

Sept. 15, 1942.

R. C. BAKER

2,295,770

PACKING DEVICE

Filed Jan. 15, 1941

2 Sheets-Sheet 1

*Fig. 1.*

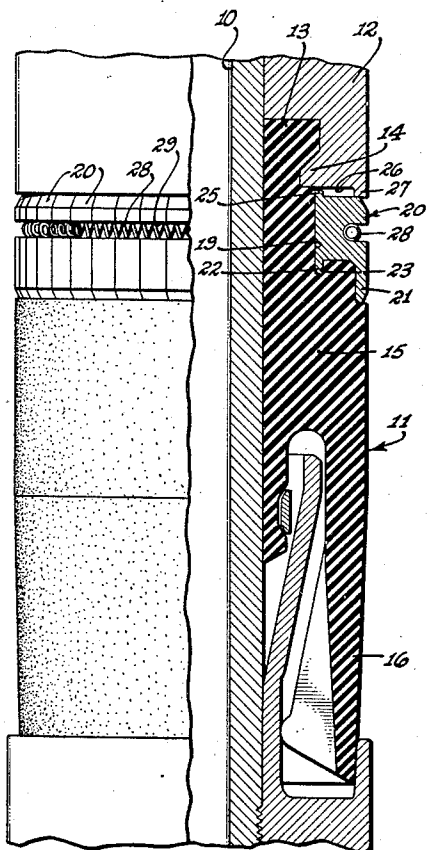
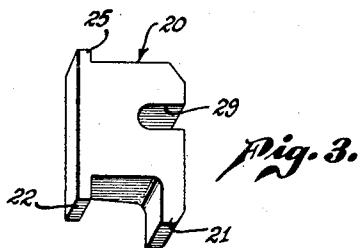
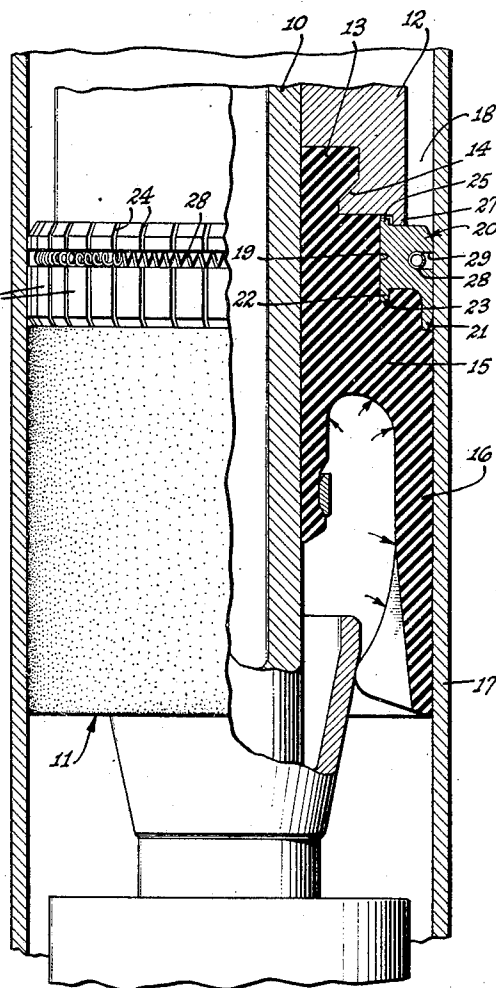


*Fig. 2.*



INVENTOR:  
REUBEN C. BAKER,  
BY Oscar A. Mellin  
ATTORNEYS.

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*Fig. 4.*

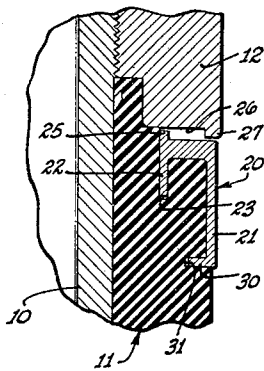


*Fig. 5.*

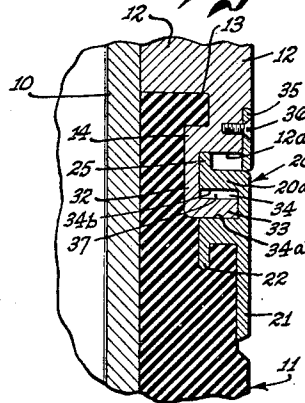


*Fig. 6.*

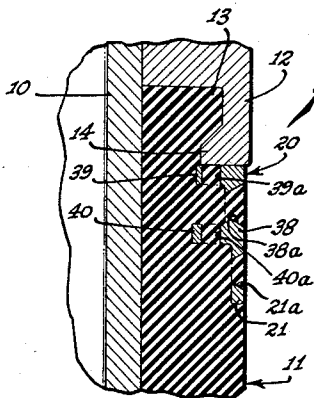


*Fig. 7.*

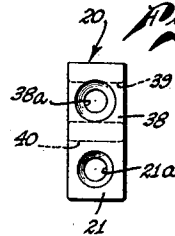


*Fig. 8.*

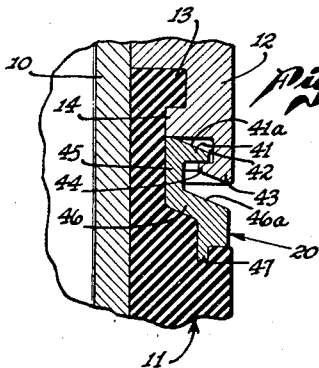
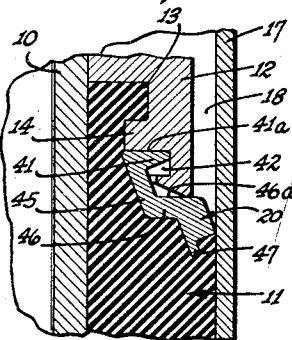


*Fig. 9.*



INVENTOR:  
REUBEN C. BAKER,

BY  
Oscar A. Mellin  
ATTORNEYS.

## UNITED STATES PATENT OFFICE

2,295,770

## PACKING DEVICE

Reuben C. Baker, Coalinga, Calif., assignor to  
Baker Oil Tools, Inc., Vernon, Calif., a corpora-  
tion of California

Application January 15, 1941, Serial No. 374,471

15 Claims. (Cl. 166—10)

This invention relates to packings of the flexible and pliable type, and particularly to packings whose supporting members have material clearance with the walls of a confining enclosure. An example of this arrangement is a well packer movable through a string of casing to a point at which it is to be set and its packing member sealed off against the casing.

This application is a continuation-in-part of my application for "Well packer apparatus," Serial No. 333,491, filed May 6, 1940.

As pointed out in my Patent No. 2,204,648, the substantial clearance that must be allowed between the supporting or retaining member for a pliable packing and the walls of a casing provides an open annulus through which the packing material can flow upon being subjected to high pressures or temperatures within the well casing. Such cold flowing has heretofore been prevented by encircling the packing with a lead ring adjacent its supporting member, the ring being initially spaced inwardly from the packing walls, but capable of being deformed or stretched outwardly by the stress induced in the packing into a position across the annular space and in contact with the walls of the casing, thereby forming a barrier to the flow of the packing material through the annular space.

Lead and similar types of pliable and inelastic materials are effective devices for maintaining the sealing material at the region where it is to perform its sealing function against the casing walls. However, these materials achieve a permanent deformation or set, and remain in engagement with the casing after having been distorted by the rubber or other pliable packing. Their use is therefore limited; and they cannot be used effectively in a well packer of the retrievable type, especially those capable of repeated setting and release without removal from the casing.

It is therefore an object of the present invention to prevent cold flowing of plastic packing material around a well packer without impeding the removability of the packer from a position in which it has been set.

Another object of the invention is to employ a packing flow preventer around the packing, movable into engagement with the casing by the expansion of the packing, and movable from engagement with the casing to its initial position upon contraction of the packing, thus permitting longitudinal movement of the well packer within the casing after it has been set and sealed there-within.

This invention has other objects that will become apparent from a consideration of the embodiments shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, but it is to be understood that such detailed description is not to be taken in a limited sense, since the scope of the invention is best defined by the claims appended hereto.

Referring to the drawings:

Figure 1 is a combined sectional and elevational view of part of a well packer embodying one form of the invention;

Figure 2 is a view similar to Figure 1, with the packing elements in expanded condition;

Figure 3 is a perspective of one of the segments shown in Figures 1 and 2;

Figures 4 and 5 are partial longitudinal sections of two modifications of the invention disclosed in Figures 1 and 2;

Figure 6 is a partial longitudinal section of still another form of the invention;

Figure 7 is a front elevation of one of the segments shown in Figure 6;

Figure 8 is a partial longitudinal section of yet another form of the invention; and

Figure 9 is a view similar to Figure 8 showing the latter's packing elements in expanded condition.

In the drawings, the invention is disclosed as forming part of a well packer, having a supporting body 10 surrounded by a packing 11 of rubber or similar material. This packing can either be fixed with respect to the body or slidable thereon, depending upon the particular use to which it is to be put. In the present instance, its upper end is anchored to a retainer 12 by means of the respective interlocking flanges 13, 14, while below the retainer is its base portion 15 from which depends a skirt 16 adapted to have sealing engagement with the wall of a confining casing 17 in which the well device is to be run.

The large clearance space 18 existing between the retainer and the wall of the casing 17 provides a passage through which the rubber material can flow upon being subjected to the pressure of fluid acting within the skirt portion 16 of the packing, or that due to compression of the packing by mechanical means. This pressure action not only distorts the rubber packing radially into engagement with the wall of the casing, but it also shortens the base portion 15 and tends to move the packing material longitudinally through the annular space 18. If the device is subjected to pressures of a comparatively high order, or if

fairly high well temperatures are encountered, substantially complete dissipation of the packing through the annular space will occur, and this material will accordingly be unavailable for performing its sealing function between the well device and the wall of the casing.

In the present instance, this difficulty is overcome by forming a recess 19 in the exterior of the packing 11 adjacent the retainer. This recess provides a groove in conjunction with the retainer 12, in which is received a plurality of small metallic segments 20, cooperably forming a substantially continuous, expansible, metallic ring. These segments are preferably cut from a steel or other suitable ring whose outer diameter is substantially equal to the inside diameter of the casing in which the well device is to be run, so that upon their expansion into engagement with the casing, they will conform very closely to its curvature.

The outer face of each segment 20 is elongated to provide a depending leg 21 engaging the exterior of the packing material, while each segment is firmly anchored to the packing by an internal leg 22 fitting within an annular groove 23 merging into the packing recess 19. The provision of the inner and outer legs 22, 21 causes the packing material to act on the segments 20 and move them outwardly into engagement with the casing, while the inner leg 22 serves to retract the segments from the casing upon contraction of the packing material from sealing action with the casing wall.

The well device is lowered into the casing with the packing parts 11, 20 in their normal, retracted position, as disclosed in Figure 1. Upon reaching the desired depth, pressure is applied to the packing 11, as by the fluid within the casing below the packing, to expand the packing skirt 16 into engagement with the casing; and if the pressure is high enough, to longitudinally compress and radially expand the base portion 15 of the packing toward the casing wall. This latter movement urges all of the segments 20 radially against the wall of the casing, and positions them across the annular space 18 between the retainer 12 and casing 17, acting as an annular barrier to the plastic flow of the rubber packing material through this space. During this expansion, the segments 20 will move from their initial position in circumferential abutment, shown in Figure 1, into the position disclosed in Figure 2, wherein there is a slight circular space 24 between adjacent segments caused by their radial outward movement. This space is of too small an extent to permit flow of the rubber material therethrough, as borne out by actual repeated tests and field operations of the packing device under pressures of as high as 6,000 lbs. per square inch.

As a precautionary measure, the extent of radial movement of the segments 20 is limited by the provision of an upper lip 25 on each segment fitting within a counterbore 26 formed by a depending annulus 27 at the lower end of the retainer 12. This lip 25 can move freely within the counterbore until it engages the annulus 27, which will prevent any further radial expansion of the segments beyond this point.

Release of the pressure upon the packing 11 will cause it to tend to assume its initial shape, due to its inherent resiliency (Figure 1). In moving to its original position, the packing will correspondingly retract the segments 20 from the casing. This action will be positive because

of the embedding of the inner leg 22 on each segment in the annular packing groove 23. As assurance that the segments will be completely retracted, a small, helical spring 28 can be placed within an external circular groove 29 formed jointly in the segments 20. This spring will not only insure retraction of the segments, but will also tend to cause them to maintain their alignment and be moved uniformly to and from casing engaging position.

It will thus be apparent that effective means has been provided for preventing plastic flow of the rubber material from the desired sealing region without impairing the retrievability of the well device. The packing can be set and released repeatedly, the small segments moving into and out of engagement with the casing between their initially retracted and casing engaging positions.

The modification of the invention shown in Figure 4 is similar in function and operation to the form disclosed in Figures 1 and 2. The main difference resides in confining a large quantity of the packing material within the segments 20 between the depending inner leg 22 and a foot 30 extended inwardly from the outer leg 21 and received within a suitable circumferential groove 31 formed within the packing. With this arrangement, loss of the segments 20 from the rubber is prevented even though the former might tilt upon their expansion to casing engaging position. Release of the expansive force on the rubber packing 11 will allow its retraction and corresponding retraction of the segments 20 due to the large quantity of packing material embraced between their legs 21, 22.

The segment construction disclosed in Figure 5 achieves the same purpose as the arrangement heretofore described. However, the segments 20 shown in Figures 1 and 2 might tilt under the expansive action of the rubber in moving to casing engaging position, rather than moving bodily outwardly to position their exterior faces in contact with the wall of the casing. To prevent this from occurring, the Figure 5 arrangement includes a ring 32 depending from the flange 14 of the retainer 12, from which extends an outwardly directed flange 33 fitting within a pocket or groove 34 formed in the interior of the segment bodies 20a between their upper lip 25 and lower leg 22.

The upper lip 25 is adapted to engage the bottom surface 12a of the retainer, while the lower face 34a of each segment groove 34 is slidable upon the underside of the external flange 33; this arrangement preventing tilting of the segments by guiding them for movement in a plane at right angles to the well packer axis.

The packing rubber 11 is pressed into the retainer 12 until the flanges 13, 14 interlock, and the segments 20 then inserted in place with the lower leg 22 embedded in the rubber 11 and the flange 33 received within the groove 34. After all segments have thus been assembled, a split ring 35 is secured to the retainer 12, as by means of screws 36 threaded into the latter member, to engage the upper lips 25 and limit the radial outward movement of the segments 20, preventing their complete removal from the flange 33. This ring 35 also guides the segments in moving, and prevents their inadvertent removal from assembled position on the flange 33 and rubber 11. It is to be noted that the clearance space 37 between the top of the flange 33 and the upper face 34b of the segment grooves 34 is less than the

length of the upper lip 25; which means that the segments 20 can be forced downwardly until the upper groove face 34b engages the flange 33 without positioning the upper lip 25 low enough to clear the split ring 35; an occurrence which would allow the segments to be forced out of assembled position on the retainer and packing.

In the form disclosed in Figure 6, the segments 20 are molded into the rubber 11. Each segment is constituted by a body portion 38 having inwardly extending spaced arms 39, 40 and a depending leg 21. All of these members are provided with holes 38a, 39a, 40a, 21a through which the rubber material will be forced during the molding operation. The packing material extending between the arms 39, 40 and into the radial hole 38a through the body, and also below the lower arm 40 and in through the radial hole 21a in the leg 21. These holes 38a, 21a can be countersunk to prevent loss of the segments 20 from the rubber, which is also prevented by the rubber material extending through the longitudinal holes 39a, 40a in the arms 39, 40.

The application of expansive force to the packing member 11 will cause its movement radially outward into engagement with the casing, carrying the segments 20 along with it. Upward thrust on the segments is transmitted between the upper surface of the upper arm 39 and the bottom of the retainer 12, which also serves to guide the segments in their movement to and from casing engaging position. Due to the molding or vulcanizing of the segments to the rubber packing, release of the expansive force allows the packing to contract to its initial position and carry the segments 20 away from the casing 17 to their initial positions in which a large running clearance is allowed with the wall of the casing.

Another form of the invention is disclosed in Figures 8 and 9, in which tilttable segments 20 are placed around the rubber 11 adjacent the retainer 12. Each of these segments consists of an outwardly extending arm movable within a counterbore 42 formed by a ring 43 depending from the retainer 12 and terminating in an inwardly directed flange 44 positioned under all of the segment arms 41. Each arm extends from one end of a segment body 45, which has an angular leg 46 whose lower end includes a toe 47 embedded in the rubber packing.

Material clearance is provided between the retainer flange 44 and the body 45 and leg 46 of each segment when the packing is in its initial unexpanded position. Upon application of pressure to the packing 11, its outward expansion will pivot the segments until the inclined upper surfaces 41a on the arms 41 engage the underside of the retainer 12, the extent of outward movement of the segments being determined by such engagement and also by contact between the upper surfaces 46a of the legs 46 with the bottom of the retainer ring 43. It is apparent from an inspection of Figure 9 that when in this expanded position, the segments 20 bridge the clearance space 18 between the retainer 12 and the wall of the casing 17 to prevent flowing of the rubber packing material therethrough. Release of the pressure on the packing 11 will allow it to assume its initial retracted position, and because of the embedding of the toes 47 in the rubber, such retracting movement also positions the segments 20 inwardly away from the casing to their original position.

In all forms of the invention, the same main

purpose is achieved, namely, the prevention of plastic flowing of the packing material through the annular space 18 between the retainer 12 and the wall of the casing 17. The packing is retractable and the well packer transferable to a different position in the casing without impedence by the segments 20, since they will return to a position generally within the circumferential confines of the retainer.

I claim:

1. A packing structure, including a non-metallic packing adapted to engage the wall of a confining enclosure, abutment means at one end of said packing, and a segmental ring encircling and embracing the end of said packing closely adjacent said abutment means, said abutment means having substantial clearance with the wall of said enclosure, the segments of said ring being closely adjacent one another when in retracted position and being movable outwardly by said packing to bridge the clearance space between said abutment means and enclosure, whereby to prevent passage of said packing through said space.

2. A packing structure, including a non-metallic packing adapted to engage the wall of a confining enclosure, abutment means at one end of said packing, and a ring composed of a plurality of small segments encircling and embracing the end of said packing contiguous said abutment means.

3. A well packer, including a non-metallic packing adapted to engage the wall of a casing, abutment means to which said packing is secured, and a ring composed of a plurality of small segments encircling and embracing the end of said packing closely adjacent said abutment means, said segments being closely adjacent one another when in retracted position and being movable outwardly by said packing to bridge the clearance space between said abutment means and casing and movable inwardly from said casing upon retraction of said packing.

4. A packing structure, including a non-metallic packing, means for retaining one end of said packing, and a ring composed of a plurality of small segments embedded in said packing and encircling and embracing the end of said packing contiguous said retaining means, said segments being movable outwardly and inwardly by said packing.

5. A packing structure, including a non-metallic packing adapted to engage the wall of a confining enclosure, abutment means at one end of said packing, said packing being provided with a circumferential recess defining a groove between it and said abutment means, and a ring in said groove composed of a plurality of small segments encircling and embracing said packing to prevent its passage between said abutment means and enclosure.

6. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, means for retaining one end of said packing, and a ring composed of a plurality of small segments encircling and embracing the end of said packing adjacent said retaining means, said segments being movable outwardly by said packing to bridge the clearance space between said retaining means and casing, and means on said retaining means for limiting such outward movement.

7. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, means for retaining one end of said packing, and a ring composed of a plurality of small segments en-

circling and embracing the end of said packing closely adjacent said retaining means, said segments being closely adjacent one another when in retracted position and being translatable bodily outwardly by said packing to bridge the clearance space between said retaining means and casing.

8. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, means for retaining one end of said packing, and a ring composed of a plurality of small segments secured to the end of said packing closely adjacent said retaining means, said segments being movable outwardly by said packing to bridge the clearance space between said retaining means and casing.

9. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, means for retaining one end of said packing, said packing being provided with a circumferential recess defining a groove between it and said retaining means, and a ring in said groove composed of a plurality of small segments secured to said packing, said segments being movable outwardly by said packing to bridge the clearance space between said retaining means and casing.

10. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, abutment means at one end of said packing, and a ring composed of a plurality of small segments encircling and embracing the end of said packing closely adjacent said abutment means, said segments being pivotally carried by said abutment means for tiltable movement outwardly by said packing to bridge the clearance space between said abutment means and casing.

11. In a well packer, a rubber packing adapted to engage the wall of a well casing, means for retaining one end of said packing, said packing being provided with a circumferential recess defining a groove between it and said retaining means, a ring in said groove composed of a plu-

5 rality of small segments movable outwardly by said packing to bridge the clearance space between said retaining means and casing, and a coil spring encircling said segments for retracting them from said casing.

12. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, means for retaining one end of said packing, and a ring composed of a plurality of small segments encircling and embracing the end of said packing closely adjacent said retaining means, said segments having legs embedded in said packing.

13. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, means for retaining one end of said packing, and a ring composed of a plurality of small segments encircling and embracing the end of said packing adjacent said retaining means, said segments having legs embedded in said packing and lips cooperable with said retaining means to limit the outward movement of said segments.

14. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, means for retaining one end of said packing, and a ring composed of a plurality of small segments encircling and embracing the end of said packing adjacent said retaining means, said segments having inner legs secured to said packing and outer legs engaging the periphery of said packing and terminating in inwardly directed feet embedded in said packing.

15. In a well packer, a non-metallic packing adapted to engage the wall of a well casing, means for retaining one end of said packing, and a ring composed of a plurality of small segments encircling and embracing the end of said packing adjacent said retaining means, said segments having inner legs embedded in said packing and outer legs engaging the periphery of said packing.

REUBEN C. BAKER.