June 3, 1941 J. E. MOE 2,244,076

CONTROL HEAD PACKER

Filed March 25, 1940

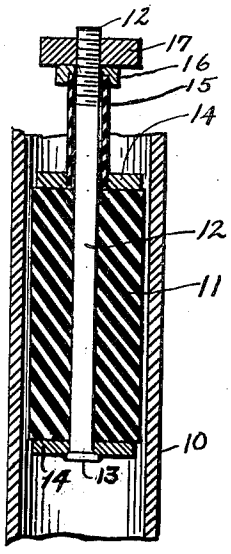

FIG. 1

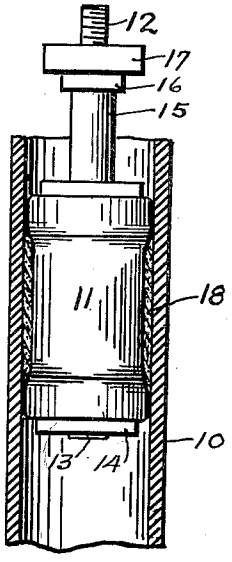

FIG. 2

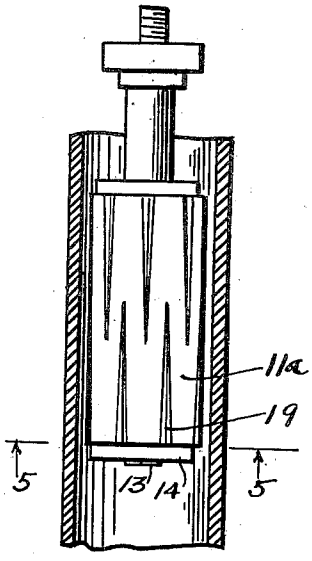

FIG. 3

FIG. 9

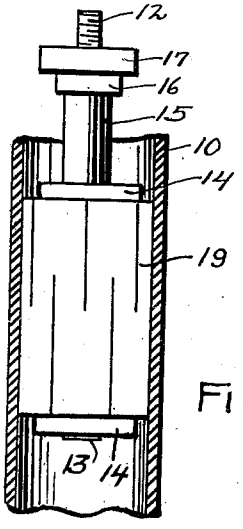

FIG. 4

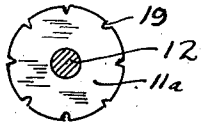

FIG. 5

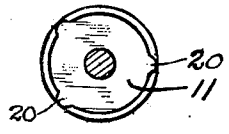

FIG. 6

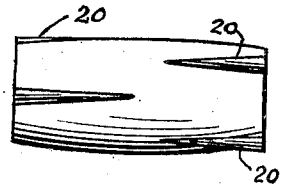

FIG. 7

FIG. 8

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CONTROL HEAD PACKER

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Application March 25, 1940, Serial No. 325,666

7 Claims. (Cl. 166—13)

This invention relates to improvements in control head packers for oil wells.

In the course of drilling and operating oil wells, it frequently becomes desirable to block off certain regions of the well from other regions, and for this purpose a device normally referred to as a packer or a control head packer is employed.

Oil wells are usually lined with an iron pipe or casing that extends to bedrock and sometimes to the very bottom of the well. If, for any reason, it is desirable to close the well, a packer is inserted into the casing or into the uncased hole of the well, as the case may be, to the point where the well is to be blocked. The packer is so constructed that it can be expanded to such a diameter that its outer surface will firmly contact the inner surface of the well casing or the well wall. Such packers are often subjected to powerful forces, and it is therefore necessary that they grip the wall of the casing firmly in order to resist such forces.

The usual construction of control head packers comprises a cylindrical tubular rubber member clamped between end plates and embodied in a mechanism that permits the cylindrical member to be compressed endwise after it has been lowered into the well. By compressing a yieldable rubber cylinder endwise it will increase in diameter and by choosing the proper diameter with respect to the casing, such a cylinder can be forced into contact with the casing wall and will remain quite firmly positioned therein until the endwise pressure is released.

It has been found that control head packers of the ordinary construction are open to criticism for several reasons, the most important of which is that they trap mud and colloidal matter between the outer wall of the rubber packer and the inner surface of the casing and permit only the ends of the rubber packer member to engage the casing. Tests have shown that a cylindrical rubber member compressed endwise expands faster at the ends than at the middle, and therefore it always has a tendency to trap mud, slime or colloidal matter as explained above.

It is the object of this invention to produce an improved packer construction in which the entire surface of the rubber packer can be forced into sealing engagement with the inner surface of the casing and thus obtain a holding and sealing effect due to the entire area of the packer surface.

The above and other objects that may become apparent as this description proceeds are attained by means of a construction and an arrangement of parts that will now be described in detail, and for this purpose reference will be had to the accompanying drawing in which the invention has been illustrated, and in which:

Figure 1 is a diametrical section through a casing and through a packer of the ordinary construction, the packer being shown in uncompressed condition;

Figure 2 is a view showing the casing in section and showing the packer in elevation and subjected to endwise compression;

Figure 3 is a view similar to that shown in Figure 2, but shows the improved construction of the packer, the latter having been shown in elevation and in uncompressed condition;

Figure 4 is a view showing the packer illustrated in Figure 3 as it appears after it has been compressed endwise;

Figure 5 is a section taken on line 5—5, Figure 3;

Figure 6 is a section similar to that shown in Figure 5, but shows a slightly modified form of construction;

Figure 7 is a side elevation of the modified packer construction illustrated in Figure 6;

Figure 8 is a side elevation showing a slightly modified form of packer; and

Figure 9 is a view partly in section showing another modification.

In the drawing reference numeral 10 designates the casing of an oil well; positioned in the casing is a packer comprising a rubber cylinder 11 which has an axial opening for the reception of a tension member 12. The lower end of member 12 has an enlarged head 13, and resting against this head is a circular plate 14 of slightly smaller diameter than the interior of the casing. A tubular compression member 15 is attached at one end to a plate 14 of the same size and shape as the one shown at the bottom of the packer member. A thrust washer 16 rests on the upper end of pipe 15 and tension member 12 extends through 16 and is provided with a nut 17, which is threadedly engaged therewith. It may be explained here that the specific construction shown is illustrative only of means for compressing the rubber packer member 11. Although the means illustrated is quite suitable for the purpose under consideration, other equivalent means may be employed.

The inner surface of the well casing is nearly always covered with slime and colloidal matter and therefore whenever the packer member 11 is expanded it will first contact this slimy coating.

Let us now assume that a packer constructed as shown in Figure 1 is subjected to compression by turning the nut 17 on the tension member 12. As soon as pressure is applied to the ends of the rubber cylinder, it begins to shorten and simultaneously therewith, to increase its diameter. The cylinder increases its diameter faster near the ends than at the middle, and as soon as the ends come into sealing contact with the inner surface of the casing, they prevent further escape of the mud, slime or colloidal matter 18, which thus becomes trapped in the manner evident from Figure 2. The application of any amount of force will not permit the escape of this trapped slime. It therefore becomes apparent that only a comparatively short zone at each end of the packer comes into actual contact with the inner surface of the casing. The trapped slime, being liquid, does not have any appreciable frictional coefficient and the efficiency of the packer as a means for resisting unbalanced pressure is therefore greatly reduced as compared to its resistance in case the entire surface were in contact with the casing.

It is evident that if passages are provided in the ends of the cylinder 11 in such a way that they will remain open until the center of the packer has expanded into contact with the casing wall, the mud and slime will escape through such openings, thereby permitting the entire surface of the rubber packer to become effective.

In Figures 3, 4 and 5 a construction has been shown in which the rubber cylinder 11*a*, which may be of the same size as cylinder 11, has been provided with grooves or channels 19 that extend from a point adjacent its middle to the ends. In the drawing, the channels have been shown as tapering towards the center and slightly overlapping. The channels do not necessarily have to overlap and may even stop short of the middle of the packer if desired; however, the overlapping construction is believed to have some desirable properties. The grooves 19 are preferably V-shaped, although not necessarily so.

Let us now assume that a packer provided with grooves or passages 19 is compressed in the same manner as described in connection with Figures 1 and 2. The ends of the packer will begin to expand faster than the middle portion thereof until the outer surface engages the inner surface of the casing, whereupon further expansion cannot take place. By further compressing the packer, the central portion will tend to expand and due to the fact that the slime or mud can escape through the channels, the center will continue to expand until it comes into actual contact with the inner surface of the casing. After the mud and slime have been expelled, the application of further force closes the grooves or channels 19 so as to form a sealing contact that is continuous and coextensive with the outer surface of the packer.

It has been found that when packers are allowed to remain in position for a long time, the surface of the packer and the surface of the casing will adhere quite strongly with the result that even after the compressive strains have been removed, it is difficult to remove the packer from the casing.

In order to provide a packer in which the compressive strains will serve to release the packer from the casing wall, a slightly modified construction has been shown in Figures 6 and 7 from which it will be seen that the packer tapers from the middle towards both ends and in which grooves 19 have been replaced by outwardly extending ribs 20 which are offset and which may be slightly less in length than half the length of the packer or which may overlap as shown in Figure 3. When a packer of this construction is used the enlarged ends of the tapering ribs will first engage the inner surface of the casing, but will resist a movement of the intermediate surface into engagement until after the slime and mud have been forced out, and thereafter upon the application of sufficient compressive forces, the ribs will flatten so as to permit the entire surface of the packer to contact with the casing. When the compressive strains are released, the forces exerted by the compressed ribs will tend to release the packer from the casing and thereby facilitates the operation of removing the packer.

Instead of longitudinally extending ribs or grooves, it is possible to provide the packer with a plurality of helically extending grooves or ribs in the manner indicated diagrammatically in Figure 8.

In Figure 9 a slightly modified form has been shown which is similar to that shown in Figure 7, but in which the ribs 20 have been omitted, leaving a packer body with a smooth surface that tapers towards the ends. In the embodiment illustrated, the surface has been tapered along curved lines, but the surface may comprise two frusto-conical surfaces tapering from the middle of the packer. When such a member is compressed, the middle, which is nearer to the casing then the ends, will contact with the casing first because, although the ends expand faster than the middle, the middle does expand and after a seal has been formed at the middle, the further compression of the resilient packer member will gradually move the surface of the packer into contact with the casing progressively from the middle towards the ends, thereby permitting the escape of slime and mud as above outlined.

The underlying principle of this invention is to produce a packer that can be forced into sealing contact with a casing without trapping slime or colloids, as always happens with packers of the type shown in Figures 1 and 2.

Where ribs 20 are employed, the outer edges of such ribs should preferably not extend beyond the outer surface of the middle of the packer. As above specified, the function of the ribs 20 is merely to assist in releasing the packer from the casing.

Since escape passages may be formed by using ribs as well as grooves, it is understood that applicant does not intend to be limited to either.

Instead of natural rubber, synthetic rubber, such as Neoprene, Duprene or Buna may be used, and therefore, whenever the term "rubber" is used, it should be construed to include both natural and artificial rubber.

From the above description it will be apparent that by the simple expedient of changing the shape of an ordinary cylindrical rubber packer, either by tapering it from the middle towards both ends, or making it frusto-conical throughout, its entire length, or by providing the surface with grooves or ribs, the objectionable feature which is inherent in the smooth surfaced cylindrical packers, namely, that of entrapping slime, is overcome, with the result that the packer will come into contact over substantially its entire surface with the inner surface of the casing and will thus be anchored more firmly to the lat-

ter and form a better and more reliable closure than a packer having a cylindrical shape and a smooth outer surface.

It will be noted that where the packer is provided with grooves 19 that taper from the ends inwardly, the cross sectional area of the packer decreases towards the end and this is also true with the construction shown in Figures 6, 7 and 9.

Having described the invention what is claimed as new is:

1. A packer element for use in a control head packer, comprising a tubular cylindrical member of yieldable resilient rubber composition whose outer surface is provided with alternate depressions and elevations arranged to form continuous passageways extending inwardly from the ends towards the middle whereby when the packer element is inserted into a casing and compressed in the direction of its length, it will expand and bring the elevations on its surface into engagement with the casing first whereby channels are formed for the escape of trapped material.

2. As an article of manufacture, a packer element made from yieldable resilient rubber composition, said element being of elongated cylindrical tubular form and provided on its outer surface with grooves extending from points near its middle to the ends thereof, whereby passages are formed for the escape of material trapped when the element is expanded by longitudinal compression while positioned in a casing or the like.

3. A device in accordance with claim 2 in which the cross sectional areas of the grooves decreases from the ends inwardly towards the middle of the element.

4. As an article of manufacture, a tubular cylindrical packer element of resilient yieldable material having rubber-like properties, the outer surface of the element having spaced ridges extending from its ends to points near the middle, for contacting the inner surface of a casing when the element is positioned therein and expanded by longitudinal compression.

5. A device in accordance with claim 4 in which the cross sectional areas of the ridges decreases from the ends towards the middle of the element.

6. A packer element for use in a control head packer, comprising an elongated tubular element of rubber, the outer surface having alternate depressions and elevations forming continuous passageways from the ends towards the middle, whereby when the element is introduced into a casing and subjected to longitudinal compression, it will expand and engage the casing, first bringing the elevated portions into engagement with the casing while passages are available for the escape of flowable material from about the middle of the element.

7. A well packer for insertion into a casing comprising, in combination, a tension member having an abutment, an elongated cylindrical tubular packer element of yieldable resilient rubber composition positioned on the tension member with one end in engagement with the abutment, an annular abutment positioned in contact with the other end, the surfaces on said abutments engaging the ends of said tubular packer element being flat surfaces, and means for urging the abutments towards each other whereby the packer element will be shortened and increased in diameter, the cross sectional areas of the packer element decreasing progressively from one point in its length whereby that portion having the greatest cross sectional area will engage the inner surface of a casing first and thereafter the next smaller areas, whereby the sealing action will proceed progressively from the point of greatest cross sectional area to the point of smallest cross sectional area, whereby mud or slime will be progressively forced outwardly thereby permitting all portions of the packer element surface to come into direct contact with the casing.

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