

Oct. 23, 1956

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2,767,795

EXPANDING BACKUP RING FOR PACKER RUBBERS

Filed Jan. 6, 1955

2 Sheets-Sheet 1

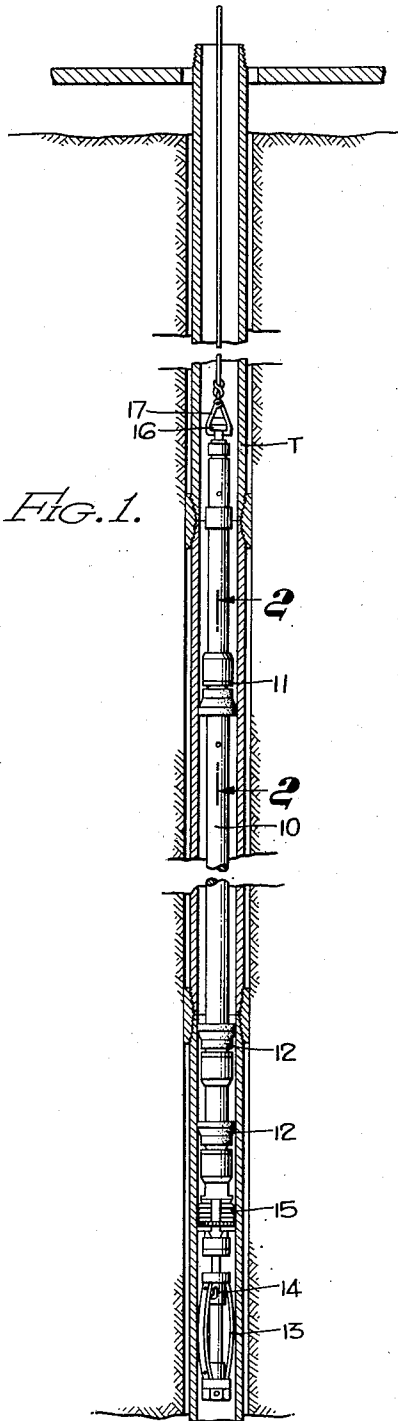


FIG. 1.

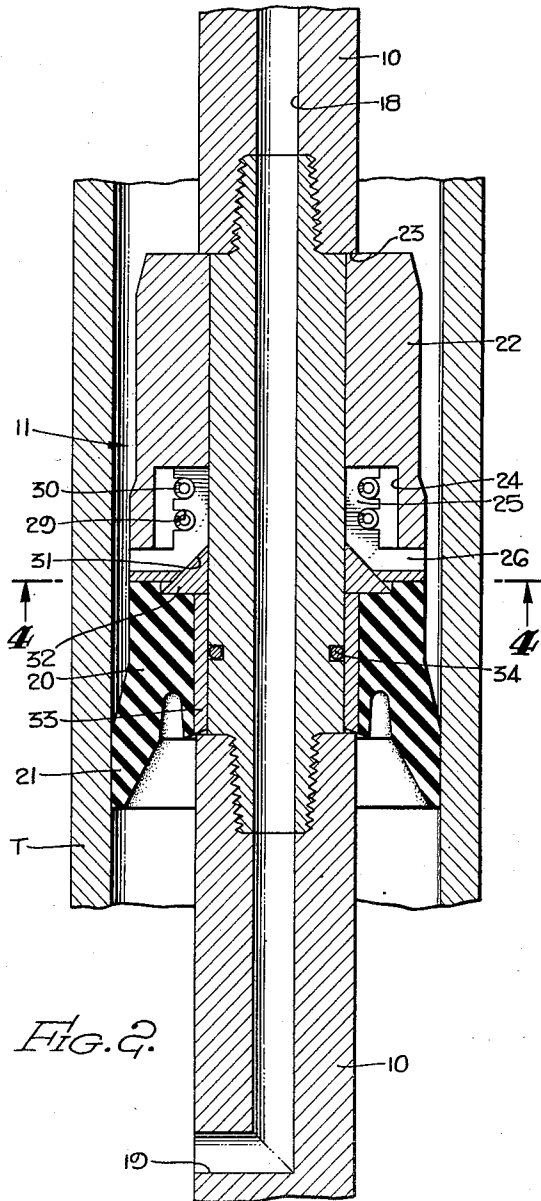


FIG. 2.

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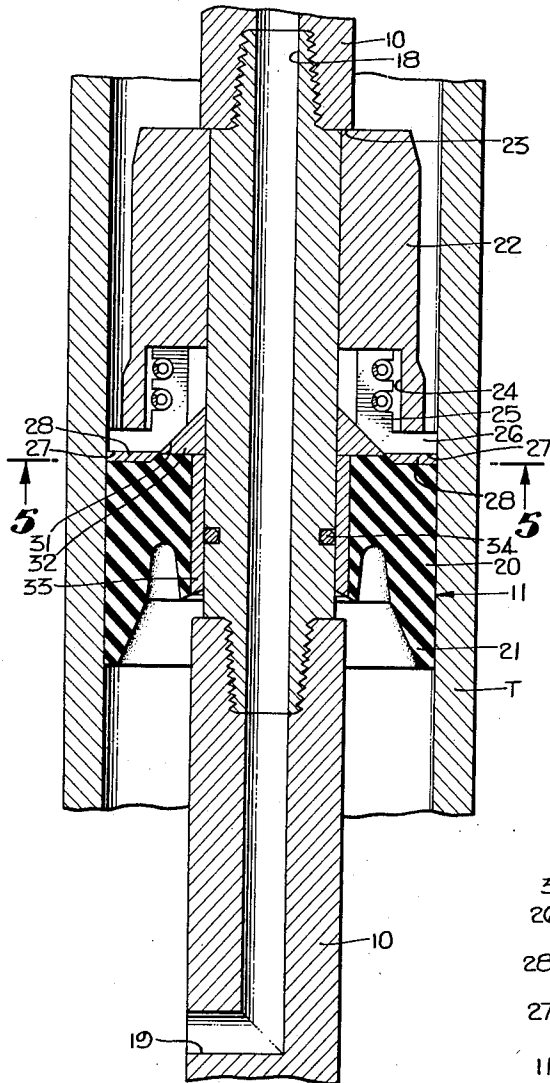


FIG. 3.

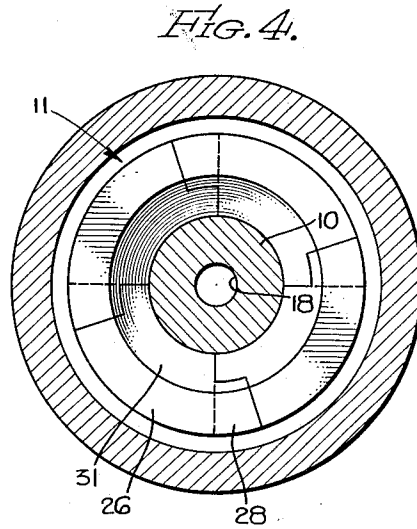


FIG. 4.

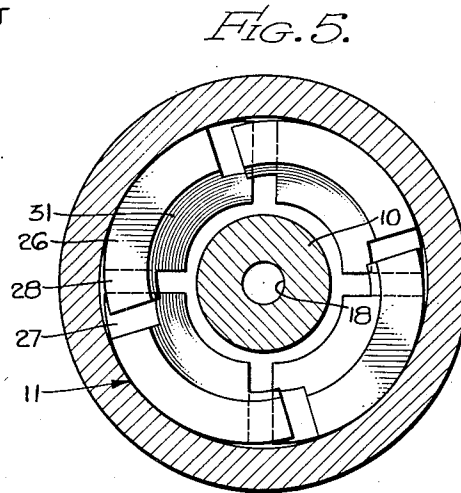


FIG. 5.

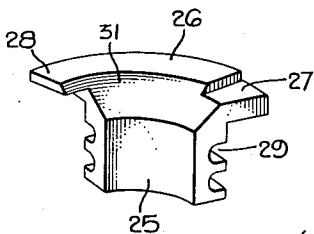


FIG. 6.

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EXPANDING BACKUP RING FOR PACKER RUBBERS

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Application January 6, 1955, Serial No. 480,162

4 Claims. (Cl. 166—204)

This invention relates to a means for forming a seal between a rod-like article and a surrounding cylindrical wall, and is particularly suitable for use in conjunction with that type of apparatus disclosed in United States Letters Patent No. 2,652,717, issued September 22, 1953, to Charles H. Collett and myself, although it may be employed in a large number of other but similar circumstances.

In the above-mentioned patent there is disclosed an apparatus for testing tubing in the course of its being lowered into a well. Essentially, the testing apparatus consists of a rod equipped with settable slips enabling the rod to be supported thereby within the tubing. On the rod there are upper and lower barriers described in that patent as consisting of swab rubbers. The upper portion of the rod is hollow and its interior communicates with the space between the barriers so that when the apparatus is positioned within the tubing a liquid may be used to fill the space between the barriers and hydraulic pressure can be applied to test the tubing for leakage. After a stand of tubing has been tested an additional stand of tubing may be connected to that portion of the tubing that is within the well and the tubing, together with the apparatus may be lowered into the well. Thereafter, the apparatus is drawn upwardly into the newly applied stand of tubing and the newly applied stand of tubing is tested in the same manner.

Present requirements are such that it is necessary in testing the tubing to apply extremely high pressures to the interior of the tubing between the barriers. These pressures may run as high as 15,000 lbs. per square inch. In lieu of swab rubbers it has been proposed to use cup rubbers to effect a seal between the rod and the interior of the tubing. If such cup rubbers are backed by means of a backing ring mounted on the rod a suitable clearance must be left between the periphery of the backing ring and the interior of the tubing to enable the apparatus to be shifted from place to place within the tubing. Under the high pressures that are now required there is danger of the cup rubbers being forced or squeezed through the clearance space between the backup ring and the interior of the tubing, and because of this, the cup rubbers become easily damaged and must be frequently replaced.

It is, therefore, another object of the present invention to provide an expansible backup ring for cup rubbers which will be expanded automatically upon the application of pressure between the opposed cup rubbers and caused to engage the interior of the tubing. If the backup ring is thus expanded into engagement with the interior of the tubing, the squeezing of the cup rubber between the backup ring and the tubing is effectively prevented.

In shifting the apparatus from one location to another within the tubing in the course of testing the stands which are consecutively applied the skirts on the cup rubbers may engage shoulders in the joints between adjacent pipe sections. It is desirable when this occurs

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that the expansible backup ring remains in its contracted condition. In other words, the mere engagement of the skirt of a cup rubber with a shoulder at a joint in the tubing should not be effective to expand the backup ring. Expansion of the backup ring is only desirable when pressure is applied between the cup rubbers.

It is, therefore, another object of the present invention to provide a construction having an expansible backup ring and which is so designed that the expansible backup ring will be expanded only when pressure is applied between the cup rubbers but will remain contracted even though the skirts on the cup rubbers are urged in an axial direction by their engagement with a shoulder on the interior of the tubing.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a sectional view through a tubing illustrating schematically therein an apparatus for testing tubing in which the structure embodying the present invention has been incorporated;

Fig. 2 is a sectional view on an enlarged scale taken substantially upon the line 2—2 upon Fig. 1, and illustrating the backup ring in its contracted position;

Fig. 3 is a view similar to Fig. 2, but illustrating the backup ring as having been expanded as a result of pressure applied to the forward face of the cup rubber;

Fig. 4 is a sectional view taken substantially upon the line 4—4 upon Fig. 2, in the direction indicated;

Fig. 5 is a sectional view taken substantially upon the line 5—5 upon Fig. 3 in the direction indicated; and

Fig. 6 is a perspective view of one of the segments of the expansible backup ring.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the apparatus as illustrated in Fig. 1 consists of a rod 10 that is adapted to be lowered into the tubing T which is to be tested. This rod has an upper barrier generally indicated at 11, and a lower barrier generally indicated at 12.

The lower end of the rod carries a set of expansible belly springs 13 which are releasably connected to the rod such as by a pin and J slot 14 and which when released will enable a lower set of slips 15 to be set within the tubing so as to cause the rod and associated structure to be self-supporting therein. At the upper end of the rod there is a head 16 that is engageable by means of a grab 17 or the equivalent to enable the rod and associated structure to be lifted from one location within the tubing T to another location therein in testing stands of tubing that are consecutively applied. The upper end of the rod is hollow and has an axial passage 18 therethrough which communicates with the space between the upper barrier 11 and the lower barrier 12, as indicated at 19. When the head 16 is projecting above the top of the tubing a source of hydraulic pressure can be connected thereto and conducted to the space between the barriers 11 and 12 within the tubing. This pressure is effective to determine whether or not leaks are present in the tubing. Leakage is determined by observing whether the pressure falls after it has been initially applied. If the stand of tubing that has last been applied to the tubing string is found to be leakproof an additional stand is connected to the tubing and the entire tubing together with the additional stand is lowered into the well. The grab 17 is then lowered to engage the head 16 and the apparatus above described is pulled upwardly into the newly applied stand and the test is repeated.

As above explained, due to the high pressures that

are now required the convention swab rubber is found to be inadequate to retain the high pressure. In lieu thereof it has been proposed to form the barriers 11 and 12 by means of cup rubbers, one of such cup rubbers being indicated at 20. The upper cup rubber 20 has its skirt 21 directed downwardly, whereas the lower cup rubbers which form the barrier 12 have their skirts facing upwardly. These skirts are normally flared so that they will engage the interior of the tubing. In the case of the upper cup rubber some form of backup ring is required to hold the upper cup rubber against movement in an axial direction and in an upstanding direction when the pressure is applied. Similarly, the lower cup rubbers must also be backed up by some form of backup ring to prevent their being axially displaced downwardly when the pressure is applied. If the rod 10 is merely equipped with a solid or stationary backup ring, some clearance must be left between the backup ring and the interior of the tubing, and there is danger of forcing the cup rubber into such clearance when the high pressure is applied.

In accordance with the present invention the rod 10 is equipped with a sleeve 22 which functions as a stop ring. This sleeve may be mounted on the rod 10 in any suitable manner to prevent its axial displacement such as by being abutted against a shoulder 23. The lower end of the sleeve 22 is recessed as indicated at 24 to accommodate the expansible backup ring. This backup ring is formed of a plurality of segments, one of which is shown in Fig. 6. Each segment is angular in cross-section, having an upright hub portion 25 and an outwardly extending flange portion or foot portion 26. The bottom of each flange portion is recessed as indicated at 27, see Fig. 6, and is also equipped with a laterally extending overlapping portion 28. These overlapping portions are receivable in the recesses 27 of adjoining segments so that even though the backup ring is expanded radially portions of the overlapping portions 28 will continue to overlie adjoining segments as depicted in Fig. 5. The upright portions 25 are circumferentially grooved with grooves 29 within which there are disposed tension springs 30. These tension springs urge the backup ring segments into contracted positions whenever the segments are capable of being moved inwardly or towards each other about the rod 10. The lower inner edges of the segments are beveled or coned out as indicated at 31 complementary to an expanding cone 32, which is slidable on the rod 10 and which is above the sleeve 33 which is arranged within the cup rubber. An O-ring 34 is recessed in the rod 10 on the interior of the sleeve 33 and prevents leakage between the sleeve and the rod.

It will be noted from an inspection of Figs. 2 and 3, that the diameter of the cone 32 is considerably less than the diameter of the upper or body portion of the cup rubber so that the top or back of the cup rubber bears partially on the bottom of the cone and partially against the expansible backup ring. With this arrangement, when pressure is applied to the lower or forward face of the cup rubber as illustrated in Fig. 2, this pressure being effective on the entire under-surface of the cup rubber is transmitted by the cup rubber to the cone 32 as well as against the segments of the backup ring, forcing the cone upwardly and causing the segments of the expansible backup ring to be expanded thereby into a position as shown in Fig. 3. Therein, the lower or flange portions 26 of the segments are forced into direct engagement with the interior of the tubing so that even though the pressure applied to the cup rubber is quite high there is no danger of the rubber being forced between the expansible backup ring and the interior of the tubing. When pressure is released at the conclusion of a test on a given stand of tubing the tension springs 30 are effective to urge the segments to collapse or contract, thus forcing the cone 32 downwardly and returning the cup rubber to the position shown in Fig. 2.

In the course of moving the apparatus within the tubing from one location to another, if the bottom of the skirt 21 should encounter a shoulder on the interior of the tubing, such as that afforded by an exposed end of tubing at a joint, the skirt under these circumstances will merely be compressed between the shoulder and the backup ring and its pressure will be transmitted directly to the under faces of the flange portions 26 of the segments of the backup ring. Very little, if any, pressure would be transmitted by the cup rubber under these circumstances to the cone 32. This is because the portions of the backup ring which are outwardly of the cone 32 are more nearly in direct alignment with the bottom of the skirt 21. The outer portion of the cup rubber that is compressed between the shoulder and the backup ring may become highly compressed but the inner or hub portion of the cup rubber which is below the cone 32 will not be greatly compressed and may merely bend or give with respect to the outer portion of the cup rubber. Consequently, when the skirt of the cup rubber merely engages an obstruction, such as above described it does not involve an upward movement of the cone 32 or the expansion of the backup ring. It is only when fluid pressure is applied to the forward or lower face of the cup rubber which is effective not only on the skirt but also on the hub portion of the cup rubber that the cone 32 is urged upwardly and causes the expansible backup ring to expand.

While the invention has been particularly described with relation to the upper cup rubber which forms the upper barrier 11, it will be readily appreciated that the same structure is incorporated in the apparatus at the bottom of the rod 10 to form the lower barriers 12. In the case of the lower barrier, the structure illustrated in Figs. 2 and 3 is merely inverted from the position shown; otherwise the structure and operation are the same as above described. While two cup rubbers and their expansible backup rings are shown as making the lower barrier 12 there are many situations where only a single cup rubber and expansible backup ring will suffice.

From the above-described construction it will be appreciated that as the expansible backup ring is caused to expand when pressure is effective on the cup rubber and that it expands into engagement with the tubing, destruction or severe wear on the cup rubber is effectively prevented inasmuch as the backup ring prevents the cup rubber from being squeezed into the clearance space that must be left between the backup ring and the interior of the tubing to enable the apparatus to be easily positioned in the tubing. When the pressure is applied the backup ring expands and thus forms a complete backup for the cup rubber. On the other hand, during the moving of the apparatus from one location to another, if the skirt of the cup rubber encounters an obstruction this does not involve an expansion of the backup ring.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. Means for forming a seal between a rod-like article and a surrounding cylindrical wall comprising a cup rubber on the rod-like article peripherally engageable with the wall, an expansible backup ring held against axial movement relative to the rod-like article adapted to be expanded into engagement with the wall, said expansible backup ring being in engagement with the outer portions of the back of the cup rubber, and a cone expander between the inner portion of the back of the cup rubber and the expansible backup ring whereby if pressure is applied to the forward face of the cup rubber the cone expander will cause the backup ring to expand into engagement with the cylindrical wall.

2. Means for forming a seal between a rod-like article and a surrounding cylindrical wall comprising a cup rub-

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ber on the rod-like article peripherally engageable with the wall, an expansible backup ring held against axial movement relative to the rod-like article adapted to be expanded into engagement with the wall, said expansible backup ring being in engagement with the outer portion of the back of the cup rubber, and a cone expander between the inner portion of the base of the cup rubber and the expansible backup ring whereby if pressure is applied to the forward face of the cup rubber the cone expander will cause the backup ring to expand into engagement with the cylindrical wall, the cup rubber having a flared skirt and engaging the cone and also the expansible backup ring whereby it is only when pressure is applied to the forward face of the cup rubber that the cone expander will cause the backup ring to expand and expansion of the backup ring will not take place if the skirt on the cup rubber engages an obstruction on the cylindrical wall.

3. Means for forming a seal between a rod-like article and a surrounding cylindrical wall comprising a cup rubber on the rod-like article peripherally engageable with the wall, an expansible backup ring held against axial movement relative to the rod-like article adapted to be expanded into engagement with the wall, said expansible backup ring being formed of segments, spring means urging said segments into contracted positions around the rod-like article, the expansible backup ring being in engagement with the outer portion of the back of the cup rubber, and a cone expander between the inner portion of the back of the cup rubber and the expansible backup

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ring whereby when pressure is applied to the cup rubber the cone expander will expand the segments of the backup ring into engagement with the cylindrical wall.

4. Means for forming a seal between a rod-like article and a surrounding cylindrical wall comprising a cup rubber on the rod-like article peripherally engageable with the wall, an expansible backup ring held against axial movement relative to the rod-like article adapted to be expanded into engagement with the wall, said expansible backup ring being formed of segments, spring means urging said segments into contracted positions around the rod-like article, the expansible backup ring being in engagement with the outer portion of the back of the cup rubber, and a cone expander between the inner portion of the back of the cup rubber and the expansible backup ring whereby when pressure is applied to the cup rubber the cone expander will expand the segments of the backup ring into engagement with the cylindrical wall, each of the segments of the backup ring having a laterally extending portion extending over an adjoining segment whereby the overlapping relationship will be retained even though the segments are expanded.

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