Nov. 23, 1954

J. R. BAKER ET AL

2,695,068

PACKING DEVICE

Filed June 1, 1951

3 Sheets-Sheet 1

Fig. 1.

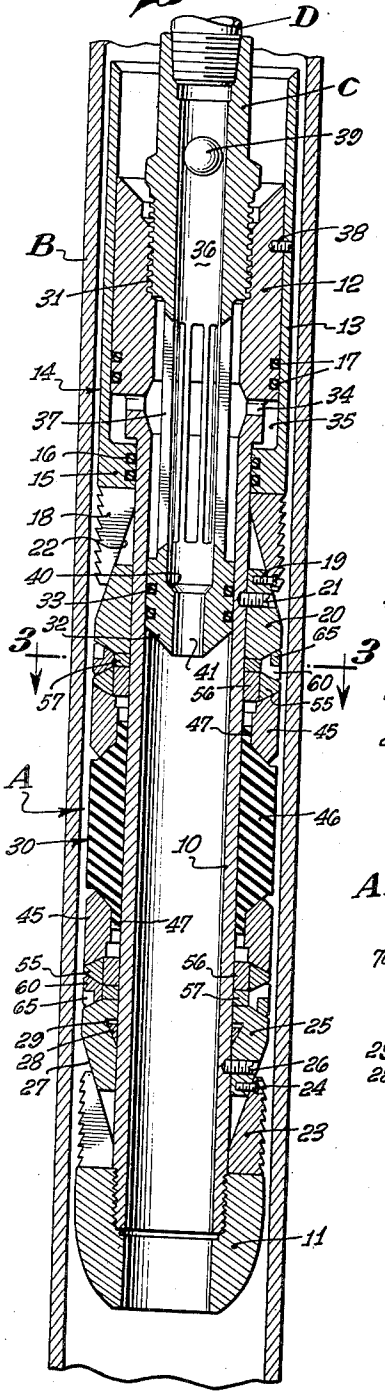


Fig. 2.

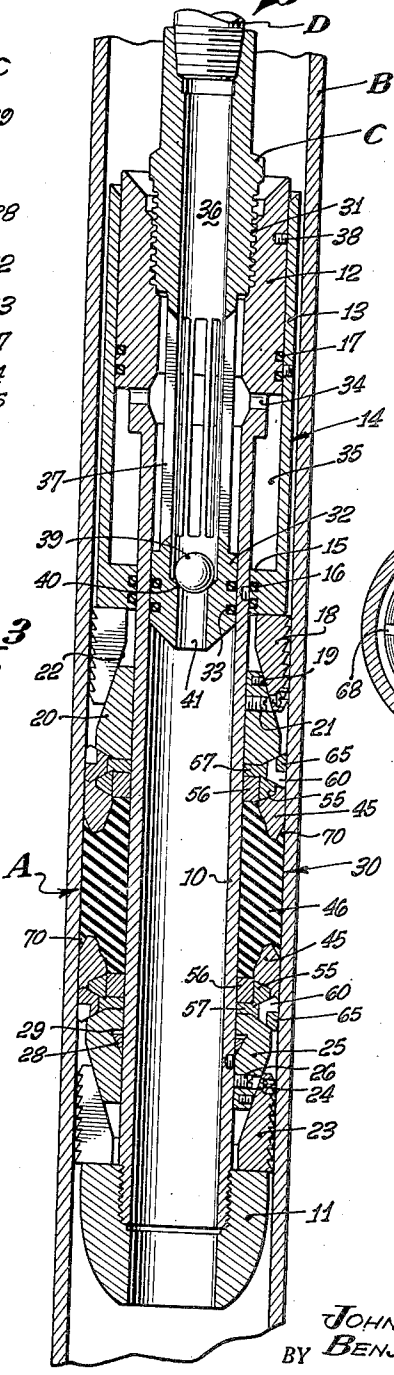
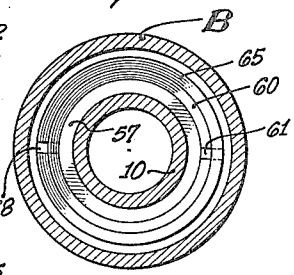


Fig. 3.



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Fig. 4.

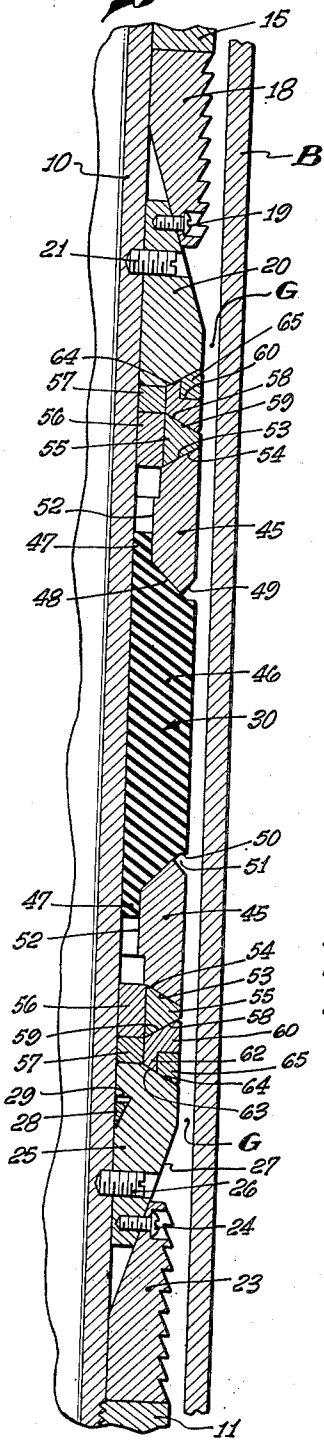


Fig. 5.

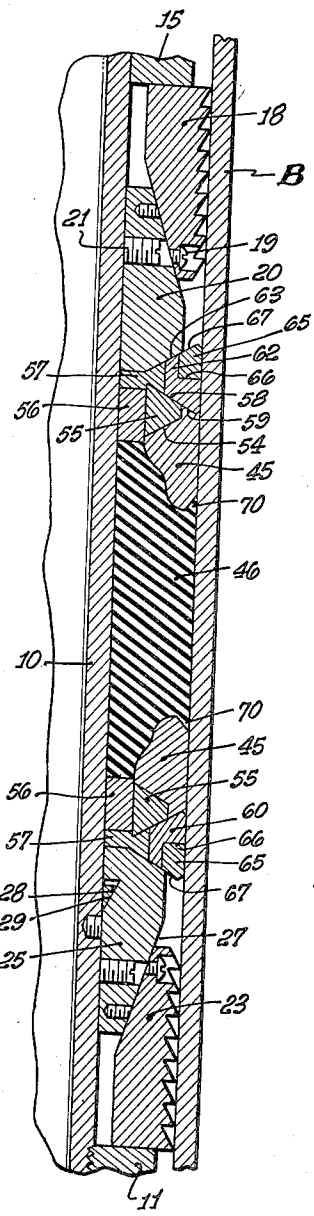
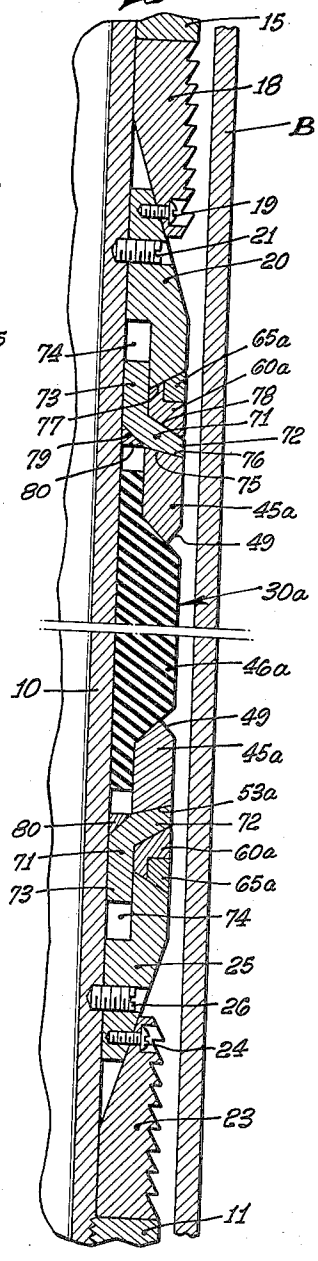


Fig. 6.



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Fig. 7.

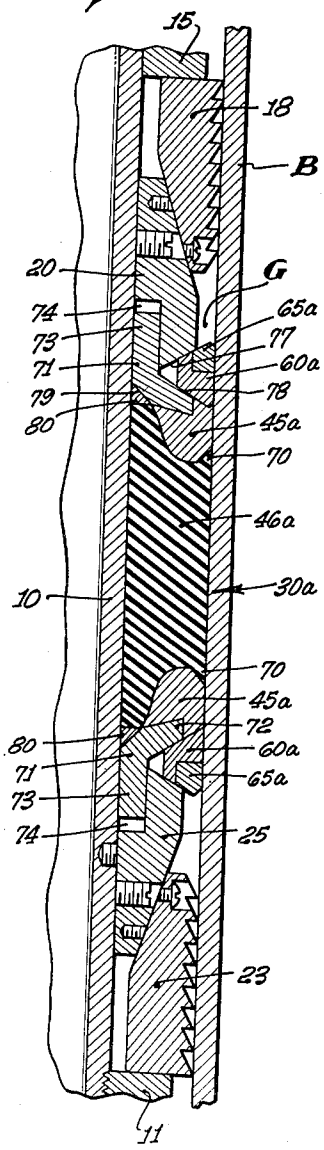


Fig. 8.

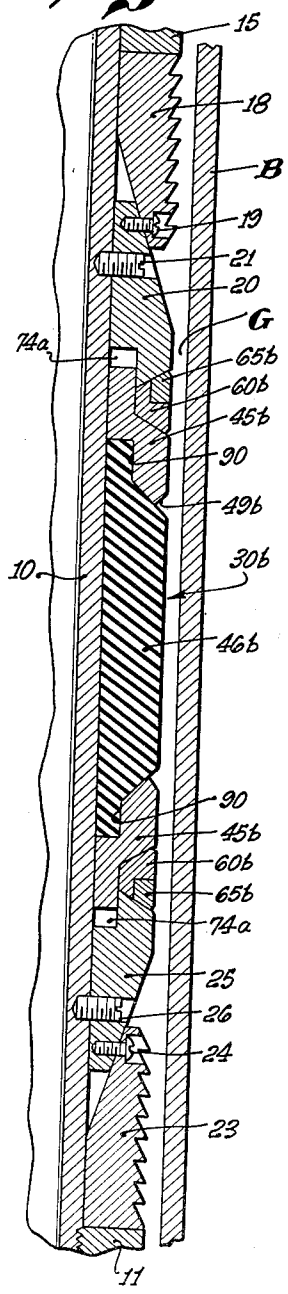
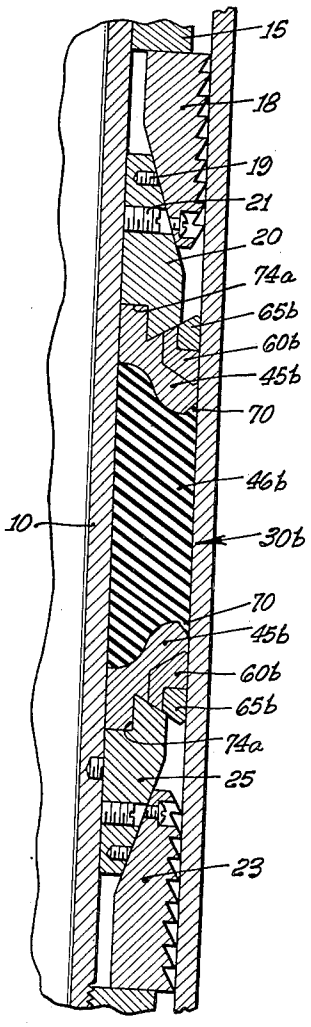


Fig. 9.



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2,695,068

PACKING DEVICE

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Application June 1, 1951, Serial No. 229,352

15 Claims. (Cl. 166—204)

The present invention relates to packing devices for forming a seal against a companion wall, and more particularly to well packers embodying a packing structure for sealing against the inner wall of well casings, or similar well conduits.

Well packers embodying packing structures are set in well conduits to prevent flow of fluids between the packers and the conduits. Ample clearance is ordinarily provided between the packer and conduit to facilitate lowering of the former to the desired setting point at which the initially retracted packing structure is expanded outwardly into leakproof engagement with the conduit. In some well bores, the packers are subjected to comparatively high pressures and temperatures, which produce cold flowing of the rubber, or rubber-like, packing material through the clearance space between the packer and the well conduit, at times causing its complete displacement and dissipation from the region of sealing against the conduit wall, resulting in leakage past the packer.

The aforementioned difficulty has been overcome to a substantial extent by placing a pliant, inelastic annulus, such as a lead ring, at the end portions of the rubber packing element, as described in the patent to Reuben C. Baker, Patent No. 2,204,648. These lead rings are stretched outwardly against the conduit wall to bridge the aforenoted clearance spaces, and prevent the dissipation of the packing material into and through such spaces. Although highly effective in preventing cold flow of the packing material, yet under certain extreme conditions even the lead rings are forced into and through the annular clearance spaces to the extent in which they are no longer present to prevent dissipation of the rubber or rubber-like packing material.

Accordingly, it is an object of the present invention to prevent cold flow or dissipaiton of lead, or similar rings from their bridging position across clearance spaces around a packer device, holding them in such locations to preclude cold flow of the rubber packing material through such clearance spaces.

Another object of the invention is to cause the expansion of a pliant, inelastic annulus to produce an adjoining comparatively rigid bridge across the clearance space which is capable of supporting and backing up the annulus, holding the latter in its appropriate position to, in turn, serve as a bridge or barrier through which the rubber or rubber-like packing material cannot pass.

A further object of the invention is to cause the pliant, inelastic annulus placed around a rubber packing element to form a lip type of seal against an adjoining wall, as a result of expansion of the annulus and packing element against such wall.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal section through a well packer embodying the invention disposed in a well casing, with certain of the packer parts in retracted position;

Fig. 2 is a view similar to Fig. 1, of the packer anchored in packed-off condition against the casing;

Fig. 3 is a cross-section taken along the line 3—3 on Fig. 1;

Fig. 4 is a fragmentary longitudinal section, on an enlarged scale, disclosing the anchoring and packing portion of the packer, with the parts in retracted position;

Fig. 5 is a view similar to Fig. 4, disclosing certain parts in expanded condition against the well casing;

Fig. 6 is a fragmentary longitudinal section through another embodiment of the invention disposed in a well casing, with parts in retracted position;

Fig. 7 is a view similar to Fig. 6 disclosing the parts in expanded position against the well casing;

Fig. 8 is a fragmentary longitudinal section through still another embodiment of the invention, with the parts disposed in a well casing in retracted position;

Fig. 9 is a view similar to Fig. 8, disclosing the parts expanded against the well casing.

The invention is illustrated in the drawings as applied to a well packer A, that is to be anchored in packed-off condition in a well casing B through use of a setting tool C secured to the lower end of a tubular running-in string D. The well packer, however, may be anchored in packed-off condition in the well casing through use of other specific instrumentalities, without departing from the present invention.

As disclosed in the drawings, the well packer A has its upper portion threadedly secured to a setting tool C, which actually forms the lower end of a tubular running-in string D running to the top of the well bore, and by means of which the packer is lowered to the desired setting or anchoring point within the well casing. The packer includes a tubular body **10** having an abutment and guide **11** threaded on its lower end, and a head **12** at its upper end around which the skirt **13** of a cylinder **14** is disposed. A cylinder head **15** is integral with and extends inwardly from the lower end of the skirt, carrying a suitable side seal ring **16** for slidable sealing engagement with the external surface of the body **10**. A suitable side seal ring **17** is also provided on the body head **12** for slidable engagement with the interior of the cylinder skirt **13**.

A set of upper segmental slips **18** is disposed around the body immediately below the cylinder head **15**. These slips are held initially in retracted position by shear screws **19**, or other frangible devices, which attach the slips to an upper conical expander **20** initially secured to the body by one or more shear screws **21**. The converging surfaces **22** of the upper set of slips and upper expander are so disposed with respect to one another as to secure the packer against movement in an upward direction within the casing B, or other well conduit following outward expansion of the slips **18** into engagement with the casing.

A set of lower segmental slips **23** is provided adjacent the body abutment **11**, these slips also being secured by shear screws **24** to a lower tapered expander **25** attached initially to the body by one or more shear screws **26**. The direction of taper of the exterior **27** of the lower expander and of the cooperable surfaces on the lower slips is such as to hold the well packer against movement in a downward direction following expansion of the slips **23** outwardly to casing engaging position.

A suitable lock is provided between the body **10** and lower expander **25**, to permit upward movement of the body within this expander, but to preclude its downward movement. Such lock may be constituted by a split tapered wedge ring **28** received within a tapered groove **29** within the lower expander.

A packing structure **30** is initially held in retracted position around the body **10** between the upper and lower expanders **20**, **25**. When the expanders are moved longitudinally relatively toward each other, the packing structure is foreshortened and expanded outwardly against the wall of the well casing B.

As stated above, the setting tool C is threaded, as by a left-hand thread **31**, into the upper head **12** of the packer body **10**. This setting tool has a lower head **32** carrying suitable side seals **33** for sealing engagement with the inner wall of the body **10**, below body ports **34** that provide communication between the interior of the body and the cylinder space **35** between the body head **12** and

the cylinder head **15**. Fluid can flow from the passage **36** through the setting tool C, through elongate ports **37** in the latter, and through the body ports **34** into the cylinder space **35**, in order to impose a fluid pressure acting in a downward direction on the cylinder head **15**.

The well packer A is run in the well bore with the slips **18**, **23** and packing structure **30** in retracted position, as disclosed in Figs. 1 and 4. The cylinder **14** is held initially in its upper position by one or more shear screws **38** securing the skirt **13** to the body head **12**. During the lowering of the packer A in the well casing B, the tubular string D is filled automatically with the fluid in the well casing, which flows upwardly through the packer body **10** and the central passage **36** in the setting tool into the tubular string.

Upon reaching the point in the well casing at which the packer is to be anchored in packed-off condition, a trip ball **39** is dropped into the tubing string D, and is pumped, or allowed to gravitate, into engagement with a seat **40** in the setting tool head **32**, closing the central passage **41** through the latter and enabling the pressure of the fluid in the tubing string D, setting tool C, its ports **37**, body ports **34** and cylinder space **35** to be increased to a degree sufficient to overcome the shear value of the screws **38**, **19** holding the cylinder **14** in its uppermost position and the upper slips **18** to the upper expander **20**. Following rupture of these screws **38**, **19**, the cylinder **14** is moved downwardly to slide the upper slips **18** down along the tapered surface **22** of the upper expander **20** and outwardly into engagement with the wall of the casing B.

The shear screws **21** attaching the upper expander **20** to the body **10** have a greater shear value than the cylinder screws **38** and the screws **19** holding the upper slips **18** to the upper expander **20**. The screws **26**, **24** holding the lower expander **25** to the body **10** and the lower slips **23** to the lower expander have a greater shear value than the screws **21** attaching the upper expander to the body. It is, accordingly, apparent that only the first two sets of screws **38**, **19** mentioned above are first sheared, causing the movement of the upper slips **18** into anchoring position against the casing. Following such anchoring, the tubular string D is pulled upwardly, to first disrupt the screws **21** holding the upper expander **20** to the body, then moving the packer body upwardly within this upper expander and carrying the lower expander **25** with the body toward the upper expander. By virtue of the movement of the lower expander **25** toward the upper expander **20**, the packing structure **30** is foreshortened and expanded outwardly into firm sealing engagement with the casing B, and also is urged into firm sealing engagement with the exterior of the packer body **10**. Following expansion of the packing structure in the manner described, a continuation of the upward strain on the tubular string D shears the lower expander screws **26** and the slip screws **24**, causing the abutment **11** to move the lower slips **23** upwardly along the lower expander **25** and outwardly into firm anchoring engagement against the wall of the well casing (Fig. 2). After the well packer A has been completely set, in the manner described, the tubular string D may be rotated to the right, to unscrew the setting tool C from the body head **12** at the left-hand threads **31**, which allows the tubular string and setting tool to be removed from the well casing B.

The upper slips **18** prevent upward movement of the well packer and its body **10** with respect to the well casing B. The lower slips **23** prevent downward movement of the well packer and its body with respect to the well casing, any tendency for the body to move downwardly being transmitted through the wedge lock **28** to the lower expander **25**, and through the lower slips **23** to the casing. Accordingly, the well packer A is prevented from moving in either longitudinal direction.

It is desirable for the slips **18**, **23** and packing structure **30** to be disposed in retracted position during lowering of the well packer in the well casing. To facilitate such lowering, sufficient clearance is allowed between the well packer parts and the wall of the well casing. Thus, a substantial clearance space or gap G exists between the periphery of each expander **20**, **25** and the wall of the well casing B, and this gap is bridged by the packing structure **30** following its expansion against the casing wall.

Under some conditions encountered in well bores, the packing material, which usually includes natural or synthetic rubber, will pass into and through the aforenoted clearance spaces G following expansion against the casing. In particular, high pressures and temperatures cause the rubber or rubber-like packing material to flow into and through such clearance spaces. At times, the flow may be of such an extent as to result in substantially complete dissipation of the packing material from its location between the expanders **20**, **25**, thereby leaving very little, if any, packing material available for the performance of its sealing function against the casing wall and the periphery of the packer body **10**. As noted above, it has been proposed to place pliant, inelastic annuli, such as lead rings **45**, at the end portions of a rubber packing element **46**, which annuli are forced outwardly by the compressed rubber packing to effect a bridge across the clearance spaces G and thereby preclude cold flowing of the rubber packing material into and through such spaces. Although highly effective in most cases, the lead annuli **45** are themselves, at times, forced into and through the aforenoted clearance spaces. Following their dissipation through the clearance spaces, the lead is not available to prevent cold flowing of the rubber packing element **46** through such spaces, resulting in failure of the well packer A to perform its sealing function against the wall of the well casing B.

The aforenoted difficulties are overcome in the devices disclosed in the drawings. The packing structure **30** disclosed in Figs. 1 to 5, inclusive, includes a rubber or rubber-like packing sleeve **46** that has reduced diameter end portions **47** received within pliant, inelastic annuli or lead rings **45**. The lead rings have outwardly tapering inner surfaces **48** converging toward each other, and also tapering outer surfaces **49** at their inner end portions diverging outwardly from each other. The inner surfaces **48** engage companion surfaces at the end portions of the rubber packing sleeve **46**, whereas the outer surfaces **49** are spaced from the outer end portions **50** of the packing sleeve to provide a substantial gap **51** therebetween. The termini **47** of the rubber packing sleeve **46** extend within the cylindrical inner surface **52** of the lead rings **45**.

The outer end **53** of each lead ring is tapered in an inward direction toward the rubber packing sleeve **46**, engaging a companion tapered surface **54** on a circumferentially continuous outer ring member **55** made of rigid material, such as cast iron. This outer ring member **55** snugly engages and encompasses a circumferentially continuous inner rigid ring member **56**, which may also be made of cast iron, and which is slidable along the exterior of the packer body **10**. The inner ring member **56** bears against a pliant, inelastic annulus, such as a lead ring **57**, that engages the inner end of the expander **20** or **25**, and which also slidably engages the exterior of the packer body **10**.

The outer rigid ring **55** has an outer tapered surface **58** which converges in an outward direction toward its other surface **54**. The ring surface **58** engages a companion tapered surface **59** on an expansible ring **60**, which may also be made of cast iron, and which is provided with a gap or split **61** (Fig. 3). This ring is of generally L-shape in cross-section, with its upwardly extending arm **62** having an upper surface **63** inclined outwardly in a direction away from the packing sleeve **46**, and engaging a companion tapered surface **64** formed on the expander **20** or **25**. The ring **60** itself tends to remain in a contracted position with its gap **61** substantially closed, and bearing upon the inner lead ring **57**.

An outer split contractile ring **65** is nested within the recess **66** of the other split ring **60**, and has an outer tapered surface **67** engaging the tapered surface **64** of the expander. The gap **68** or split of this ring **65** is preferably circumferentially offset with respect to the other ring gap **61**. As disclosed most clearly in Fig. 3, the gaps are displaced about 180 degrees from each other.

When the packer body **10** is moved upwardly to foreshorten the packing structure **30**, the upper expander **20** is held stationary by the upper slips **18**, which are anchored in the casing wall. The upper lead annulus **45** exerts an upward force on the circumferentially continuous outer thrust ring **55**, causing such ring to move upwardly and exert an outward force on the split expansible rings **60**, **65** which slide along the tapered surface **64** of the expander **20** in an outward direction, and into engagement with the wall of the well casing B, substantialy completely bridging the clearance gap G between

the expander 20 and the well casing wall. As the compressive force foreshortening the packing sleeve 46 increases, as a result of continued upward movement of the packer body 10, the rubber packing sleeve is moved upwardly within the lead ring 45, the coengaging tapered surfaces 48 on the sleeve and inner lower portion of the lead ring urging the latter outwardly. In view of the malleable characteristics of lead, the continuous annulus is stretched and deformed in an outward direction, at first sliding upwardly on the tapered surface 54 of the outer thrust ring 55 and across the gap between the periphery of this ring and the wall of the well casing B. When the lead ring 45 engages the inner split contractile ring 60, it can move upwardly to no further extent. As a result, it is then deformed in an inward direction, bridging the annular space between the packer body 10 and the casing wall. As the compressive force on the packing sleeve 46 is increased to a further extent, the inner thrust ring 57 is moved by the packing sleeve and the deformed lead ring 45 toward the expander 20, foreshortening the inner lead ring 57 and causing it to expand outwardly into engagement with the inner surface of the expansible split ring 60, completely filling the gap left by the latter ring as a result of its outward expansion against the well casing. This lead ring 57 not only fills such gap, but it also is pressed firmly against the body 10 of the packer, completely closing the slight clearance space that exists between the inner cylindrical surface of the conical expander 20 and the exterior of the packer body.

During the compression of the packing structure 30, in the manner described above, the outer lead ring 45 and inner lead ring 57, as well as the inner and outer thrust rings 56, 55 and split expansible rings 60, 65 at the lower end of the packing sleeve 46, are also urged outwardly and caused to occupy the same general positions as the corresponding structure at the upper end of the packing sleeve. The upper and lower portions of the packing structure 30 are identical, although arranged reversely with respect to one another.

It is, accordingly, apparent that the expansible rings 60, 65 form an annular bridge or barrier across the clearance space G between each expander 20 or 25 and wall of the well casing B. The adjoining pliant, inelastic annulus 45 cannot pass into or be dissipated through this clearance space G. The only gap that remains is the relatively small distance 61 between the ends of the inner ring 60, and the lead material 45 can pass into this gap 61. However, this gap is bridged by the other expansible ring 65, and, as a result, there is no straight-through path that can be followed by the casing engaging lead member 45. Any tendency for the lead material to flow inwardly through the gap 61 in the expansible ring 60 is forestalled, inasmuch as the inner lead ring 57 will have been compressed between the thrust rings 55, 56 and the expander 20 or 25, and will fill such gap partially, as well as the space within the expansible ring 60 that would otherwise result upon expansion of the split rings 60, 65 against the wall of the well casing. Here again, the inner lead ring 57 cannot pass outwardly through such gap 61, since the upper portion of such gap is bridged by the outer split expansible ring 65.

Accordingly, there are no paths through which the lead bridging material 45 can flow upon being subjected to extreme conditions of temperature and pressure. The lead 45 forms an additional bridge or barrier between the packer body 10 and wall of the well casing B, allowing no space whatsoever through which the rubber packing material 46 can flow. However, the rubber packing material is still available for engagement with the wall of the well casing B and the packer body 10, and is capable of forming a much more efficient seal therewith than other materials, such as lead.

The beveling or tapering of the outer inner portions 49 of the lead rings has still another important advantage. Since the packing sleeve 46 is more readily expandible against the casing than the lead rings 45, foreshortening of the packing sleeve 46 causes its outer portion to first be deformed upwardly around the tapered part 49 of each lead ring, forming a circumferential lip 70 around each outer end portion of the packing sleeve against the tapered surface 49 of each lead ring 45 (Fig. 5). That is, the packing material 46, in effect, becomes wedged between the exterior of the end of each lead ring and the casing, forming a wedge-shaped lip 70 projecting in a longitudinally outward direction with respect to the packing sleeve. Any fluid under pressure that might seep or leak past a lead ring 45 would engage such lip and urge it more firmly against the casing wall. As a result, each lip 70 insures against leakage of fluid along the exterior of the packing sleeve when the latter has been compressed outwardly against the wall of the well casing.

In the form of packing structure disclosed in Figs. 6 and 7, a lead ring 45*a* is provided at each end portion of the rubber packing sleeve 46*a*. The upper end 53*a* of the lead ring bears upon an L-shaped, circumerentially continuous thrust ring 71 having an outwardly directed leg 72 engaging the outer end of the lead ring and a longitudinal portion 73 slidable along the exterior of the body 10, and extending upwardly within a pocket 74 formed between an expander 20 or 25 and the periphery of the packer body. The inner end 75 of the leg is tapered in an outward direction leading away from the expander and is engaged by a companion inner tapered end 76 of lead ring 45*a*. A pair of nested split, rigid rings 60*a*, 65*a* is disposed between the leg 72 and the end of the expander 20 or 25, the opposed surfaces 77, 78 on the expander and leg diverging with respect to one another in an outward direction, the split rings 60*a*, 65*a* having companion tapered surfaces engageable with the expander and leg surfaces 77, 78. As in the other form of the invention, the split portions of the rings are angularly displaced with respect to each other.

The inner corner 79 of each circumferentially continuous thrust member 71 may be chamfered or beveled to receive a pliant, inelastic ring 80, such as a lead ring, of generally triangular shape, which engages the beveled surface, as well as the exterior of the packer body 10.

When the packer body 10 is moved upwardly, to foreshorten the packing structure 30*a* and expand it outwardly against the casing wall, the longitudinally directed expanding force is transmitted through each thrust ring 71, urging it toward its companion slip expander 20 or 25 and forcing the split rigid rings 60*a*, 65*a* outwardly against the casing wall, to bridge the annular space G between an expander and the casing wall. A continuation of the longitudinally directed force on the packing structure then foreshortens the rubber packing sleeve 46*a*, causing its outer portion to be deformed around the beveled corner 49 of the lead ring, to provide the lip 70 referred to in connection with the other embodiment of the invention. A continuation of the longitudinal force then deforms the lead ring 45*a*, causing it to bridge the space between the thrust ring 71 and casing wall and pass into engagement with the split expander bridge ring 60*a*. The lead ring 45*a* may also be deformed inwardly against the packer body 10, and will exert a force upon the inner lead ring 80, wedging it against the packer body 10 and sealing completely the slight clearance space existing between the thrust ring 71 and exterior of the packer body (Fig. 7).

It is apparent that, in the form of invention disclosed in Figs. 6 and 7, the longitudinal thrust on the packing structure 30*a* has first expanded the split rings 60*a*, 65*a* against the casing B, forming a bridge or barrier against which the lead rings 45*a* will engage. Each lead ring 45*a* also forms a bridge or barrier, precluding cold flow of the rubber packing material 46*a* into or through any clearance spaces between the well packer A and the casing wall B, as well as through any clearance spaces around the packer body 10.

In the form of invention disclosed in Figs. 8 and 9, the packing sleeve 46*b* is received within pockets 90 in pliant, inelatsic circumferentially continuous lead rings 45*b*. These rings are received within recesses or pockets 74*a* formed between an expander 20 or 25 and the exterior of the packer body 10, and they are also engageable with the split expansible rings 60*b* that contact the expanders, and which are embraced by the outer split rings 65*b* which also contact the expanders, all in essentially the same fashion as in the device illustrated in Figs. 6 and 7.

When the packing structure 30*b* is compressed by imposing a longitudinally directed force thereupon, the rubber packing sleeve 46*b* shifts each lead ring 45*b* longitudinally toward its associated expander 20 or 25, causing the expansible rings 60*b*, 65*b* to move outwardly into engagement with the casing wall, to bridge the clearance space G between the latter and the expander. A continuation of the upward strain then deforms each lead ring 45*b* outwardly against the expanded split ring 60*b*. The

lead ring, however, cannot flow through the annular clearance space G, since it is effectively stopped by the bridging action of the split rings 60*b*, 65*b* across this space. The rubber sleeve 46*b* cannot flow past the lead ring 45*b*, since the latter is bridging the annular space between the packer body 10 and casing wall. As before, the lead ring 45*b* and rubber 46*b* cooperate to form the lip seals 70 on the packing element, to preclude leakage of fluid past the rubber sleeve.

The inventors claim:

1. A packing structure, including an annular non-metallic packing adapted to engage a companion wall, abutment means adjacent said packing, a pliant, inelastic annulus engaging said packing and adapted to be moved by said packing against the companion wall, and means engageable with said annulus and abutment and including a laterally movable ring-shaped structure movable against the wall in response to said movement of said annulus by said packing.

2. A packing structure, including an annular non-metallic packing adapted to engage a companion wall, abutment means adjacent said packing, a pliant, inelastic annulus engaging said packing and adapted to be moved by said packing against the companion wall, and means engageable with said annulus and abutment and including a laterally movable split ring-shaped structure movable against the wall in response to said movement of said annulus by said packing.

3. A packing structure, including an initially retracted annular non-metallic packing adapted to engage an encompassing wall, abutment means adjacent said packing, a pliant, inelastic initially retracted annulus engaging said packing and adapted to be expanded by said packing against the companion wall, and means engageable with said annulus and abutment and including an expansible split ring-shaped structure movable outwardly against the wall in response to said movement of said annulus by said packing.

4. A packing structure, including an annular non-metallic packing adapted to engage a companion wall, abutment means adjacent said packing, a pliant, inelastic annulus engaging said packing and adapted to be moved by said packing against the companion wall, a circumferentially continuous thrust ring engaging and movable by said annulus, and a laterally movable ring-shaped structure engaging said thrust ring and abutment and movable against the companion wall in response to said movement of said thrust ring.

5. A packing structure, including an annular non-metallic packing adapted to engage a companion wall, abutment means adjacent said packing, a pliant, inelastic annulus engaging said packing and adapted to be moved by said packing against the companion wall, a circumferentially continuous thrust ring engaging and movable by said annulus, and a laterally movable split ring-shaped structure engaging said thrust ring and abutment and movable against the companion wall in response to said movement of said thrust ring.

6. A packing structure, including an initially retracted annular non-metallic packing adapted to engage an encompassing wall, abutment means adjacent said packing, a pliant, inelastic initially retracted annulus engaging said packing and adapted to be expanded by said packing against the companion wall, a circumferentially continuous thrust ring engaging and movable by said annulus, and an expansible split ring-shaped structure engaging said thrust ring and abutment and movable outwardly against the wall in response to movement of said thrust ring.

7. In apparatus of the character described: a supporting body; an initially retracted non-metallic packing around said body and expandible into engagement with an encompassing wall; abutment means around said body adjacent said packing; a pliant, inelastic initially retracted annulus around said body expandible by said packing against the wall; a circumferentially continuous thrust ring movable longitudinally of said body and engaging and movable by said annulus; and an expansible split ring-shaped structure engaging said thrust ring and abutment and movable by said thrust ring outwardly against the wall.

8. In apparatus of the character described: a supporting body; an initially retracted non-metallic packing around said body and expandible into engagement with an encompassing wall; abutment means around said body adjacent said packing; a pliant, inelastic initially retracted annulus around said body expandible by said packing against the wall; a circumferentially continuous thrust ring movable longitudinally of said body and engaging and movable by said annulus; and a plurality of expansible split rings mounted one upon the other and engaging said thrust ring and abutment, said split rings having their split regions circumferentially offset with respect to each other, and said split rings being movable by said thrust ring outwardly against the wall.

9. In apparatus of the character described: a supporting body; an initially retracted non-metallic packing around said body and expandible into engagement with an encompassing wall; abutment means around said body adjacent said packing; a pliant, inelastic initially retracted annulus around said body expandible by said packing against the wall; a circumferentially continuous outer thrust ring engaging and movable by said annulus; a circumferentially continuous inner thrust ring on said body and within said outer ring and engageable by said packing; and an expansible split ring structure engaging said outer ring and abutment and movable by said outer ring outwardly against the wall.

10. In apparatus of the character described: a supporting body; an initially retracted non-metallic packing around said body and expandible into engagement with an encompassing wall; abutment means around said body adjacent said packing; a pliant, inelastic initially retracted annulus around said body expandible by said packing against the wall; a circumferentially continuous outer thrust ring engaging and movable by said annulus; a circumferentially continuous inner thrust ring on said body and within said outer ring and engageable by said packing; and a plurality of expansible split rings mounted one upon the other and engaging said outer ring and abutment, said split rings having their split regions circumferentially offset with respect to each other, and said split rings being movable by said outer thrust ring outwardly against the wall.

11. In apparatus of the character described: a supporting body; an initially retracted non-metallic packing around said body and expandible into engagement with an encompassing wall; abutment means around said body adjacent said packing; a pliant, inelastic initially retracted annulus around said body expandible by said packing against the wall; a circumferentially continuous outer thrust ring engaging and movable by said annulus; a circumferentially continuous inner thrust ring on said body and within said outer ring and engageable by said packing; an expansible split ring structure engaging said outer ring and abutment and movable by said outer ring outwardly against the wall; and a pliant, inelatsic annulus within said expansible split ring structure and between said inner thrust ring and abutment.

12. In apparatus of the character described: a supporting body; an initially retracted non-metallic packing around said body and expandible into engagement with an encompassing wall; abutment means around said body adjacent said packing; a pliant, inelastic initially retracted annulus around said body expandible by said packing against the wall; a circumferentially continuous thrust ring movable longitudinally of said body and engaging and movable by said annulus; a plurality of expansible split rings mounted one upon the other and engaging said thrust ring and abutment, said split rings having their split regions circumferentially offset with respect to each other, and said split rings being movable by said thrust ring outwardly against the wall; and a pliant, inelatsic annulus within said expansible split ring structure and between said thrust ring and abutment.

13. In apparatus of the character described: a supporting body; an initially retracted non-metallic packing around said body expandible into engagement with an encompassing wall; abutment means around said body and adjacent said packing; a pliant, inelastic initially retracted annulus around said body engageable by said packing and expandible by said packing against the wall; and an expansible split ring structure engaging said annulus and abutment and movable by said annulus outwardly against the wall.

14. A packing structure, including an annular non-metallic packing adapted to engage a companion wall, abutment means adjacent said packing, a pliant, inelastic annulus engaging said packing and adapted to be moved by said packing against the companion wall, and a laterally movable ring-shaped structure engaging said annulus and

abutment and movable by said annulus laterally against the wall.

15. A packing structure, including an annular non-metallic packing adapted to engage a companion wall, a pliant, inelastic annulus engaging said packing and adapted to be moved by said packing outwardly against the companion wall, said annulus having a circumferential outer surface inclined laterally outward in a direction leading longitudinally away from said packing to form a circumferential wall engaging lip on said packing upon outward expansion of said packing and annulus against the wall.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,734,040	McEvoy	Nov. 5, 1929
2,135,583	Layne	Nov. 8, 1938
2,204,648	Baker	June 18, 1940
2,467,801	Baker	Apr. 19, 1949
2,474,491	Penick	June 28, 1949