Oct. 1, 1940. C. H. BARNES ET AL 2,216,336

MULTIPLE RING PACKER

Filed July 15, 1939 2 Sheets-Sheet 1

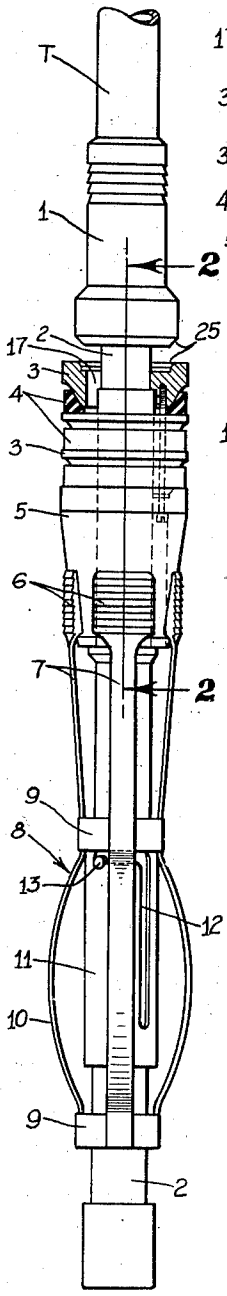


FIG. 1

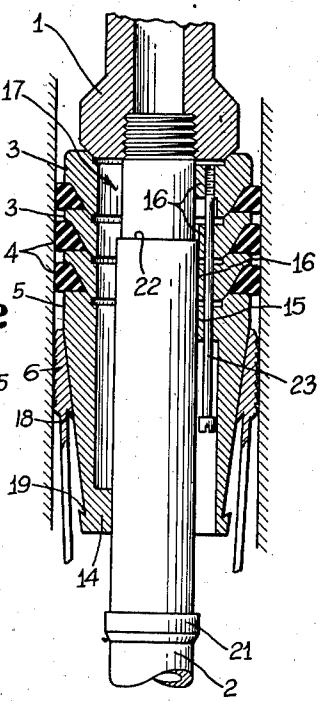


FIG. 2

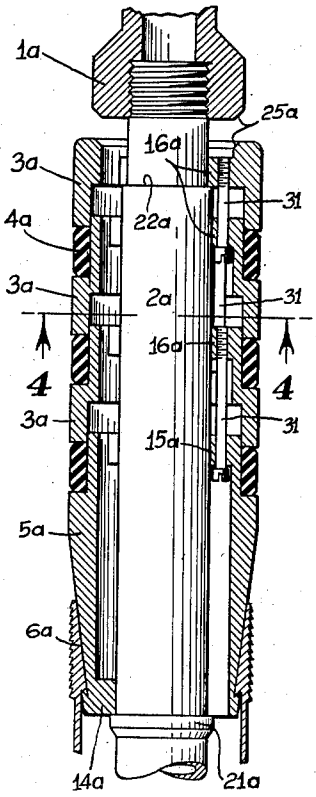


FIG. 3

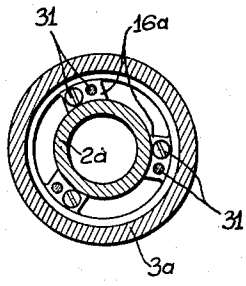


FIG. 4

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MULTIPLE RING PACKER

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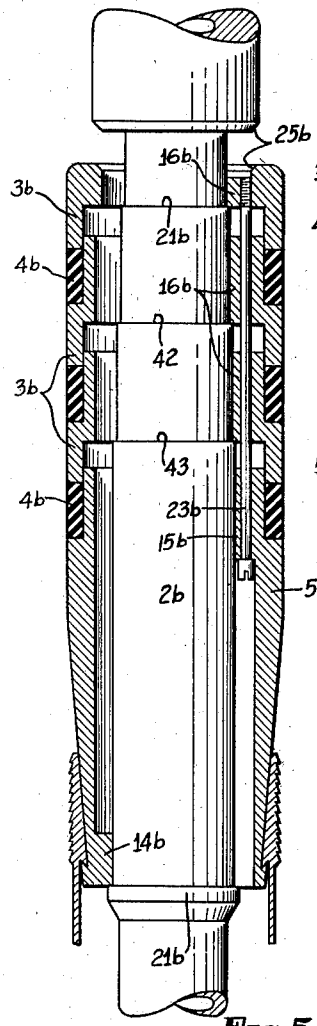


FIG. 5

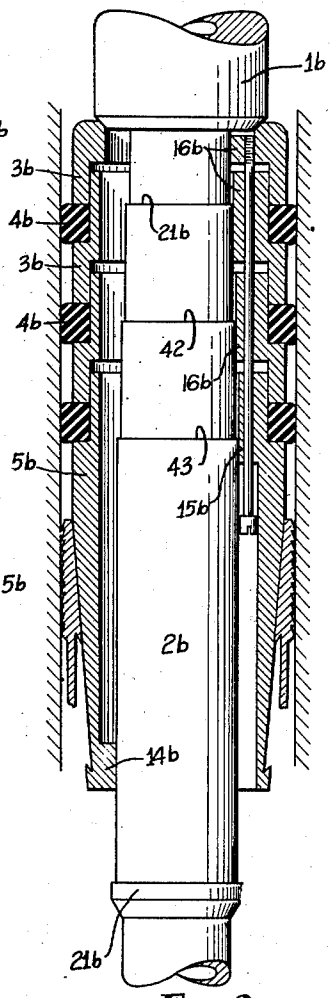


FIG. 6

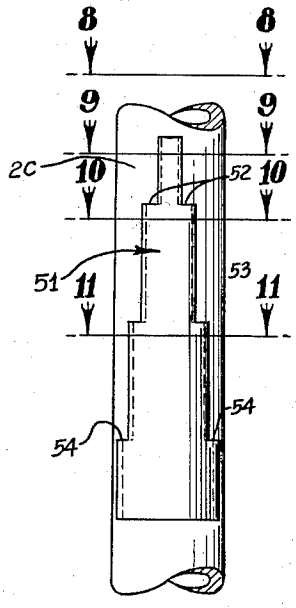


FIG. 7

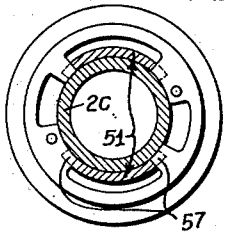


FIG. 11

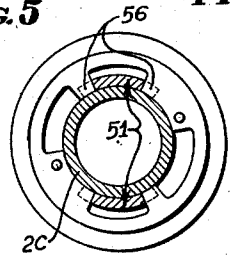


FIG. 10

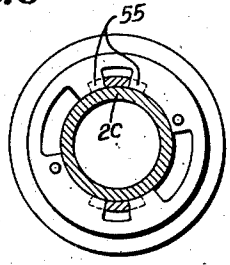


FIG. 9

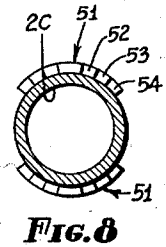


FIG. 8

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MULTIPLE RING PACKER

Charles H. Barnes, Glendale, and John Young, Jr., Huntington Park, Calif., assignors to Lane-Wells Company, Los Angeles, Calif., a corporation of Delaware

Application July 15, 1939, Serial No. 284,660

5 Claims. (Cl. 166—12)

Our invention relates to multiple ring packers for oil wells, and among the objects of our invention are:

First, to provide a packer of the multiple ring type wherein packing rings and spacer rings are arranged alternately and wherein means are provided to insure proper separation of the spacer rings upon withdrawing the packer, so as to permit return of the packing rings to their proper positions;

Second, to provide a separating ring spacer construction which is applicable to different types of multiple ring packers;

Third, to provide a means for association with a well packer wherein proper spacing of the upper and lower ends of a packing element is automatically accomplished upon withdrawing the packer from the well;

Fourth, to provide a device of this character which materially reduces the wear and damage to packer rings and greatly increases the life thereof;

Fifth, to provide a device of this character which in no manner interferes with the normal operation of the packer with which it is incorporated, and

Sixth, to provide a multiple ring packer having alternate packer rings and spacers or separator rings wherein, during movement of the packer in the well casing, the uppermost spacer or separator ring is positively restrained against downward movement against the packing rings below, even though the upper spacer ring should strike or bear against the casing wall.

With the above and other objects in view, as may appear hereinafter, reference is directed to the drawings, in which:

Figure 1 is an elevational view of a packer, with portions thereof shown in section and illustrating our device;

Figure 2 is an enlarged fragmentary longitudinal sectional view thereof, taken through 2—2 of Figure 1, showing the packer in its set position;

Figure 3 is a fragmentary longitudinal sectional view similar to Figure 2, showing a modified form of packer incorporating our device;

Figure 4 is a transverse sectional view thereof through 4—4 of Figure 3;

Figure 5 is another fragmentary longitudinal sectional view similar to Figures 2 and 3, showing a further modified form of our device;

Figure 6 is a similar longitudinal sectional view showing said further modification as it appears when the packer is set;

Figure 7 is an elevational view of a packer mandrel or body in which is incorporated a still further modification of our device;

Figure 8 is a transverse sectional view thereof, taken substantially through 8—8 of Figure 7; and

Figures 9, 10 and 11 are transverse sectional views taken through 9—9, 10—10 and 11—11, respectively, of Figure 7, showing in association therewith plan views of separate ring elements to illustrate the manner of their coaction with the special mandrel shown in Figure 7.

Reference is first directed to Figures 1 and 2: Here illustrated is a substantially conventional type of multiple ring packer, such as shown in Patent No. 1,925,016; modified, however, to incorporate our invention. This packer comprises a top collar 1, the upper end of which is threaded for connection to a tubing string T and the lower end of which is threaded for connection to a tubular body or mandrel 2.

Fitted around the mandrel 2, below the top collar 1, are a series of separator rings and packer rings 3 and 4, respectively, arranged alternately. Below the series of separator rings and packer rings is a slip cone 5, upon which fits, on its conical surface, a plurality of slips 6. These are connected by reins 7 to a cage 8 which comprises upper and lower collars 9 connected by bow springs 10. Secured to one of the collars 9 is a latching sleeve 11 having a bayonet slot 12 therein which coacts with a latching pin 13 secured in the mandrel 2.

The cone 5 is provided with inwardly directed spacer lugs 14 and 15 at its lower and upper end, respectively, and the separator rings are provided with spacer lugs 16. These engage the mandrel and hold the cone and separator rings in concentric spaced relation with the mandrel to define passages 17 for the purpose of permitting flow of liquid through the packer during movement of the packer in the well bore.

The packer structure as described above is conventional. Our invention resides particularly in the provision of certain shoulders or stops on the mandrel, or body, which coact with the spacer lugs of the cone and separator rings, whereby, upon unsetting the packer and withdrawing the same from the hole, the cone and spacer rings are caused to assume positions which facilitate return of the packing rings to their normal position within the area of the spacer rings; more specifically, the mandrel, or body, 2 is provided with a flange 21 below the cone,

upon which the cone rests when the slip and cage assembly is in its retracted position. The cone is held against the shoulder when the assembly is in its retracted position by reason of catches 18 provided on the slips which coact with an undercut flange 19 formed around the lower end of the cone 5.

The upper portion of the mandrel is provided with a shoulder 22, upon which the lugs 16 of the upper separator ring rest when the parts of the packer are in their normal or retracted position, shown in Figure 1. The packing and separator ring assembly are tied by means of bolts 23 which extend upwardly through the spacer lugs. The heads of the bolts 23 are restrained by the upper spacer lugs 14 of the cone and the upper ends of the bolts are screwthreaded into the spacer lug 16 of the upper separator ring. The bolts are of such length that when the cone rests upon the flange 21 and the upper spacer ring rests on the shoulder 22 the heads of the bolts are almost, but not quite, in engagement with the spacer lugs 14. If, however, the flange 21 is omitted the bolts may function to limit downward movement of the cone.

The upper spacer ring and the top collar 1 are provided with confronting valve seat and valve face elements 24 and 25, respectively. When the packer is in a seated position these elements engage to seal the passages 17, as shown best in Figure 2.

Operation of a packer incorporating our invention is as follows: The seating of the packer is accomplished in the conventional manner. When the packer is seated the spacer rings and packing rings slide upwardly with respect to the mandrel until the upper spacer ring is in engagement with the top collar. The cone likewise moves upwardly so that both the cone and the upper spacer ring are clear of their flange 21 and shoulder 22, respectively. When unseating the packer for withdrawal the mandrel is pulled upwardly; the shoulder 22 first engages the upper separator ring 3, releasing the upper packing element, and continued upward movement causes either the flange 21 or heads of the bolts 23, or both, to lift upwardly on the cone 5 to withdraw it from between the slips. With the cone and the upper separator ring necessarily occupying the proper spaced relation with each other, a minimum amount of restraint is placed on the packing rings and consequently they readily contact to their initial position between the intermediate spacer rings.

While added advantage may be gained in providing means for moving the intermediate separator rings to their initial position (such means shown in the modified form to be described hereinafter), it is of primary practical importance to lift the upper ring for the reason that during the time the packer is set, sand or the like may pack in around the upper separator ring. Thus, without the shoulder 22 the mandrel flange 21 is the only member acting to cause upward movement of the cone and packer assembly. As a result, any wedging action or packing of the sand, or the like, around the top of the packing rings will prevent these members from returning to their normal position, causing them to wear against the walls of the casing and possibly hampering removal of the packer. In other words, a pulling rather than a pushing action is obtained by reason of the shoulder 22.

Heretofore, in the design of multiple ring packers the head or top collar 1 necessarily has had to have an outside diameter equal to the diameters of the spacer or separator rings and packer rings. This meant that the circulation area was limited to the clearance between the packer head and casing, and therefore, in part at least, nullifying the effect of the circulation space provided between the packer rings and mandrel.

By reason of the positive support afforded by the shoulder 22 the head or collar 1 may be of smaller diameter than the uppermost spacer ring, and the uppermost spacer ring may serve as the protecting means for the packer rings and other spacer rings below. The importance of this feature becomes apparent when it is realized that the packer is supported by relatively stiff tubing and moved through a well casing which often contains crooked places or "dog legs." Under such conditions, which are the rule rather than the exception, the packer is forced against one side or the other of the casing and the pressure may amount to several hundred pounds. Without the shoulder 22, or the protection of a circulation obstructing collar above the spacer rings, very material difficulty would be encountered in withdrawing the multiple ring packer.

Reference is now directed to Figures 3 and 4, in which our invention is shown in conjunction with another type of multiple ring packer and, in addition, means are shown whereby the intermediate separator rings are caused to assume their initial spaced relation upon release and withdrawal of the packer. More specifically, the packer shown in Figures 3 and 4 has parts corresponding to those previously described in relation to the packer shown in Figures 1 and 2; consequently, these corresponding parts are designated by similar reference characters but with the suffix *a*. Thus, the packing assembly comprises a series of separator rings 3*a*, between which fit packing rings 4*a*.

In this case the separator rings comprise major and minor cylindrical portions, the inner portions of which telescope within the major portions of the adjacent ring so as to form channels to receive the packing rings which are likewise cylindrical in form and of substantially uniform thickness. With this construction the packing rings are deformed by compressing axially, whereas in the first described structure the packing rings are deformed by wedging them outwardly to increase their diameter. However, insofar as the function of our invention is concerned, either construction of packer operates the same. Some advantage is gained, however, in the use of our invention with the type of packer shown in Figures 3 and 4, in that this design permits the use of a larger body or mandrel, or the provision of more space between the spacer rings and mandrel for passages and the accommodation of our invention.

In the construction shown in Figures 3 and 4 a series of tie bolts 31 are substituted for the tie bolts 23. Each of the spacer lugs 14*a*, 15*a* and 16*a* are provided with two sets of holes therethrough, one threaded for the accommodation of the threaded ends of one set of spacer bolts 31 and the other set of holes adapted to receive the shanks of another set of tie bolts. Thus a first set of spacer bolts extend through the upper spacer lugs 15*a* of the cone 5*a* and into the lugs 16*a* of the adjacent separator ring 3*a*. A second set of tie bolts extend upwardly through the lugs 16*a* of the foremost separator ring and screwthread into the lugs 16*a* of the next separator ring, and so on. As many separator rings may be provided

as are desired. The uppermost set of tie bolts screwthread into the upper separator ring. As in the first described structure, the mandrel 2a is provided with the flange 21a and the shoulder 22a.

Operation of the structure shown in Figures 3 and 4 is as follows: The seating of the packer is accomplished in the ordinary manner. Upon release of the packer the mandrel is moved upwardly and the shoulder 22a engages the lugs 16a of the uppermost separator ring and, as soon as the slack occasioned by the telescoping movement of the upper separator ring with the adjacent separator ring has been taken up, the heads of the uppermost set of tie bolts link the upper and adjacent separator rings together so that the two members are drawn upwardly. This action continues until the lowermost set of tie bolts has engaged the cone. However, inasmuch as more force may be required to raise the cone than is necessary to move the separator rings upwardly, it is, preferred to rely on the flange 21a, rather than the lower set of tie bolts, to raise the cone.

Inasmuch as each separator ring is limited in its movement with respect to the adjacent separator ring, it follows that they are automatically moved into their proper relationship to accommodate the packing rings when the mandrel is moved upwardly, and no restraint is placed upon the packing rings which would tend to prevent their returning to their normal position. No reliance need be had on the inherent resiliency of the packing rings to spread the separator rings. On the other hand, should the tie bolts break for any reason, the packer is still capable of being unseated for it will at least operate as well as the conventional packer of this type.

Attention is now directed to Figures 5 and 6: The construction here illustrated discloses a further modified construction whereby each of the separator rings are caused to assume their proper spaced relationship upon withdrawal of the packer. The construction differs from the previously described structure in that a series of shoulders are provided on the mandrel in place of the sets of tie bolts 31. Inasmuch as the packer parts are similar to the previous described structures, similar parts are given similar reference characters with the added suffix b. Thus the several separator rings 3b are interposed between packing rings 4b.

The packing assembly thus provided is preferably in the form shown in Figures 3 and 4 in order to accommodate as large a mandrel as possible.

The mandrel 2b is provided, in addition to the shoulder 22b, with a series of additional shoulders 41 and 42, and the lugs 16b of the separator rings are of such length as to support the separator rings on their respective shoulders. When so supported the rings are in their normal spaced relation for accommodation of the packer rings.

When, however, after the packer has been seated and it is desired to remove the same, upward movement of the mandrel causes the shoulders to engage the separator rings in succession so that each moves into its initial relationship to the adjacent separator ring and the packing rings are free to move to their initial position. It should be noted that the length of the different spacer lugs 15b and 16b are such that they at all times rest on the particular section of the mandrel upon which they fit, that is, they do not slide beyond an upper or smaller shoulder which might prevent their return to their normal position.

Reference is now directed to the structure shown in Figures 7, 8, 9, 10 and 11. In this construction the operation is substantially identical to that described in Figures 5 and 6, with the exception that the mandrel herein designated 2c is provided with diametrically oppositely disposed plates 51 which are welded or otherwise secured thereto. The two plates increase circumferentially in steps which form shoulders 52, 53 and 54, corresponding in location to the shoulders 22b, 41 and 42 of the structure shown in Figures 5 and 6. With this arrangement the diameter of the mandrel is kept relatively small. In order to utilize the construction the several separator rings 3c are provided with special lugs 55, 56 and 57, so spaced circumferentially as to coact with shoulders 52, 53 and 54, respectively. Operation of the packer with this construction is, of course, similar to that previously described.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is our intention to claim all novelty inherent in the invention as broadly as the prior art permits.

We claim:

1. A multiple ring packer comprising: a mandrel; a packer assembly mounted around said mandrel; an anchor means associated with said mandrel and engageable with a surrounding casing to support said packing assembly when said packer is set; said packer assembly including a plurality of separator rings and packer rings arranged alternately, the separator rings being spaced from said mandrel to define a circulation passage; a packer head mounted on said mandrel above said packer assembly; valve means incorporating the packer head and uppermost separator ring for controlling said passage; and positive stop means operatively associated with at least said upper separator ring for positively limiting movement of said separator ring with respect to said packer head, whereby downward load upon said upper separator ring cannot be transmitted to the other separator rings and packer rings.

2. A multiple ring packer comprising: a plurality of separator rings arranged coaxially and having a normal expanded portion when said packer is unset and a contracted position when said packer is set; packer rings between said separator rings adapted to be urged, upon compression of said separator rings, into contact with a surrounding casing; and a mandrel extending through said rings, said mandrel having a plurality of shoulders engageable by said separator rings and tending to urge them into equally spaced relation upon releasing the packer.

3. A well packer including: a mandrel having spaced shoulders formed thereon; a series of spacer rings slidably mounted on said mandrel between said shoulders, the uppermost and lowermost spacer rings adapted normally to rest on the respective shoulders but capable of upward movement relative to the mandrel; tie means connecting said spacers to limit relative axial expansion thereof; yieldable and resilient packing elements between the several spacer rings adapted, upon axial contraction of said rings, to expand radially, said spacer rings having relatively telescoping major and minor diametered cylindrical portions defining contractable channels therebetween; yieldable and resilient pack-

ing elements filling said channels; and means for telescoping said spacer rings.

4. A well packer including: a mandrel having spaced shoulders formed thereon; a series of spacer rings slidably mounted on said mandrel between said shoulders, the uppermost and lowermost spacer rings adapted normally to rest on the respective shoulders but capable of upward movement relative to the mandrel, all of the intermediate of said spacer rings having relatively telescoping major and minor diametered cylindrical portions defining contractable channels therebetween; tie means connecting said spacers to limit relative axial expansion thereof and to maintain said rings in telescopic relation; yieldable and resilient packing elements filling said channels; and means for telescoping said spacer rings.

5. A multiple ring packer comprising: a packer head; a mandrel depending therefrom; a plurality of separator and packer rings slidably mounted around said mandrel and forming therewith a circulation passage; valve means incorporating the upper separator ring and said packer head, said packer head having a smaller diameter than said upper separator ring in approximate proportion to the area of said circulation passage; and stop means for positively limiting movement of said upper separator ring away from said packer head, and said stop means being engageable by said upper separator ring when said packer is being moved in a well bore, whereby said upper separator ring is restrained against transmitting loads to the other separator rings or packer rings.

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