Oct. 1, 1940. L. SPENCER 2,216,358

WELL PACKER

Filed Dec. 24, 1938

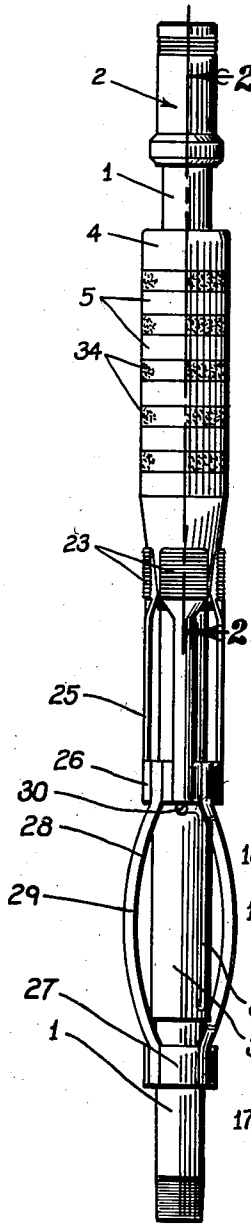


FIG. 1

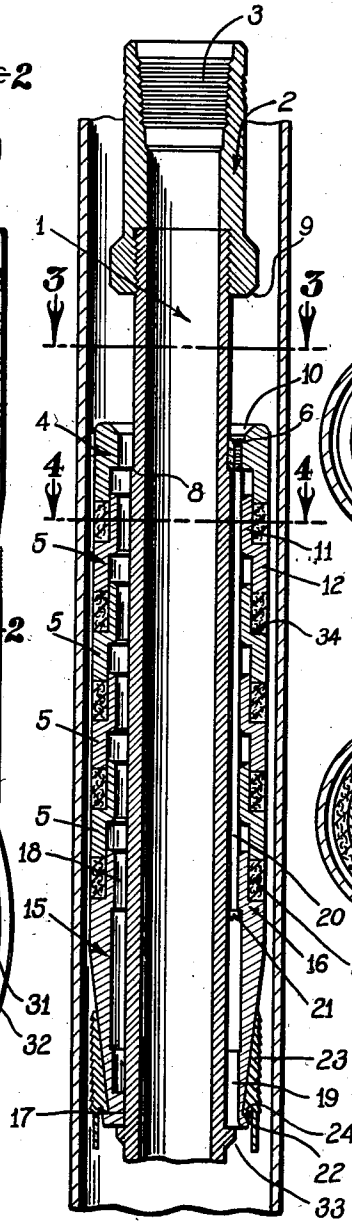


FIG. 2

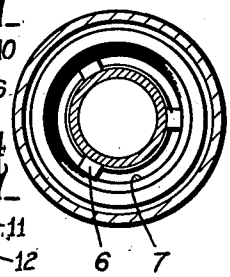


FIG. 3

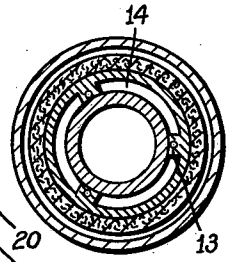


FIG. 4

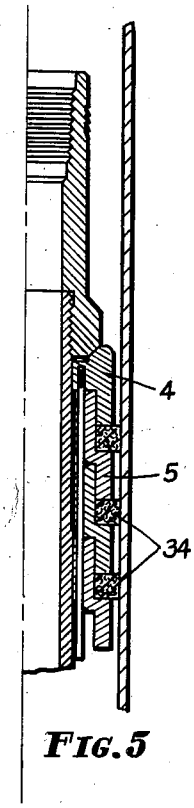


FIG. 5

INVENTOR

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Patented Oct. 1, 1940

2,216,358

UNITED STATES PATENT OFFICE

2,216,358

WELL PACKER

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Application December 24, 1938, Serial No. 247,597

7 Claims. (Cl. 166—12)

My invention relates to well packers, that is, to devices adapted to be lowered on a tubing or casing string and manipulated to form a sealed connection between such string and a surrounding casing, to prevent or control flow of fluid between such a string and the casing. Among the objects of my invention are:

First, to provide a well packer of the multiple ring type wherein a plurality of independent sealing connections are provided between the packer and well casing in which it fits;

Second, to provide a well packer of this type wherein, for a given outside diameter, a maximum internal diameter is provided;

Third, to provide a well packer of this type which is particularly adapted for use in conjunction with formation testing apparatus or swabbing tools, in that the internal diameter need not be less than the tubing to which it is attached;

Fourth, to provide a packer of this type which, although having a large internal diameter, is provided with a passageway of large area between its mandrel or body and the packing element so that in lowering or raising the packer, fluid present between the tubing string and surrounding casing may flow freely through the packer, thereby eliminating any swabbing action;

Fifth, to provide a packer which incorporates a novel packing ring support and spacer element; and

Sixth, to provide a packer of this character wherein, when the packer is in position for ascent or descent, the packing elements and their spacers are held in their extended relation so as to insure adequate clearance around the outside of the packer.

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

Figure 1 is an elevational view of my packer;

Figure 2 is an enlarged fragmentary, sectional view thereof, taken through 2—2 of Figure 1, showing the packer in position in a casing, the parts being in the relationship assumed when the packer is free to be lowered or raised;

Figures 3 and 4 are transverse sectional views thereof, through 3—3 and 4—4, respectively, of Figure 2; and

Figure 5 is a fragmentary longitudinal, sectional view similar to Figure 2, but showing the parts of the packer in the positions assumed when the packer is set.

My packer incorporates a central mandrel or body 1 having an internal diameter equal, preferably, to the diameter of the tubing or casing from which it is suspended, not shown. The upper end of the mandrel 1 is screwthreaded into a top collar or head 2, the upper end of which is provided with an internal pipe thread 3 for attachment to a tubing string or casing string. Surrounding the mandrel below the top collar 2 is an upper spacing ring or collar 4 and a series of intermediate spacing rings 5. The upper spacing ring 4 is provided with inwardly directed spacing lugs 6 which bear against the mandrel 1 and define therebetween passages 7 whereby fluid may flow between the spacer ring 4 and the mandrel 1. Downward movement of the ring or collar 4 is limited by a shoulder 8 provided on the mandrel, while upward movement is limited by the top collar 2. The top collar 2 is provided with a valve face 9 and the upper, inner corner of the ring 4 is provided with a complementary seat 10 so that when the collar 2 is in its lower position it forms a fluid-tight seal with the upper ring 4, as shown best in Figure 5.

Each intermediate spacer ring or collar 5 comprises a minor diameter portion 11 and a major diameter portion 12. The minor diameter portion of each ring 5 telescopes within the major diameter portion of an adjacent ring. The lower end of the upper spacer ring 4 has an internal diameter equal to the major diameter portions of the intermediate rings so that the adjacent intermediate ring telescopes therein.

Projecting inwardly from the inner surface of the minor diameter portion of each intermediate spacer ring 5 there are provided spacer lugs 13 corresponding to the lugs 16, defining passages 14 therebetween.

Below the spacer rings the mandrel 1 receives a slip expansion cone or collar 15. This member is in the form of a sleeve or ring having a normal internal diameter approximating that of the spacer rings and provided with spacer lugs 16 and 17 at its upper and lower ends, respectively, to form therebetween passages 18 and 19. The spacer lugs 16, as well as lugs 13, are provided with holes therein, while spacer lugs 6 are tapped. Elongated bolts 20 extend upwardly through the several spacer lugs and screwthread into the lugs of the top spacer ring. The heads 21 of said bolts are movable within the cone 15 between its spacer lugs 16 and 17 as the spacer rings telescope.

The outer surface of the collar 15 is conical, to form a downwardly converging wedge, and its lower end terminates in an external latching flange 22. The cone or collar 15 receives a plu-

rality of slips 23 having latching lugs 24 therein adapted to engage the flange 22 when the slips are in their lower or retracted position, as shown in Figures 1 and 2. The slips 23 are connected by reins 25 to a collar 26 which, with a collar 27 and bow spring 28 therebetween, forms a guide cage 29 tending to center the mandrel 1 and form a frictional connection between the packer and the surrounding casing to urge the slip 23 upwardly. Such upward movement, however, is prevented by a pin 30 extending from the mandrel into a bayonet slot 31 provided in a sleeve 32 depending from the collar 26. Normally the pin 30 is in a laterally directed portion of the slot 31 so that the cage and slip cannot move relative to the mandrel. Also, the mandrel is provided with a shoulder 33 upon which the cone 15 rests when the several rings 5 are in their extended position, and ring 4 is resting on the shoulder 8.

Each minor diameter portion 11 of the spacer rings 5, as well as the upper portion of the cone 15 which is reduced in diameter and formed similarly to said minor diameter portions, receives a packing ring 34 which is formed of bias fabric, fabric and rubber or rubber substitute, or other flexible or distortible material.

Operation of my packer is as follows: The packer is run into the casing on a tubing string or casing string with the parts as shown in the position illustrated in Figures 1 and 2, that is, the several packing rings and their spacer rings are in the extended position illustrated and the top collar 2 is raised above the top ring 4, so that there is a continuous passage between the several spacer lugs from the top of the packer down through the cone 15. Of course, additional passageway is provided between the packer and the casing; however, it is preferred that this space be as small as possible in order that the packing rings will not be required to expand greatly. Furthermore, it is preferred that the several spacer rings and cone be slightly larger in diameter than the packing rings so that these members, and not the packing rings, are subjected to wear as the packer is lowered into the well. It should be noted that substantial wearing area is provided by the upper spacer ring 4 and the cone 15 so that the top collar 2 need not provide a wearing surface and may be made smaller in its major diameter to provide ample clearance.

When the packer has been lowered to the desired point the mandrel is rotated while the cage, by its engagement with the casing, holds the sleeve 32 so that the pin 30 lines up with the vertical portion of the slot 31 whereby, upon downward movement of mandrel 1 and tubing string, the cone 15 forces the slips 23 against the casing to secure the cone in place. The slip and cone construction in this respect is conventional. It should be noted that in the initial movement of the mandrel 1 the top collar 2 moves downwardly into engagement with the spacer ring 4 and the force necessary to urge the cone between the slips is transmitted through the series of spacer rings and packer rings. Thus, with one movement the cone is locked into position and the several packing rings expanded by the telescopic movement of the several spacer rings into engagement with the casing, as shown in Figure 5. It is desired that the distortion or expansion of the packer rings be confined within reasonable limits, and this is accomplished by permitting the minor diameter portions 11 to abut the internal shoulder of the adjacent spacer rings, as shown in Figure 5. Actually such abutment between spacer rings only occurs in the event a packer ring is damaged or is positioned opposite a collar, in which case the other rings insure proper sealing.

When it is desired to remove the packer it is merely necessary to pull upwardly on the tubing string while giving the tubing string a torque in the direction which will cause the pin 30 to move into the lateral portion of the slot 31. The first upward movement of the mandrel causes the shoulder 8 to engage the top spacer ring 4, thus positively lifting this ring and at the same time the slips 23, on engaging the latch flange 22, pull downwardly on the cone 15 and the frictional movement against the several packing elements tends to free and distribute the intermediate spacer rings 5 between the top ring 4 and cone so that they again assume the position shown in Figure 2.

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

I claim:

1. A well packer including: a mandrel; a plurality of spacer rings slidably mounted on said mandrel, said spacer rings having relatively telescoping minor and major diametered cylindrical portions each of constant diameter and defining external packing ring channels; yieldable packing rings adapted to fit said channels; and means for telescoping said spacer rings to cause axial compression and radial expansion of said packing rings.

2. A packer as specified in claim 1 wherein said spacer rings are spaced from said mandrel to form therewith a circulation passage and a valve means incorporating an enlargement on said mandrel and one of said spacer rings controls said passage.

3. A well packer including: a mandrel; a plurality of spacer rings slidably mounted upon and spaced from said mandrel to define therewith a fluid passage, said spacer rings being relatively telescoping and defining between the several rings contractable channels; tie means limiting relative extension of the several spacer rings and maintaining the rings in telescopic relation; and yieldable, resilient packing elements fitting the several channels whereby, upon telescoping of said spacer rings, said packing elements compress axially and expand radially.

4. A well packer comprising: a mandrel; a plurality of collar elements slidably mounted on said mandrel and relative to each other and the intermediate of said collar elements having relatively telescoping major and minor diametered portions which define external packing ring channels of variable widths; means spacing said collar elements from said mandrel to form a circulation passage between the collar elements and mandrel; means for maintaining said collar elements in overlapping telescopic relation at all times whereby said packing ring channels are at all times separated from said circulation passage; and expansible packing rings fitting said channels and protected by said collar elements from the flow of fluid through said circulation passage.

5. A well packer comprising: a mandrel; a plurality of collar elements each of which has a major diametered portion and a minor diametered portion, said major portion telescoping over said minor portion, means maintaining said collar ele-

ments in telescoping relation at all times to define a continuous wall; spacer means for mounting said collar elements in axially slidable, radially spaced relation with said mandrel, whereby said wall and mandrel define a circulation passage; and expansible packing rings mounted between the major diametered portions of said collar elements and isolated from said circulation passage.

6. A well packer comprising: a mandrel; a packing assembly comprising a plurality of alternate spacer rings and packing rings of cylindrical form, each spacer ring including an offset, axially directed guard sleeve extending within an adjacent packing ring and telescoping with said adjacent spacer ring to isolate the packing rings from the interior of the packing assembly; and means spacing the packing assembly from said mandrel to form therebetween a circulation passage.

7. In a circulation packer having a hollow mandrel in communication with a tubing string from which the packer is suspended and having a packing assembly slidably mounted on and spaced from the mandrel to form a circulation passage, there being a valve means for closing said circulation passage when said packer is set, the combination of: a plurality of packing units comprising said packing assembly, each packing unit including a spacer collar having cylindrical major and minor diametered portions; and a cylindrical packing ring adapted to fit over said minor diametered portion and abut one end of said major diametered portion, said minor diametered portion extending axially beyond said packing ring and adapted to telescope within the major diametered portion of an adjacent spacer collar.

LLOYD SPENCER.