

Oct. 9, 1956

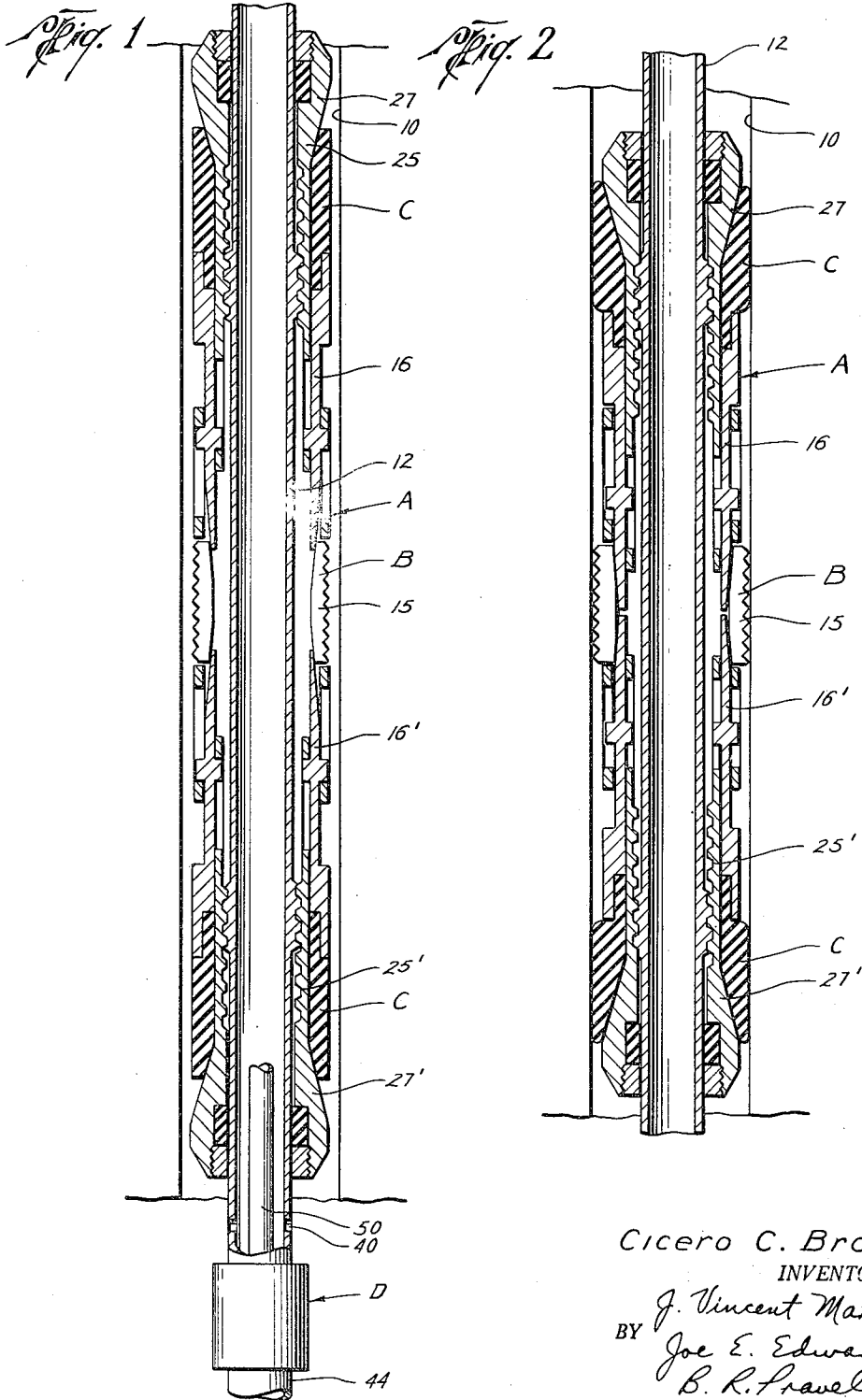
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2,765,852

WELL PACKERS

Filed Oct. 10, 1952

3 Sheets-Sheet 1



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Fig. 3B

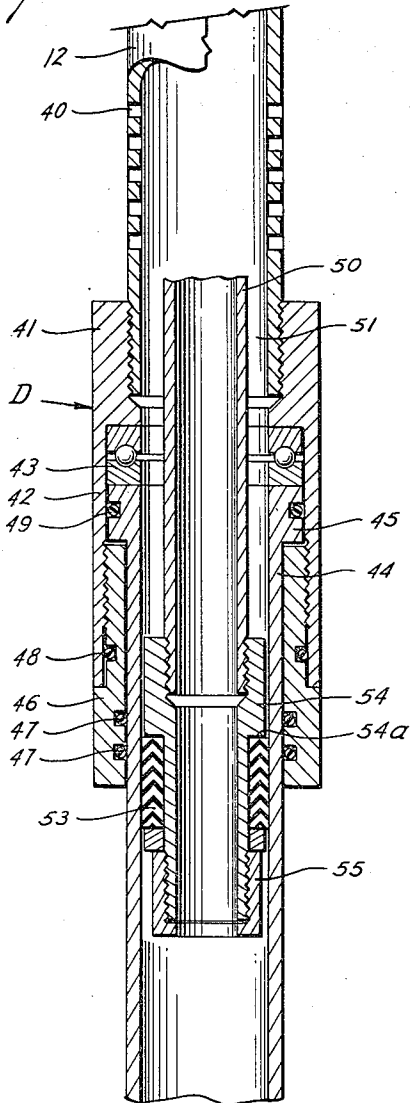


Fig. 4

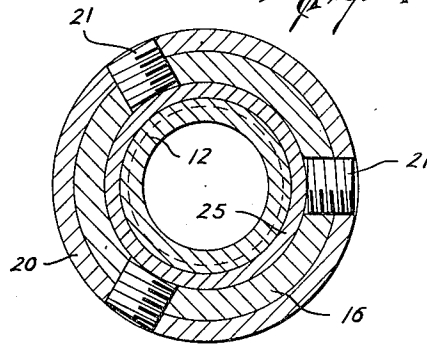
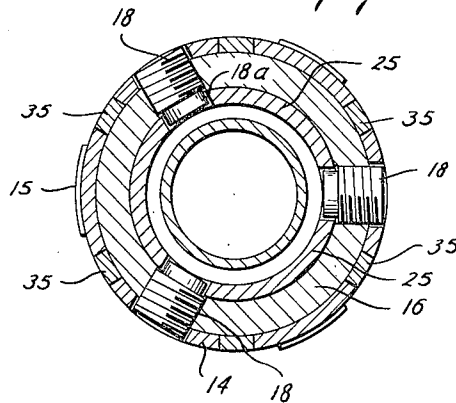


Fig. 5



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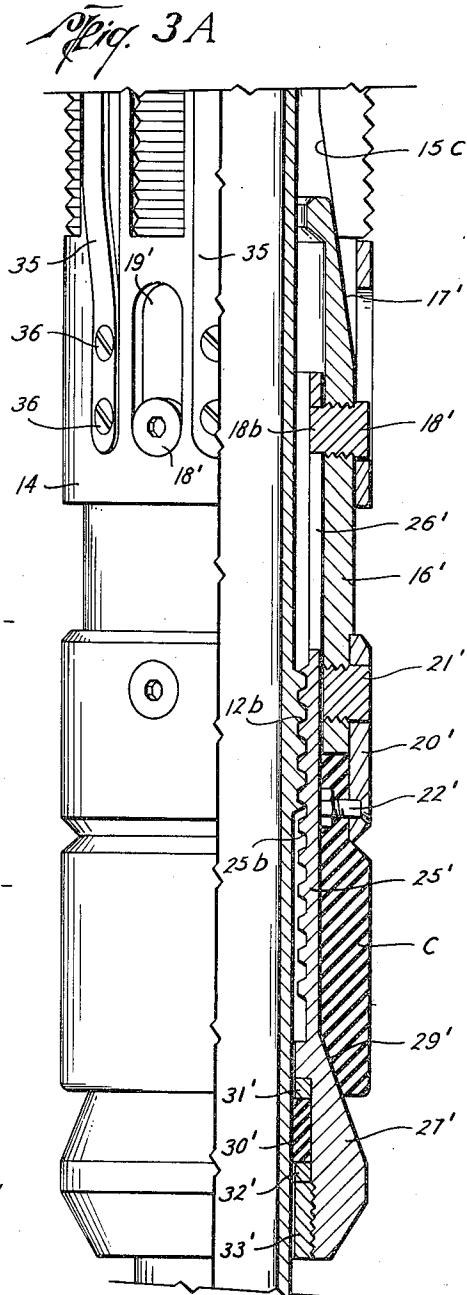
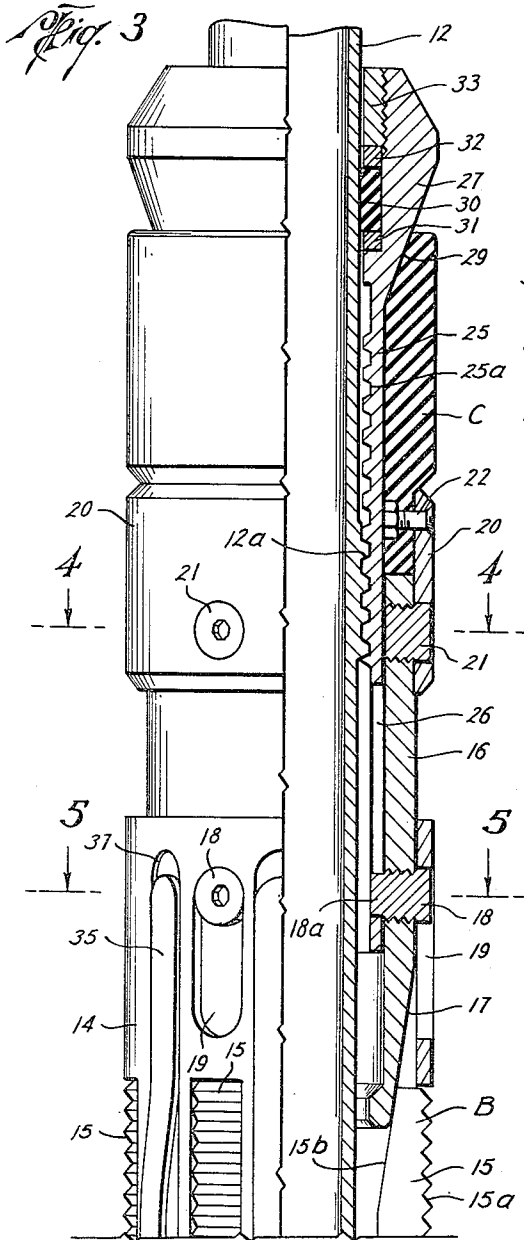
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WELL PACKERS

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Application October 10, 1952, Serial No. 314,007

8 Claims. (Cl. 166—119)

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

The well packer of this invention is an improvement over by copending U. S. patent application, Serial No. 202,467, filed December 23, 1950. In said patent application, the well packer is set in a well casing by the rotation of a tubular support which co-acts with a pair of slip expanders to move them toward each other to urge the slips into gripping contact with the well casing. Packing elements are disposed on the slip expanders which are moved into and maintained in sealing position by the differential in fluid pressure in the well above and below the packer. One of the important improvements in the well packer of the invention resides in the provision of a mechanical setting of the packing elements into sealing contact with the casing by a rotation of the support.

One object of this invention is to provide an improved well packer wherein the slips and packing elements thereof are both set mechanically by rotation of the pipe or support on which the packer is lowered into a well casing.

An important object of this invention is to provide a well packer having a pipe or support extending axially therethrough, said packer having slips which are adapted to be set in gripping contact with a well casing upon rotation of said pipe or support, said packer also having packing elements with packing expander means associated therewith for co-action with the pipe or support whereby upon rotation of said pipe or support longitudinal movement is imparted to said packing expander means to expand said packing elements into sealing engagement with the well casing.

Another object of this invention is to provide a well packer wherein the slips and packing elements thereof are both set mechanically by rotation of the pipe or support on which the packer is lowered into a well casing, and wherein the lower end of the support has a swivel means for connection with a lower well pipe, whereby another packer or well device connected to said lower well pipe will be unaffected by the rotation of said pipe or support.

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 vertical sectional view of the well packer of this invention, illustrating the relationship of the parts as the well packer is lowered into the well casing.

Figure 2 is a view similar to Figure 1 but illustrates the well packer in its set position in the well casing.

Figures 3, 3A and 3B are vertical views, partly in section and partly in elevation, with the Figure 3 illustrating the upper portion of the well packer of this inven-

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tion, Figure 3A illustrating the intermediate portion thereof, and Figure 3B illustrating the lower portion thereof.

Figure 4 is a horizontal sectional view taken on line 4—4 of Figure 3.

Figure 5 is a horizontal sectional view taken on line 5—5 of Figure 3.

In the drawings, the letter A generally indicates the improved well packer which is adapted to be lowered within a well pipe or casing 10 on a pipe string (not shown) which has connection with the pipe or tubular support 12 of the well packer. The well packer of this invention includes an anchoring assembly B which, as will be explained, is adapted to anchor the packer within the well casing 10. Above and below the anchoring assembly B are packing elements C, which like the anchoring assembly B, are supported by the tubular support 12 during the lowering and raising of the well packer A within the well casing 10. Both the anchoring assembly B and the packing elements C are set by a rotation of the tubular support 12, as will be hereinafter described in detail.

The details of construction of the improved packer A are clearly illustrated in Figures 3—5, with Figures 3, 3A, and 3B being continuing views of the complete assembly, while Figures 4 and 5 are horizontal sectional views taken on Figure 3. The anchoring assembly B includes a tubular slip carrier 14 which has a plurality of spaced longitudinal openings therein for the confinement and radial movement of pipe gripping slips 15 disposed therein, each slip 15 having an outer toothed portion 15a for gripping contact with the well pipe or casing 10.

Slidably connected to the upper end of the slip carrier 14 is an upper slip expander 16 which is in the form of a sleeve and has its lower outer end inclined or tapered inwardly to form a conical or cone portion 17 thereon. Upon downward longitudinal movement of the slip expander 16 with respect to the slip carrier 14, the cone 17 engages with the upper inner inclined surface 15b of each of the slips 15. The incline or taper of the surface 17 is substantially the same as that of the inner inclined surfaces 15b of the slips 15 so that the downward longitudinal movement of the slip expander urges the slips 15 radially outwardly into gripping contact with the well casing 10. The upper slip expander 16 is held against relative rotational movement with respect to the slip carrier 14 and the slips 15 by a plurality of pins 18 which are threaded thereto and which extend radially outwardly into a plurality of corresponding longitudinal slots 19 on the slip carrier 14. The pins 18 on the slip expander 16, by reason of their location in the slots 19 of the slip carrier 14, provide a slidable connection longitudinally between the slip expander 16 and the slip carrier 14, and likewise prevent the separation of these two parts 16 and 14.

The upper packing element C is connected to the upper end of the slip expander 16 through a retaining collar 20 which is connected to the upper slip expander 16 by screws 21. Bolts 22 are provided on the collar 20 for attaching the packing element C to such collar. It will be appreciated, of course, that other attaching means could be utilized for connecting the packing element C to the upper slip expander 16.

In order to expand the upper packing element C radially outwardly into sealing contact with the well casing 10, and in order to effect the longitudinal movement of the slip expander 16 relative to the slip carrier 14 upon a rotation of the tubular support 12, a packing expander member 25 is slidably connected to the upper slip expander 16. As will be observed in Figure 3, each pin or lug 18 has an inner projection 18a, which extends radially inward into a longitudinal slot 26 in the packing expander mem-

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ber 25. Thus, the pins or lugs 18 prevent relative rotational movement between the slip expander 16 and the packing expander member 25, but permit limited longitudinal movement therebetween. The extreme upper end of the upper packing expander member 25 has an enlargement 27 which is in the form of a cone, whereby an external inclined or tapered surface is provided. The packing element C has its inner upper end inclined or tapered at 29 with a similar inclination to that of the cone 27, and in the retracted position illustrated in Figure 3, the cone 27 fits flush against the tapered inner surface 29 of the upper packing element C. The cone 27 on the upper end of the packing expander member 25 preferably has an internal recess in which an annular packing or sealing member 30 is disposed. This sealing member 30 may have metallic rings 31 and 32 disposed on either side thereof, with a locking collar 33 being threaded into the inner recess of the cone 27 to hold the sealing member 30 and the rings 31 and 32 in their position as shown in Figure 3. This sealing member 30 contacts the exterior surface of the tubular support 12 and serves to limit the amount of well fluids which enter into the vicinity of the threads 25a on the packing expander member 25 and the threads 12a on the exterior of the tubular support 12. These threads 12a and 25a co-act with each other, whereby a rotation of the support 12 imparts a longitudinal movement to the packing expander member 25. It will be observed that the slip carrier 14 has a friction means 35 in the form of curved spring fingers spaced about the outside of the carrier 14 for contact with the inner surface of the well casing. These spring members 35 may be formed and constructed in numerous ways but as illustrated in the drawings, the lower end is secured to the slip carrier by screws 36 while the upper end is free to slide in a recess 37 on the slip carrier 14. These spring members 35 frictionally engage the inner surface of the well pipe or casing 10 and prevent rotational movement thereof. Likewise since the slip expander 16 is connected to the slip carrier 14 and is prevented from having relative rotational movement with respect to such carrier by means of the pins 18 extending within the longitudinal slots 19, the slip expander 16 is similarly prevented from rotational movement by reason of the engagement of the spring members 35 with the well casing 10. Also the packing expander member 25 is locked against rotational movement with respect to the slip expander 16 through the projections 18a in the slots 26 of the member 25 so that the friction spring members 35 also prevent the rotational movement of the upper packing expander member 25. Thus when the tubular support 12 is rotated to effect a co-action between the threads 12a and the threads 25a, there is no rotation of the rest of the well packer structure, but instead there is only the longitudinal movement imparted to the members 25 and 16. Such operation will be described in detail hereinafter.

In Figure 3A, it can be seen that the lower slip expander 16', the packing element C, and the lower packing expander member 25' and their related parts are all substantially duplicates of the upper structure above the slip carrier 14, except that the structure below the slip carrier 14 is inverted as compared to the structure thereabove. Thus, the slip carrier 14 has slots 19' which are substantially identical with the slots 19 except that the slots 19' are disposed in the lower portion of the slip carrier 14. The pins or lugs 18' are positioned similarly to the pins or lugs 18 on the upper slip expander 16 and extend into the lower longitudinal slots 19' as well as having their inner projection extending into the longitudinal slot 26' of the lower packing expander member 25'. The connection of the lower packing element C to the lower end of the slip expander 16' is effected in a similar manner to that of the packing element C with the upper slip expander 16. That is, a retaining collar 20' is utilized in conjunction with screws 21' and bolts 22'. The lower end of the packing expander member 25' is tapered or inclined and enlarged

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to form a cone 27' which has its inclined surface substantially complementary to the lower inner end 29' of the packing element C. An inner sealing element 30' with the retaining rings 31' and 32', as well as the internal locking nut 33', are also provided on the lower packing expander member 25, internally of the cone 27'.

The lower end of the tubular support 12 has threads 12b similar to the threads 12a near the upper end of the tubular support 12. Likewise, the packing expander member 25' has threads 25b thereon and internally disposed for co-action with the external threads 12b. Preferably, the threads 12a and 25a are left-hand threads, while the lower threads 12b and 25b are right-hand threads, so that upon rotation of the tubular support 12 in a clockwise direction as viewed in Figure 4, the upper packing expander member 25 will be moved downwardly while the lower packing expander member 25' will be moved upwardly. It will be appreciated, of course, that the upper threads 12a and 25a may be right-hand threads while the lower threads 12b and 25b are left-hand threads so that a counter-clockwise direction as viewed in Figure 4 may be utilized for the same purpose.

In Figure 3B, the lower end of the tubular support 12 is illustrated with the radial openings therein designated by the numeral 40 for the passage of fluids. Below such radial passages 40, there may be disposed a swivel means D which is suitably connected to the lower end of the tubular support 12.

The swivel means D has an upper sleeve 41 which is threaded to the lower end of the support 12. This sleeve 41 has a lower portion thereof 42 which has an enlarged internal diameter for the reception of an annular bearing 43 which may take the form of ball bearings as illustrated in the drawings, and below such bearing 43, a lower well pipe 44 is disposed within the lower portion 42 of the sleeve 41. This lower well pipe 44 has an enlarged upper end or shoulder 45, whereby a locking collar 46 serves to hold the lower well pipe 44 in the position shown in Figure 3B by the threaded engagement of the locking collar 46 with the internal surface of the lower portion 42 of the sleeve 41. Suitable seal rings 47 are provided on the inner surface of the locking collar 46 for sealing contact with the outer surface of the lower well pipe 44. Also a suitable seal ring 48 may be disposed on the outer surface of the locking ring 46 in contact with the inner surface of the lower portion 42 below the threaded connection thereof. The shoulder 45 of the lower well pipe 44 may also include a seal ring 49 on its external surface for contact with the internal surface of the lower portion 42 above the threaded connection between the sleeve 41 and the locking ring 46. By reason of the bearing 43, rotation of the tubular support 12 will impart similar rotation to the sleeve 41 and the locking collar 46, but the lower well pipe 44 will not be rotated. Thus the lower well pipe 44 may be connected to a well packer adapted to be set by reciprocation or a non-rotational movement, so that such well packer will not be set when the rotation of the tubular support 12 is effected for the setting of the well packer of this invention. Other types of well devices may also be connected to the lower well pipe 44 if desired.

In some cases, where the well packer of this invention is utilized with a crossover construction thereabove of the usual type, an inner conductor 50 may be disposed inside of the tubular support 12, such inner conductor 50 extending substantially the full length of the tubular support 12 and being provided with suitable outlets above the well packer A of this invention, in the usual manner. The inner conductor 50 will be of a lesser diameter than the internal diameter of the tubular support 12 so that an annular space 51 is provided between the inner conductor 50 and the support 12 for the flow of fluids therethrough, as well as through the bore of the inner conductor 50. At the lower end of the inner conductor 50 a sealing construction may be provided to assure that the well fluids

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pass through the radial ports or passages 40 of the tubular support 12. This sealing means may include a packing 53, preferably of the chevron type which is disposed on an enlarged sleeve 54 threaded to the lower end of the inner conductor 50. This sealing element 53 is retained on the external surface of the sleeve 54 by a retaining nut 55 which engages the lower end of the sealing element 53, while the upper end thereof contacts an annular shoulder 54a of the sleeve 54. Thus a seal is provided by the element 53 between the inner conductor 50 and the support 12, which seal is below the passages 40.

The operation of the well packer of this invention is best illustrated by Figures 1 and 2, wherein Figure 1 illustrates the packer with the slips and the packing elements retracted for raising and lowering the packer in the well casing 10, while Figure 2 illustrates the slips and the packing element in their set and sealing position with the well casing 10. In the lowering of the well packer A of this invention, the tubular support 12 is of course connected to a pipe string extending to the surface of the well and the packer is lowered to a predetermined point in the casing 10, at which it is desired to set such packer. Upon reaching such predetermined point, the tubular support 12 is rotated. If the threads 12a and 25a are left-hand threads and the threads 12b and 25b are right-hand threads, the rotation will be in a clockwise direction as viewed from Figure 4 so that the upper packing expander member 25 and the lower packing expander member 25' are moved longitudinally toward each other. As was previously explained, these packing expander members 25 and 25' are prevented from rotational movement during the rotation of the pipe 12 because of their slidable connection with the expanders 16 and 16' which in turn are held against rotational movement by the friction spring members 35 engaging with the well casing 10. The packing elements C are of sufficient stiffness and rigidity so that as the packing expander members 25 and 25' are moved toward each other, their respective packing elements C are carried toward each other also. Since the packing elements C are connected to the slip expanders 16 and 16', this movement longitudinally therefore transmits the same longitudinal movement to such slip expanders 16 and 16' and urges them toward each other. This, of course, causes the upper cone 17 to engage with and move longitudinally with respect to the inclined surface 15b of the slips 15 and similarly causes the lower cone 17' to engage with and cause the radial expansion of the slips 15 by the contact of the cone 17' with the inner inclined surfaces 15c of the slips 15. When the slips 15 have been set in gripping contact with the well casing 10, further movement of the slip expander 16 and 16' toward each other is prevented. Further or continued longitudinal movement of the packing expander members 25 and 25' toward each other then causes a relative longitudinal movement with respect to each of their packing elements C, so that the expander cones 27 and 27', respectively, urge the packing elements C radially outwardly into sealing contact with the well pipe. As can be seen in Figure 2, particularly, the expander cones 27 and 27' enter the bore of the packing elements C during such expansion into their sealing contact. This expansion is therefore a positive mechanical action which assures that the sealing between the well casing 10 and the exterior surface of the packer is effected. Thus, in this invention the well fluid pressure is not relied upon to maintain the packing elements C in their expanded sealing position, but instead a positive mechanical setting thereof is effected by the rotation of the tubular support 12. It will be appreciated, of course, that any fluid pressure in the well which may act on the packing elements C would tend to force them toward each other to maintain the slips 15 in their gripping position. During the rotation of the tubular support 12 the lower well pipe 44 will of course not be rotated due to the swivel means D. Also any desired well operations utilizing the inner conductor

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50 may be carried out once the well packer A has been set and any other necessary operations are performed with the other apparatus which might be used above or below the well packer of this invention.

It is believed evident from the foregoing description and drawing that the well packer of this invention provides a structure wherein the anchoring assembly and the packing elements are both set mechanically by the rotation of the tubular support extending axially through the packer, and additionally that the well fluid pressure, or differential above and below the packing elements, will affect the tendency of the anchoring assembly to grip the well casing after the anchoring assembly and the packing elements have been set mechanically, if such fluid pressure or differential oil pressure has any effect at all upon the packing elements.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in size, shape and material, 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 packer for use in a well casing, comprising a tubular support, an anchoring assembly surrounding and rotatable on said support and having a slip carrier, friction spring means on said carrier resisting movement of said anchoring assembly in the well casing, casing gripping slips for gripping engagement with the well casing, a slip expander slidably and non-rotatably connected to said slip carrier for urging said slips radially into gripping contact with the well casing upon a longitudinal movement of the expander relative to the slips, an annular packing element connected to said slip expander and surrounding said support, an annular packing expander member surrounding said support and engageable with said packing element, said packing expander member and said support having co-engaging threads thereon for rotatably connecting said packing expander member to said support, and means slidably and non-rotatably connecting said packing expander member to said slip expander to permit said packing expander member to move longitudinally while preventing rotation thereof relative to said slip expander and said support upon a rotation of said support, the longitudinal movement of said packing expander member being transmitted to said slip expander by a longitudinal movement of said packing element until said slip expander has urged said slips into gripping contact with the well casing whereupon said packing expander member moves longitudinally relative to said slip expander and said packing element to radially expand said packing element into sealing contact with the well casing.

2. A well packer for use in a well casing, comprising a tubular support, an anchoring assembly surrounding and rotatable on said support and having a slip carrier, friction spring means on said carrier resisting movement of said anchoring assembly in the well casing, casing gripping slips for gripping engagement with the well casing, upper and lower slip expanders slidably and non-rotatably connected to said slip carrier for urging said slips radially into gripping contact with the well casing upon longitudinal movement of said expanders toward each other and relative to said slips, an upper annular packing element connected to and above said upper slip expander and surrounding said support, a lower annular packing element connected to and below said lower slip expander and surrounding said support, an upper annular packing expander member surrounding said support and engageable with said upper packing element, a lower annular packing expander member surrounding said support and engageable with said lower packing element, said support and each of said packing expander members having threads thereon rotatably connecting said packing expander members on said support for longitudinal move-

ment toward each other upon a rotation of said support, longitudinal movement of said packing expander members toward each other being transmitted to the slip expanders by longitudinal movement of said packing elements whereby said slip expanders are moved toward each other to urge said slips into a set position in gripping contact with the well bore wall, means slidably and non-rotatably connecting said upper packing expander member to said upper slip expander, and means slidably and non-rotatably connecting said lower packing expander member to said lower slip expander for permitting said packing expander members to move longitudinally toward each other and relative to said slip expanders and said packing elements after said slips are in the set position to radially expand said packing elements into sealing contact with the well casing.

3. A well packer for use in a well casing including, a tubular support, an anchoring assembly having a slip carrier slidably and rotatably mounted on the tubular support, radially expansible gripping slips mounted on said carrier, an upper slip expander and a lower slip expander mounted on said support with said slips therebetween, said expanders being movable longitudinally relative to each other and with respect to said gripping slips, coacting means on each slip expander and on said slip carrier for permitting longitudinal movement of said expanders while preventing rotational movement of said expanders relative to said slip carrier, friction spring means on said slip carrier in constant contact with the well casing to prevent rotation of said carrier, a packing element carried by each slip expander, said packing elements and said slip expanders being mounted on said support for rotational and longitudinal movement relative thereto, an upper packing expander member and a lower packing expander member slidably and non-rotatably connected to said upper slip expander and said lower slip expander respectively, said packing expander members being also mounted on said support for longitudinal movement relative thereto to engage the upper and the lower packing elements respectively to effect longitudinal movement of said upper packing element and said upper slip expander toward said lower packing element and said lower slip expander, and co-engaging means on said packing expander means and said support to effect a movement of said packing expander means to move said packing elements and said slip expanders longitudinally upon a rotation of said support so that said slip expanders urge said slips into gripping engagement with the well casing and so that thereafter said packing expander members expand said packing elements into sealing contact with the well casing upon rotation of said support.

4. The well packer set forth in claim 3, wherein each

packing expander member has a tapered external surface adapted to enter the bore of each packing element to effect the sealing contact thereof with the well casing.

5. The well packer set forth in claim 3, including a rotatable threaded connection between each support and each of said packing expander members, whereby rotation of said support imparts longitudinal movement to said packing expander members toward each other to effect the setting of said slips and the sealing contact of the packing elements with the well casing.

6. A well packer for use in a well casing comprising a tubular support, an anchoring assembly surrounding said support and having a slip carrier, pipe gripping slips mounted on said carrier, a slip expander slidably and non-rotatably connected to said slip carrier and adapted to be moved longitudinally upon rotation of said support, a packing element on said slip expander, said slip expander and said packing element being mounted on said support for rotational and longitudinal movement relative thereto, a packing expander means slidably and non-rotatably connected to said slip expander, said packing expander means being mounted on said support for longitudinal movement relative thereto, co-engaging means on said packing expander means and said support to effect a movement of said packing element and said slip expander longitudinally upon a manipulation of said support to move said slips into gripping contact with the well casing and to thereafter expand said packing elements into sealing contact with the well pipe upon rotation of said support, and means for holding said slip expander and said packing element against rotation when said support is manipulated.

7. The well packer set forth in claim 6, wherein said packing expander means is slidably connected with said slip expander and includes a tapered surface adapted to enter the bore of said packing element to effect the sealing contact thereof with the well casing.

8. The well packer set forth in claim 6, wherein said packing expander means has a threaded connection with said support, whereby rotation of said support imparts a longitudinal movement to said packing expander means.

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