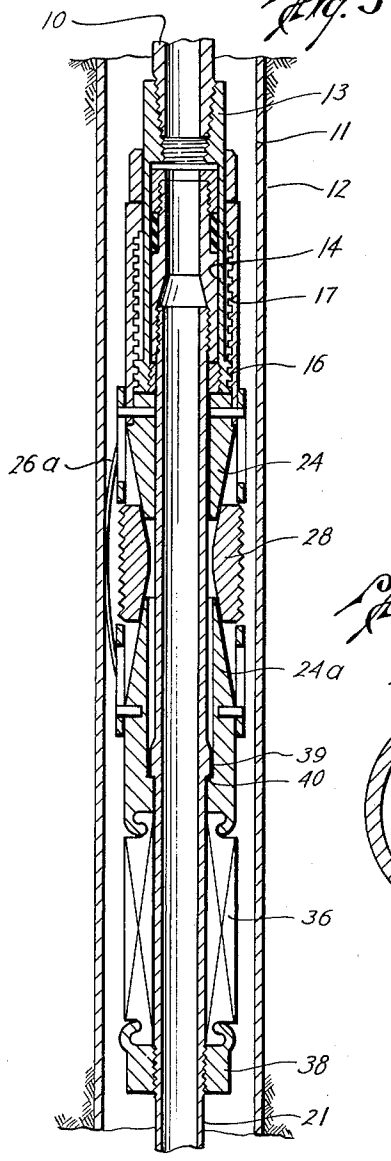


Fig. 2

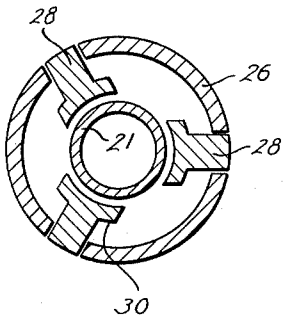
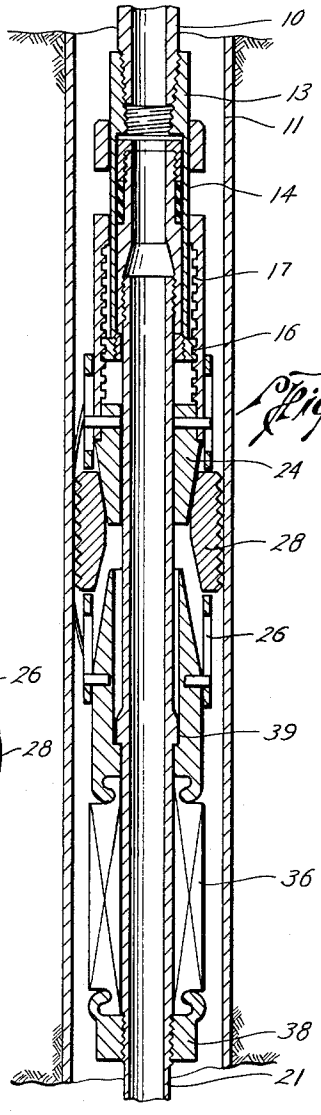


Fig. 4



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Aug. 16, 1955 C. C. BROWN 2,715,442

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Filed Nov. 26, 1951 3 Sheets-Sheet 3

Fig. 5

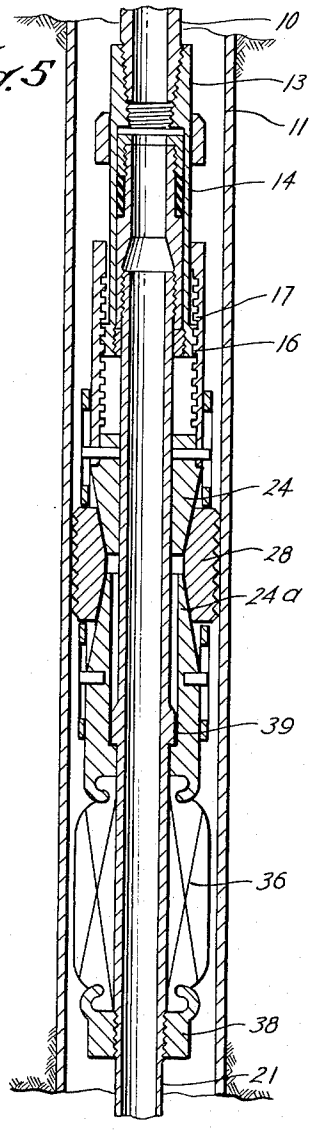
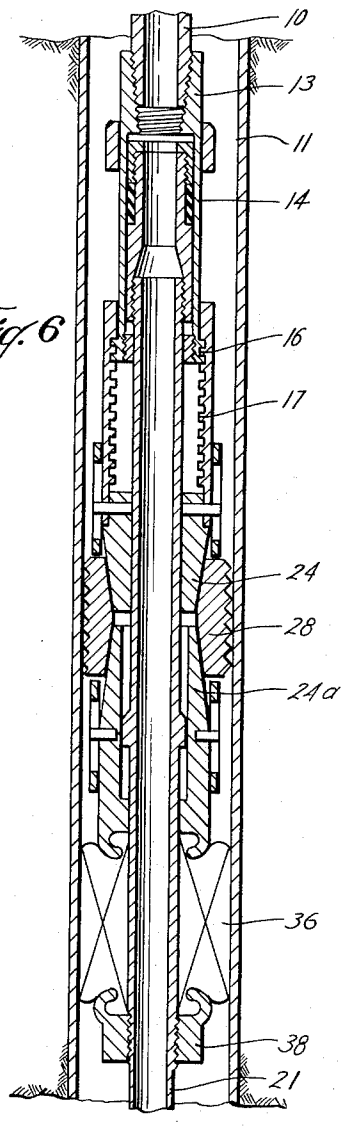


Fig. 6



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United States Patent Office 2,715,442 Patented Aug. 16, 1955

2,715,442

WELL PACKERS

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Application November 26, 1951, Serial No. 258,166

7 Claims. (Cl. 166—139)

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

One object of the invention is to provide an improved well packer which is arranged to be set and released by a rotation of the well conductor or tubing on which the packer is mounted, whereby the construction is simplified and positive control of the actuation of the packer is had.

An important object is to provide a well packer including an anchoring assembly and a packing element, together with means actuated by the rotation of the conductor or pipe on which the device is mounted for applying end-wise compression to the packing element to distort the same into sealing position and for thereafter setting the anchoring assembly.

A further object is to provide a well packer of the character described wherein an actuating member having connection with the lowering pipe coacts with the upper end of the packer assembly, whereby rotation of said member sets said assembly; the actuator member being so constructed that it does not extend through the packer assembly but coacts only with the upper end thereof whereby the construction is simplified.

Still another object is to provide a packer apparatus, of the character described, in which a mechanical force is applied to the packer element and also wherein a mechanical force is applied to the slip expander cones to assure positive setting of the device.

The construction designed to carry out the invention will be hereinafter described together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

Figure 1 is a view partly in section and partly in elevation of the upper portion of a well packer constructed in accordance with the invention,

Figure 1A is an extension of Figure 1 illustrating the lower portion of the device,

Figure 2 is a horizontal cross-sectional view taken on the line 2—2 of Figure 1,

Figure 3 is a schematic view illustrating the device with the parts in the position during lowering within the well bore with the packer element and the slips in an unset position,

Figure 4 is a view similar to Figure 3 illustrating the initial movement of the actuator member,

Figure 5 is a view similar to Figures 3 and 4 with the packer element in a partally set position, and

Figure 6 is a view similar to Figure 5 with both the packer element and the slips in a fully set position.

In the drawings the numeral 10 designates a well conductor (Figures 3 to 6) such as a well tubing, which is adapted to be lowered within the well casing 11 within a well bore 12. The tubing extends through a suitable

swivel head (not shown) which is located on the floor of the derrick so that said tubing may be rotated. As shown in Figures 1 and 1A, the lower end of the tubing 10 is threaded into a tubular coupling 13, which coupling has a relatively elongate cylindrical mandrel 14 made integral therewith and extending downwardly therefrom. An annular enlargement 15 is secured to the lower end of the mandrel and is provided with coarse external screw threads 16 which are adapted to engage similar coarse screw threads 17 formed internally of an elongate actuating sleeve 18. The screw threads 16 and 17 are preferably left hand threads so that a left hand rotation of the tubing 10 will transmit a similar rotation through the coupling 13 to the mandrel 14, whereby rotation is imparted to the threaded enlargement 15. Obviously, with the sleeve 18 held stationary, rotation of the mandrel and its enlargement will result in the sleeve 18 moving longitudinally with respect to the mandrel 14. The mandrel 14, its enlargement and the interengaging threads 16 and 17 provide an actuator, whereby longitudinal movement may be imparted to the sleeve 18.

A clutch collar 13*a* surrounds the upper portion of the mandrel 14 and is non-rotatably secured thereon by suitable screws 13*b*. When the enlargement 15 of the operating mandrel 14 is at the lower end of the actuating sleeve 18, as shown in Figure 1, clutch teeth 19 on the upper end of the sleeve are in engagement with complementary clutch teeth 20 provided on the lower end of the collar 13*a*. The teeth are arranged so that right hand rotation of the tubing will impart the same rotation to the sleeve 18 and thus when the tubing is rotated in a right hand direction when the parts are as shown in Figure 1, a similar rotation is imparted to the sleeve. The pitch of the clutch teeth 19 and 20 is preferably the same as the pitch of the actuating teeth 16 and 17 so that when the tubing is rotated in a left hand direction and the sleeve 18 moves downwardly relative to the mandrel, the clutch teeth 19 and 20 will move apart.

An elongate tubular support 21 has its upper end connected to a sleeve 21*a*, which sleeve is rotatable within the bore of the mandrel 14. The lower end of the sleeve 21*a* is supported upon a bearing ring 22, which in turn is supported upon a collar 14*a* which is threaded within the lower end of the bore of the mandrel 14, whereby the tubular support 21 is rotatably suspended from the mandrel 14. Suitable packing 23 is mounted on the exterior of the sleeve 21*a* and is confined by a retaining collar 21*b* which is threaded onto the upper end of the sleeve. With this arrangement a rotation of the tubing 10 and coupling 13, together with the mandrel 14 forming an integral part of the coupling may be rotated with respect to the tubular support 21. The tubular support 21 extends entirely through the device and may have its lower end connected by suitable coupling (not shown) to a section of well tubing therebelow.

Mounted upon the tubular support 21 is an anchoring unit A and a packer assembly B. The anchoring unit A includes an upper expander cone 24 which is connected to the lower end of the sleeve 18 by a plurality of radial pins 25. The radial pins 25 also function to connect the expander cone with the upper end of a slip carrier sleeve 26, the pins engaging in slots 27 provided in the sleeve 26. A plurality of gripping slips 28 are mounted to move radially within slots 29 in the sleeve and complete outward displacement of each slip is prevented by shoulders 30 on said slip engaging the inner surfaces of the carrier sleeve adjacent the slots 29. The lower end of the carrier sleeve is connected to a lower slip expander cone 24*a* by means of a plurality of pins 31 which are secured to the cone and which project outwardly into slots 32 in the sleeve.

It will be evident that when the lower slip expander cone 24*a* is held stationary and downward movement is applied to the upper expander cone 24, the cones move longitudinally toward each other and their inclined surfaces coact with the rear inclined surfaces of the gripping slips 28 to cause a radially outward movement of said gripping slips. Bowed friction springs 26*a* are secured to the slip carrier sleeve 26 and tend to hold said sleeve and the slips 28 stationary. Since the upper expanding cone 24 is directly connected to the sleeve 18 through the pins 25, it is evident that a longitudinal movement of the sleeve with respect to the tubular support on which the anchoring assembly A is mounted will result in a downward movement of the upper expander cone.

The lower end of the lower expander cone 24*a* is connected through suitable screws 33 with a retaining collar 34. The collar 34 forms the upper end of the packing element assembly and functions to retain a plurality of segmental confining elements 35 which enclose and are secured to the upper end of a packing element or sleeve 36. Similar confining elements 37 are attached to and enclose the lower end of the packing sleeve and the confining elements are retained by a lower retaining collar 38 which is threaded or otherwise secured to the tubing support 21. For limiting the upward movement of the lower expanding cone 24*a* with respect to the tubular support 21, said support is formed with a stop ring 39 which is welded or otherwise secured to the external surface of the support. This ring is adapted to engage an internal shoulder 40 which is formed within the lower portion of the lower expander. By observing Figure 1A, it will be evident that the stop ring limits upward movement of the lower expander 24*a* on the support but since the shoulder 40 is below the ring a downward movement of the expander with respect to the support may occur.

In the operation of the device and with the parts in the position shown in Figures 1 and 3, the gripping slips 28 of the anchoring unit A are retracted and the packing element or sleeve 36 of the packer assembly B is in a normal unexpanded position. At this time the enlargement 15 of the mandrel 14 is at the lower end of the sleeve 18 and the clutch teeth 19 and 20 between the sleeve 18 and collar 13*a* are engaged. In such position and assuming the actuating threads 16 and 17 to be left hand, the tubing 10 may be rotated to the right and the complete apparatus will rotate therewith. As the device is lowered within the casing the friction springs 26*a* engage and ride upon the wall of the well casing with the result that the pins 31 of the lower expander will ride in the lower end of the slots 32 as shown in Figure 1A.

When the apparatus has reached the elevation at which it is to be set, it is only necessary to impart a left hand rotation to the tubing 10. At this time the friction springs 26*a* will hold the slip carrier sleeve 26 and the actuating sleeve 18 which is attached thereto against rotation with the result that a rotation of the tubing will impart rotation to the actuating mandrel 14 and its enlargement 15. This will result in the sleeve 18 and the upper expander 24 beginning a downward movement as illustrated in Figure 4.

Upon continued rotation of the tubing and actuating mandrel 14, the engagement of the upper expander with the gripping slips causes said slips and the sleeve 26 to be moved downwardly until the slips engage the lower expander 24*a* as illustrated in Figure 5. At this time, there is some outward radial movement of the gripping slips because the expanding cones have moved toward each other but since the lower end of the lower expander is not yet anchored there is a tendency for both expanders, slips and slip carrier sleeve 26 to continue a downward movement. The lower end of the packer assembly is anchored to the support 21 because of the supporting or retaining collar 38, and thus as the tubing continues to rotate the parts finally move to the position shown in Figure 6. In such position the lower expander 24*a* has applied an endwise compression to the packing sleeve 36 to expand the same into sealing position. When this occurred, further downward movement of the lower expander is halted and the applied pressure of the upper expander sets the slips. The packer sleeve 36 and the slips thus remain in a set position so long as the threaded enlargement 15 of the actuating mandrel 14 remains in the position shown in Figure 6 with respect to the actuating sleeve 18.

When it is desired to remove the device, it is only necessary to rotate the tubing in a right hand direction and because the clutch teeth 19 and 20 became separated by reason of the longitudinal movement of the sleeve 18 with respect to the mandrel 14, such right hand rotation rotates the mandrel and its enlargement with respect to the sleeve 18. The continued right hand rotation ultimately returns the parts to the position shown in Figure 3, in which position the slips are retracted and endwise compression has been removed from the packer sleeve 36. It is then only necessary to lift the device from the well by means of the tubing 10, such lifting being possible by the engagement of the upper end of the collar 14*a* with the supporting sleeve 21*a* on the tubular support 21.

It is evident that a simple and effective well packer which may be set and released by a rotation of the lowering pipe or tubing is provided. It is noted that the actuating mandrel 14 does not extend through the anchoring assembly or through the packer unit but merely coacts with the tubular sleeve which has connection with these parts. Since the actuating member does not extend entirely through the apparatus the construction is greatly simplified, since the anchoring assembly and packing unit may be mounted on the single tubular support.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the claims, without departing from the spirit of the invention.

Having described the invention, I claim:

1. A well packer apparatus including a tubular support, means rotatably suspending the support from a lowering pipe, an annular elastic packing element having its lower end anchored to the support with its upper end slidable longitudinally with respect to the support, an anchoring unit surrounding the support above the packing element and having its lower end connected with the upper end of the packing element, said anchoring unit being slidable longitudinally of the support and including gripping slips, and means for moving said slips radially outwardly into gripping position upon relative longitudinal movement of said anchoring means, actuating means interposed between the lowering pipe and the upper end of the anchoring unit for imparting a longitudinal movement to the anchoring unit with respect to the support upon a rotation of the lowering pipe, whereby initial longitudinal movement of the anchoring unit will apply endwise compression to the upper end of the packing element to distort the same into packing position, and a frictional wall engaging means for holding the anchoring unit and the packing element against rotation during the rotation of the lowering pipe.

2. A well packer apparatus as set forth in claim 1, wherein the actuating means comprises an actuating mandrel surrounding the upper end of the support and connected with the lowering pipe, an actuating sleeve attached to the upper end of the anchoring unit and surrounding the mandrel, and a threaded connection between the actuating mandrel and sleeve whereby rotation of the mandrel with respect to the sleeve imparts a longi-

tudinal movement to the anchoring unit with respect to the support.

3. A well packer apparatus as set forth in claim 1, wherein the actuating means comprises an actuating mandrel surrounding the upper end of the support and connected with the lowering pipe, an actuating sleeve attached to the upper end of the anchoring unit and surrounding the mandrel, and a threaded connection between the actuating mandrel and sleeve whereby rotation of the mandrel with respect to the sleeve imparts a longitudinal movement to the anchoring unit with respect to the support, said frictional wall engaging means maintaining the anchoring unit and actuating sleeve substantially stationary during rotation of the actuating mandrel.

4. A well packer apparatus as set forth in claim 1, wherein the actuating means comprises an actuating mandrel surrounding the upper end of the support and connected with the lowering pipe, an actuating sleeve attached to the upper end of the anchoring unit and surrounding the mandrel, and a threaded connection between the actuating mandrel and sleeve whereby rotation of the mandrel with respect to the sleeve imparts a longitudinal movement to the anchoring unit with respect to the support, said threaded connection between the mandrel and sleeve being coarse left hand threads.

5. A well packer apparatus adapted to be lowered into a well pipe including a tubular support, means rotatably suspending the support from a lowering pipe, an annular elastic packing element surrounding said support and having its lower end anchored to the support with its upper end slidable longitudinally with respect thereto, an anchoring unit surrounding the support above the packing element and having its lower end connected with the upper end of the packing element, said anchoring unit being slidable longitudinally of the support and including gripping slips, and means for moving said slips radially outwardly into gripping position upon relative longitudinal movement of said anchoring means, an actuating mandrel surrounding the upper portion of the tubular support and rigidly connected by means of a coupling with the lowering pipe, an actuating sleeve surrounding the mandrel and attached to the upper end of the anchoring unit surrounding the mandrel and having a left hand threaded connection with the mandrel, friction means on said anchoring unit for frictional engagement with the wall of the well pipe, and clutch means on the upper end of the sleeve and on the coupling to which the mandrel is attached adapted to be interengaged when the mandrel is fully telescoped with respect to the actuating sleeve, said clutch means including clutch teeth which will transmit a right hand rotation from the coupling to the sleeve and to the anchoring unit.

6. A well packer as set forth in claim 5, wherein the anchoring unit also includes a lower expander cone which is connected to the upper end of the packer element, an upper expander cone connected with the actuating means, a slip carrier sleeve surrounding the expander cones and connected therewith for limited longitudinal movement, said gripping slips being carried by said sleeve whereby movement of the expander cones with respect to each other result in a coaction of the expander cones with the gripping slips to actuate the same.

7. A well packer as set forth in claim 5, wherein the anchoring unit also includes a lower expander cone which is connected to the upper end of the packer element, an upper expander cone connected with the actuating means, a slip carrier sleeve surrounding the expander cones and connected therewith for limited longitudinal movement, said gripping slips being carried by said sleeve whereby movement of the expander cones with respect to each other result in a coaction of the expander cones with the gripping slips to actuate the same, and stop means on the tubular support engageable by the lower expander cone of the anchoring unit to limit upward movement of said cone on the support.

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