

Jan. 7, 1969

C. C. BROWN

3,420,306

WELL ANCHOR OR PACKER

Filed Dec. 19, 1966

Sheet 1 of 2

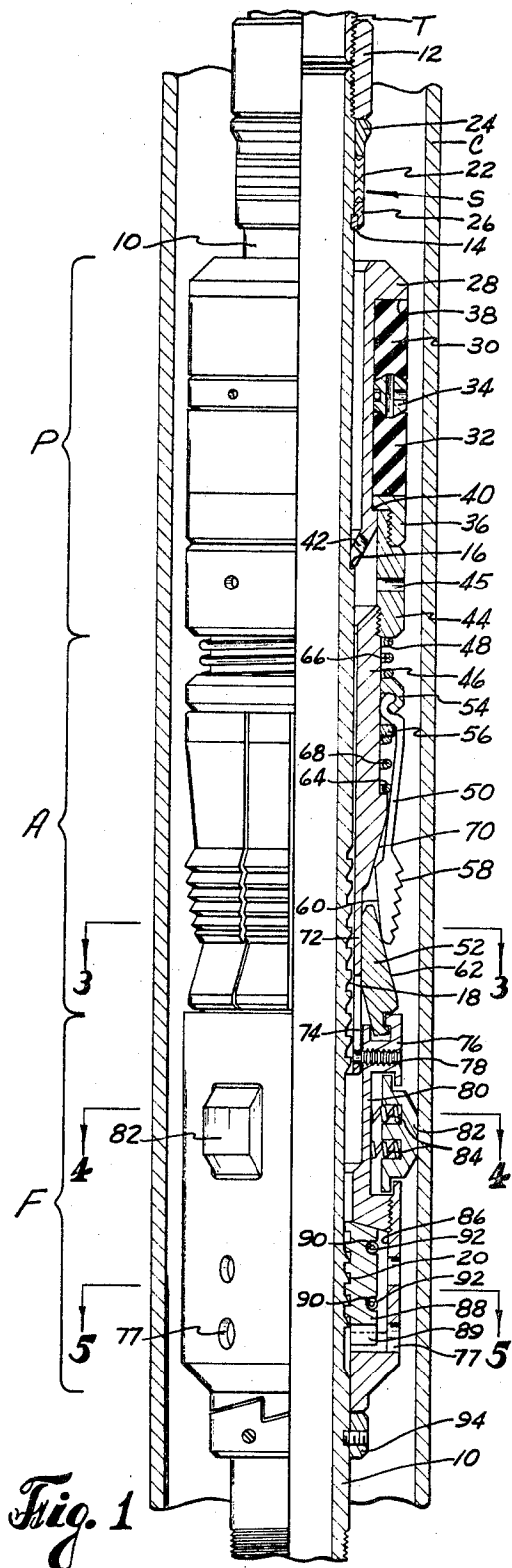


Fig. 1

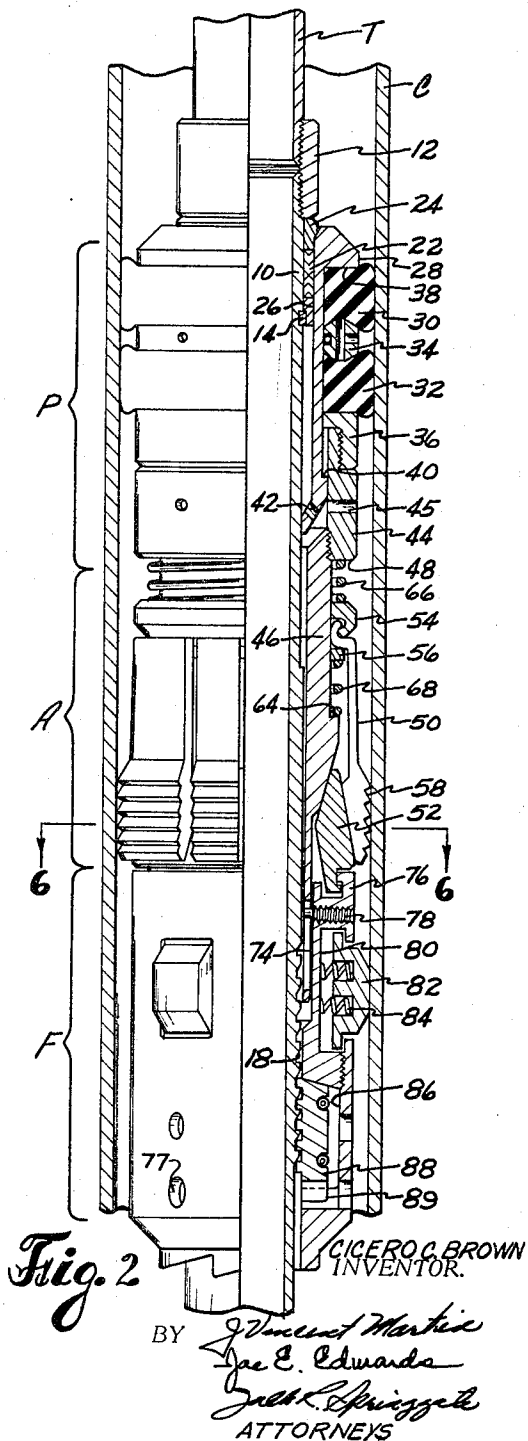


Fig. 2

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Sheet 2 of 2

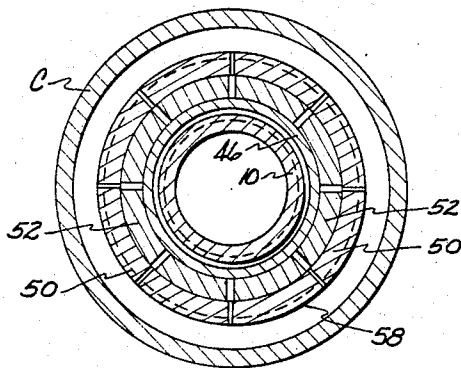


Fig. 3

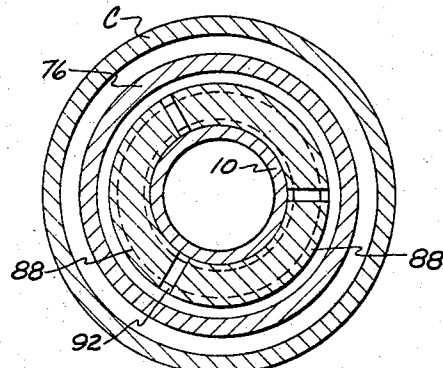


Fig. 5

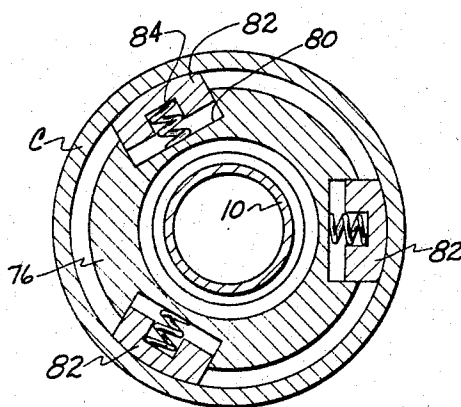


Fig. 4

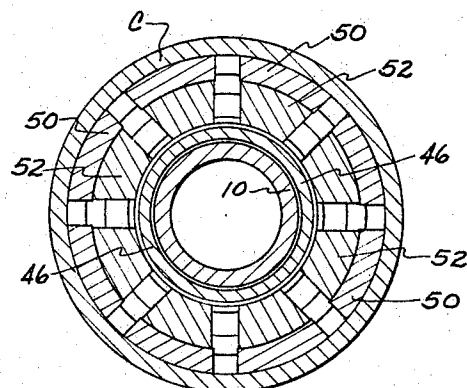


Fig. 6

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WELL ANCHOR OR PACKER

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11 Claims

ABSTRACT OF THE DISCLOSURE

A releasable packer and anchor assembly which utilizes rotation of the tubing string for initiating the setting of the assembly and also for the release of the assembly. The assembly is locked in set position and a pressure differential on either side of the packer will act to hold the assembly in set condition.

The present invention relates to an improved well tool such as an anchor, a packer or the like.

The improved well tool is an improvement on the well tool disclosed in my U.S. Patent No. 3,279,542, issued Oct. 18, 1966.

An object of the present invention is to provide an improved well tool such as an anchor which is easily set and released in a well bore.

Another object is to provide an improved well packer which uses pressure forces to hold its anchored or set position and has an anchoring assembly which may be unset by a movement of the tubing string on which the packer is mounted.

A further object is to provide an improved anchoring assembly for a well tool which when set is easily unset by lifting the tool.

Still another object of the present invention is to provide an improved well packer having anchoring slips movable both longitudinally and outwardly which are readily and easily set and released from set position.

These and other objects and advantages of the present invention are hereinafter set forth and explained in reference to the preferred form of the invention shown in the drawings wherein:

FIGURE 1 is a longitudinal quarter sectional view of the preferred form of well packer of the present invention in position as it is being run into a well bore.

FIGURE 2 is a similar view showing the well packer in set position.

FIGURE 3 is a transverse sectional view of the anchoring assembly taken along line 3—3 in FIGURE 1.

FIGURE 4 is a transverse sectional view showing the friction block assembly and taken along line 4—4 in FIGURE 1.

FIGURE 5 is a transverse sectional view taken along line 5—5 in FIGURE 1 and showing the locking means.

FIGURE 6 is a sectional view similar to FIGURE 3, taken along line 6—6 in FIGURE 2 and illustrating the set position of the anchoring assembly.

Referring more in detail to the drawings wherein the preferred form of well packer is illustrated, the well packer is lowered into a well bore as defined by the casing C on the tubing string T. The well packer includes the tubular support 10 on which are mounted the packing assembly P, the anchoring assembly A and the friction block assembly F. The tubular support 10 is connected to the tubing string T by the coupling 12. The tubular support 10 includes the snap ring 14 to support the seal assembly S, the upwardly facing external shoulder 16 to support the packing assembly P and the upper and lower external threads 18 and 20, respectively, which coact with a portion of the friction block assembly F to retain the well packer in running position when it is being run into the

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well bore and to retain the well packer in set position once it has been set within the well bore.

The sealing assembly S which includes the sealing rings 22, the abutment ring 24, and the guide ring 26 is secured to the exterior of the tubular support 10 between the lower shoulder of the coupling 12 and the snap ring 14. The sealing assembly S is adapted to seal against the interior of the packing sleeve 28 to close the by-pass around the packing assembly defined between said packing sleeve 28 and the exterior of the tubular support 10.

As clearly shown in FIGURE 1, the packing assembly includes the packing sleeve 28, which is supported in surrounding relationship to the tubular support 10 and in running position has its lower edge in engagement with the shoulder 16; and the packing elements 30 and 32, the central packing follower 34 and the lower packing follower 36, all of which are mounted in surrounding relationship to the packing sleeve 28 between its downwardly facing shoulder 38 and its upwardly facing shoulder 40. It should be noted that the lower end of the packing sleeve 28 defines the port 42 providing communication from the exterior of the packing assembly to the interior of the packing sleeve 28. Collar 44 which connects to follower 36 defines the port 45 which with port 42 and the space between sleeve 28 and tubular support 10 completes the by-pass around the packing assembly P.

The anchoring assembly A is connected to the packing assembly P by the collar 44 which threadably engages the anchor cone 46. The collar 44 defines the downwardly facing shoulder 48 surrounding the upper tubular portion of the anchor cone 46. The anchoring assembly, in addition to the anchor cone 46, includes the gripping slips 50 and the expander segments 52. The gripping slips 50 are pivotally mounted at their upper ends between the rings 54 and 56 as shown. Slips 50 define the gripping teeth 58 which are adapted to be moved into pipe-gripping engagement with the interior of the casing C and also define the interior surfaces 60 which are adapted to be engaged by the exterior of the surfaces 62 on the expander segments 52 as hereinafter described. The upper portion of the anchor cone 46 defines the upwardly facing shoulder 64. As previously set forth, the gripping slips 50, supporting rings 54 and 56 are mounted surrounding and slidable on the upper portion of the anchor cone and are resiliently urged to a center position by the springs 66 and 68. The spring 66 is positioned between the shoulder 48 on the collar 44 and the upper side of the ring 54 while the spring 68 is positioned between the lower side of the ring 56 and the shoulder 64. The anchor cone 46 immediately below the shoulder 64 defines the tapered surface 70 which is adapted to coact with the expander segments 52 in moving the gripping elements 50 into pipe-gripping position. The lower portion of the anchor cone 46 terminates in the sleeve portion 72 which defines vertically oriented slots 74.

The expander segments 52 are also pivotally mounted to the upper end of the friction assembly body 76 as shown. Additionally, guide pins 78 extend through the upper portion of the body 76 and have their innermost extensions positioned within the slots 74 whereby relative rotation between anchor cone 46 and friction body 76 is prevented without interfering with their relative longitudinal movement.

The friction block assembly body 76 also defines the recess 80 in which the friction blocks 82 are mounted with the springs 84 urging the friction blocks 82 outwardly into frictional engagement with the interior of the casing C. The lower portion of the body 76 defines an interior recess 86 in which the internally threaded locking segments 88 are positioned. The outer portion of the locking segments 88 are provided with grooves 90 to receive the resilient bands 92 urging the segments inwardly

into engagement with the threads 20 or 18. The locking segments therefore when in engagement with the threads 20, hold the well packer in running position and when in engagement with the threads 18 as hereinafter explained, hold the well packer in set position. The holes 77 in the body 76 provide slots in which the depending projections 89 of the locking segments are positioned to prevent relative rotation between the locking segments 88 and the body 76. The upper end of recess 86 is tapered upwardly and inwardly to assist in wedging the locking segments 88 inwardly into engagement with the threads on tubular support 10. In the preferred form of the invention, the threads 20 are right-hand threads and the threads 18 are left-hand threads with the interior surface of locking segments 88 being formed to engage with either of said threads.

The collar 94 is secured to tubular support 10 and is adapted by its engagement with the lower end of body 76 to prevent an excess threading of the locking segments on threads 20 whereby the well packer might become stuck or jammed in running position. The collar 94 is secured to the tubular support 10 and is adapted to abut the lower end of the body 76 with the abutting intersection being adapted to provide freedom of rotation of the tubular support 10 with respect to the friction block assembly F in one direction and direct engagement when rotation of the tubular support 10 is in the opposite direction.

In operation, the well packer is run into the well bore in the running position as illustrated in FIGURE 1, supported from the tubing string T. When the well packer has been lowered to the position in the well bore at which it is desired to be set, the tubing string T is rotated to release the engagement of the locking segments 88 with the threads 20. As soon as such release is completed, the tubing string T is lowered to set the well packer.

With the locking engagement between the segment blocks 88 and the threads 20 being released, the tubular support 10 thereafter is free to move downwardly through the friction block assembly F. The engagement of the interior of the casing C by the friction blocks 82 holds the friction block assembly F and expander segments 52 relatively stationary while the tubular support 10 is lowered. As the tubing string T is lowered, the sealing assembly S moves into sealing engagement with the interior of the packing sleeve 28 to close the by-pass and the abutment ring 24 which provides an upper abutment for the well packer, comes into engagement with the packing sleeve 28. Further downward movement of the tubular support 10 moves the packing assembly P, the anchor cone 46 and the gripping slips 50 downwardly with respect to expander segments 52. This movement wedges expander segments 52 between the tapered surface 70 on anchor cone 46 and the surface 60 on the gripping slips 50. Because of the relative tapers, the gripping slips 50 are wedged outwardly into pipe-gripping position as shown in FIGURE 2.

When the teeth 58 on slips 50 are anchored in the interior of casing C, further downward movement of tubular support 10 forces packing sleeve 28 downward within follower 36 to apply an endwise force on packing elements 30 and 32 to deform them radially outward into sealing engagement with the interior of casing C. In this position, both the packing assembly P and the anchoring assembly A are set.

To hold these assemblies in set position, the locking segments 88 have moved into engagement with the threads 18. This is possible since the segments 88 are resiliently urged inward by the bands 92. Also, the lower side of each of the threads 18 is tapered so that as the tubular support 10 moves downwardly through the friction block assembly F, the locking segments 88 ratchet upward on the threads 18, to thereby hold the well packer in set position.

It should be noted that during the setting of the anchor-

ing assembly A, the springs 66 and 68 exert force tending to hold the gripping slips 50 in the desired position longitudinally with respect to the tapered surface 70 of the anchor cone 46. With the well packer in set position, the by-pass passage defined by the ports 42 and 45 and between packing sleeve 28 and tubular support 10 is closed. Therefore, any pressure differential exerted across the packing assembly P in which the higher pressure is above the packing assembly P, results in a downward force on the packing elements 30 and 32 which is transmitted through the collar 44 to the anchor cone 46 and tends to move the anchor cone 46 downwardly with respect to the gripping slips 50. Through the contact with the expander segments 52, this force on anchor cone 46 causes the gripping slips 50 to be more tightly wedged into engagement with the interior of the casing C. Also, a pressure differential with the higher pressure below the packing assembly P creates a force which is exerted through the packing sleeve 28, the abutment ring 24, the shoulder on the coupling 12, the tubular support 10 and is transmitted by the threads 18, the locking segments 88 and the friction body 76 to the expander segments 52 to wedge the expander segments 52 further between the surface 70 on the anchor cone 46 and the surface 60 on the gripping slips 50. This further wedging assures the gripping slips 50 remain set in the interior wall of the casing C. From this it can be seen that differential pressures on the packing assembly are converted into forces which assure that the well packer holds its set position against pressure differentials in both directions.

Release of the well packer is accomplished by rotating the tubing string T and thereafter lifting it. The rotation of the tubing string is in a direction to thread the tubular support upwardly through the locking segments 88. When the threads disengage from the locking segments 88, the lifting of the tubing string T and the tubular support 10 provides release. Initial upward movement of the tubular support 10 relaxes the packing elements 30 and 32 and also if the packing elements are held in sealing position by pressure differentials, opens the by-pass by disengaging the sealing assembly S from within the packing sleeve 28 thereby equalizing pressures across the packing assembly to allow the packing elements 30 and 32 to relax. When the packing sleeve 28 is supported on the shoulder 16, the continued upward movement of the tubular support 10 is transmitted through the shoulder 40 to lift the collar 44 and the anchor cone 46 upwardly. Since the gripping elements 50 are resiliently mounted, the anchor cone 46 and its tapered surface 70 may be moved upwardly relative to both the gripping slips 50 and the expander segments 52. This releases the force holding the gripping slips 50 in set position, and thereby relaxes the anchoring assembly. Both gripping slips 50 and expander segments 52 move inwardly and as soon as the teeth 58 disengage from casing C, the spring 68 moves the gripping slips upwardly on anchor cone 46 to their unset position. When the anchoring assembly is being unset, the locking segments 88 are ratcheting downwardly on the threads 20 which have their upper sides sloped to allow this ratcheting. With the packing assembly P and the anchoring assembly A completely unset, the well packer may be pulled from the well bore.

During the release or unsetting of the anchoring assembly A, the resilient mounting of the gripping slips 50 allows the movement of the anchor cone 46 upwardly to unset the gripping slips 50 even though the gripping slips 50 are not moved. As soon as the teeth 58 disengage from the interior of the casing C, the force of the spring 68 urges the gripping slips 50 upwardly to complete unset position. This resilient mounting of the gripping slips 50 assures that they are in proper position when being set and also assists in the release or unsetting of the anchoring assembly.

As can be understood from the foregoing description of the operation of the well packer, the locking segments

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88 perform the function of providing a releasable connecting means supporting the friction block on the tubular support and also the expander segments 52 in the running position. These locking segments 88 also perform the function of providing a means to retain the packing and anchoring assemblies in set position once they have been set, which means is really releasable by rotation of the tubular support 10.

From the foregoing it can be seen that the well tool of the present invention provides a new and improved anchoring assembly in which the gripping elements are pivotally and resiliently mounted for ease of setting, when set, hold against movement both upwardly and downwardly, and because of such resilient mounting are readily released or unset. The improved well tool when used as a well packer, converts pressure differentials exerted across the packing assembly into forces holding the anchoring assembly in set position in the well bore.

The foregoing disclosure and description of the invention are 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 appended claims without departing from the spirit of the invention.

What is claimed is:

1. A well tool adapted to be run and set in a well bore, comprising
 - a tubular support,
 - an upper abutment mounted on said tubular support,
 - an anchoring assembly mounted on said tubular support below said upper abutment and having a cone, expander segments and gripping slips,
 - said expander segments being adapted to be wedged between said cone and said slips to move said slips outwardly into set position,
 - a lower abutment supported on said tubular support below said anchoring assembly,
 - means for reducing the space between said abutments whereby said expander segments are wedged between said cone and said slips to set said anchoring assembly, and
 - means releasably locking said tubular support to said lower abutment when said anchoring assembly is set to hold said anchoring assembly in set position.
2. A well tool according to claim 1, including
 - a packing assembly mounted on said tubular support and adapted to be set by the reduction in space between said abutments.
3. A well tool according to claim 2, including
 - a by-pass defined by said packing assembly communicating between opposite sides of said packing assembly, and
 - means closing said by-pass responsive to setting of said packing assembly.
4. A well tool according to claim 2, including
 - means connecting said packing assembly to said anchoring assembly whereby force resulting from a differential pressure across the packing assembly in one direction is exerted on said cone to wedge said gripping slips into tighter set position and force resulting from a differential pressure across the packing in the opposite direction is exerted on said expander segments to wedge said gripping slips into tighter set position.
5. A well tool according to claim 1, including
 - a mounting ring slidably mounted on said cone, one end of said gripping slips being pivotally mounted to said mounting ring, and
 - resilient means urging said mounting ring toward a preferred position on said cone whereby the free ends of said gripping slips are held in a preferred position with respect to said cone and said expander segments when said anchoring assembly is unset.
6. A well tool according to claim 5, wherein

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said cone includes a tubular portion and a tapered portion,
said ring surrounds said tubular portion to position the free ends of said gripping slips in surrounding relation to the tapered portion of said cone.

7. A well tool according to claim 3, wherein said means closing said by-pass includes,
a sealing ring mounted on said tubular support and adapted to sealingly engage said by-pass when said well tool is set.

8. A well tool adapted to be run and set in a well bore, comprising

- a tubular support,
- an upper abutment secured to said tubular support,
- an anchoring assembly mounted around said tubular support below said upper abutment and having a cone, expander segments and gripping slips,
- said expander segments being adapted to be wedged between said cone and said slips to move said slips outwardly into pipe-gripping position,
- a lower abutment supported on said tubular support, and
- means releasably connecting said lower abutment to said tubular support,

 movement of said tubular support after release of said connecting means moving said upper abutment toward said lower abutment to wedge said expander segments between said cone and said slips and thereby set said slips.

9. A well packer comprising,

- a tubular support,
- a packing assembly slidably mounted on said tubular support and having a packing element adapted to move radially outward to seal against the interior of a well bore when subjected to an endwise force,
- an upper abutment secured to said tubular support,
- an anchoring assembly mounted around said tubular support and having a cone, expander segments, gripping slips,
- said expander segments being adapted to be wedge between said cone and said slips to move said slips outwardly into pipe-gripping position,
- means resiliently mounting said gripping slips on said cone,
- a lower abutment supported on said tubular support,
- means releasably connecting said lower abutment to said tubular support,
- friction means connected to said lower abutment and adapted to engage the wall of a well bore to support said lower abutment on release of said connecting means,
- movement of said tubular support after release of said connecting means moving said upper abutment toward said lower abutment to set said packing and anchoring assemblies, and
- means releasably locking said tubular support to said lower abutment when said assemblies are set to hold said assemblies in set position.

10. In a well tool adapted to be run and set in a well bore, an anchoring assembly comprising,

- an anchor cone having a tubular portion and a tapered portion,
- a plurality of gripping slips,
- a mounting ring surrounding said tubular portion of said anchor cone and being slidable thereon,
- one end of said gripping slips being pivotally mounted to said mounting ring to position the other end of said gripping slips in surrounding relation to said tapered portion of said anchor cone, and
- a plurality of expander segments adapted to be wedged between the tapered portion of said anchor cone and the free end of said gripping slips to move said gripping slips outwardly into pipe-gripping position.

11. An anchoring assembly according to claim 10, including

- resilient means for urging said mounting ring toward a

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preferred position with respect to said tubular portion of said anchor cone.

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JAMES A. LEPPINK, *Primary Examiner.*

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U.S. Cl. X.R.

166—139, 215