June 5, 1951 C. M. KING 2,555,647

PACKING FLOW PREVENTING DEVICE

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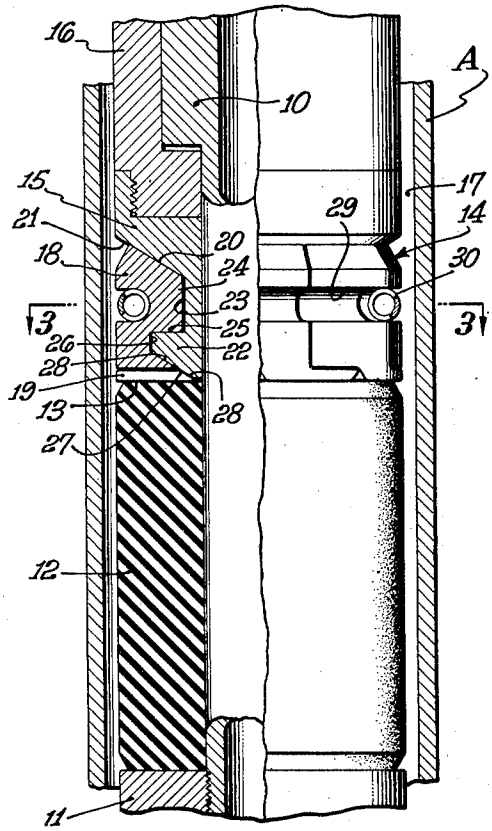


Fig. 1.

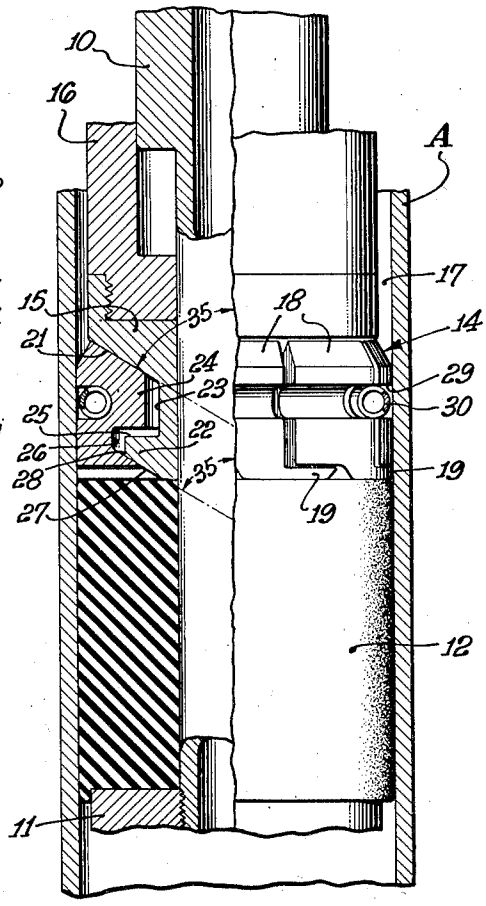


Fig. 2.

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Fig. 3.

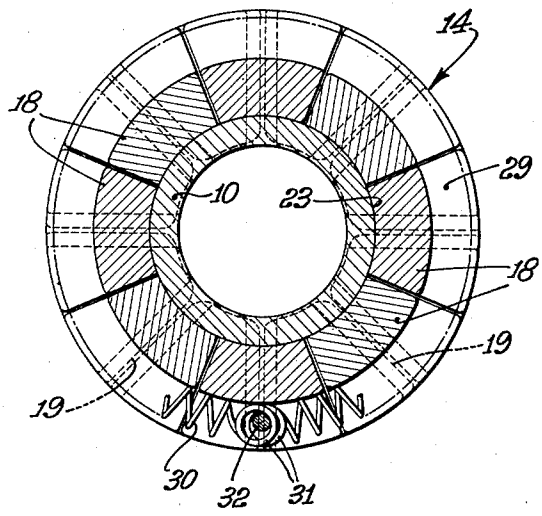


Fig. 5.

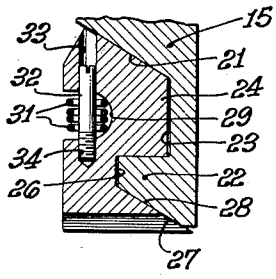


Fig. 6.

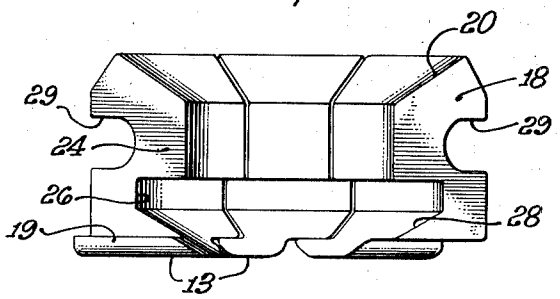
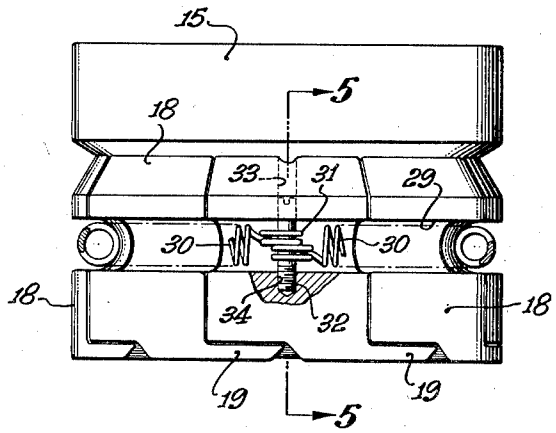


Fig. 4.



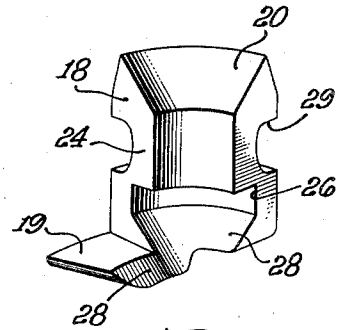


Fig. 7.

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UNITED STATES PATENT OFFICE

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PACKING FLOW PREVENTING DEVICE

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13 Claims. (Cl. 166—10)

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This invention relates to packing structures including flexible and pliable materials, and particularly to such structures whose supporting or cooperable members have material clearance with the wall of a confining enclosure, such as a well casing.

As pointed out in my United States Patent 2,368,928, the substantial clearance that must be allowed between the supporting or retaining member for a pliable packing and the wall of a well casing provides an open annulus through which the packing material can flow upon being subjected to high pressures or temperatures within the casing. The patent referred to provides expansible and retractable means for preventing such flow in packer structures of the retrievable type; that is, in packers which are run into the well casing for performance of an operation therein, and are then bodily removed from the well casing. The device for preventing cold flowing of the packer materials includes an expansible and contractile ring composed of a plurality of segments.

An object of the present invention is to provide an improved packing structure for preventing flow of packing material from its intended sealing region against a confining enclosure.

A further object of the invention is to provide a packing structure embodying an expansible and contractile flow preventing device capable of easy and rapid assembly and disassembly on the packer.

Yet another object of the invention is to provide a flow preventer for a packing, which permits the employment of a relatively simple and inexpensive packing.

This invention has other objects which will become apparent from a consideration of the embodiment shown in the drawings accompanying and forming part of the present specification. This embodiment will now be described in detail to illustrate the general principles of the invention, 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, with its packing structure shown in retracted position;

Figure 2 is a view like Figure 1, with the packing structure in expanded position;

Figure 3 is a cross-section taken generally along the line 3—3 in Figure 1;

Figure 4 is a side elevation, with part broken away, of the segmental ring and ring expander;

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Figure 5 is a partial section taken along the line 5—5 in Figure 4;

Figure 6 is an elevation of a group of overlapping segments, as seen from the interior thereof; and

Figure 7 is a perspective of one of the segments composing the segmental ring.

In the embodiment disclosed in the drawings, the invention forms part of a well packer which can be of the type illustrated in United States Patent 2,368,400. This particular packer includes a tubular body 10 to which is threaded or otherwise secured a packing actuator 11 engaging the lower end of a packing sleeve 12 surrounding the body. The upper end of the packing sleeve is engageable with the lower surface 13 of a flow preventing segmental ring 14 mounted on a ring abutment or expander 15 threaded on a slip expander 16, which can be held stationary by any suitable means, such as casing engaging slips (not shown), disclosed in Patent 2,368,400.

Whenever the packing 12 is to be engaged with the wall of a casing A, an upward strain is taken on the tubular body 10 to move its actuator 11 longitudinally towards the expander 15, and thus shorten the packing sleeve 12 and expand it radially outward against the wall of the confining casing A, to effect an annular seal between the latter and the packer body.

It is to be noted that the expanded packing material must bridge the comparatively large annular space 17 between the exterior of the retracted segmental ring 14 and the casing wall. This material might flow upwardly through this space under the influence of high pressures and temperatures, with the possibility that a large portion or substantially all of the packing material would be dissipated and unavailable for effecting its sealing function between the packer body 10 and casing wall. However, such packing material is prevented by the bridging segmental ring 14, which is moved, as an incident of expanding the packing, across the annular space 17.

The segmental ring is composed of adjacent upper and lower steel segments 18, 19 surrounding the abutment 15, the lower segments 19 being staggered with respect to the upper segments 18 so as to lap over from one upper segment to the next adjacent upper segment and extend across their adjacent ends. The lower segments 19 are preferably made with their undersides 13 flat and substantially at right

angles to the axis of the packing 12, and extend inwardly substantially to the exterior of the tubular body 10 when the segmental ring is in retracted position.

The upper segments 18 have upper tapered surfaces 20 inclined upwardly and outwardly engageable with a companion upper tapered surface 21 on the ring expander 15. The latter is also provided with a lower external flange 22 forming a groove 23 with its upper tapered surface 21 in which inwardly directed portions 24 of the upper segments are received. The flange provides a shoulder 25 substantially at right angles to the tubular body axis on which the inwardly extending portions 24 may rest.

The flange 22 is received within an inner groove 26 formed collectively in the upper and lower segments and is provided with a lower tapered surface 27 substantially parallel to the upper inclined abutment surface 21. The upper and lower segments have companion surfaces 28 adapted to engage and ride upon the lower abutment surface 27.

An external peripheral groove 29 is formed in the upper segments 18 for reception of a coil spring 30 tending to urge and maintain the segments in retracted position. The looped ends 31 of the spring are secured together by a pin or screw 32, which extends through a hole 33 in one of the upper segments, across the circumferential groove 29 and through the looped ends 31 and into a threaded hole 34 on the other side of the groove 29. This pin 32 prevents inadvertent removal or loss of the coil spring 30 from its assembled position in the ring groove 29.

In the operation of the device, the well packer is run in the well casing A to the desired point at which the packing 12 is to be expanded against the casing. An upward strain is then taken on the tubular body 10 to move the packing actuator 11 toward the ring abutment 15, which, through being attached to the slip expander 16, is prevented from upward movement by engagement of the packer slips (not shown) with the wall of the casing A. Movement of the lower packing actuator 11 toward the ring abutment 15 foreshortens the packing sleeve 12 and expands it outwardly against the casing wall. Upon applying sufficient expansive force to the packing sleeve through the packing actuator 11 and tubing body 10, the packing exerts an upward thrust against the segmental ring 14, causing its segments 18, 19 to ride upwardly on the spaced upper and lower tapered surfaces 21, 27 of the ring expander 15 and outwardly against the wall of the casing A, bridging the annular space 17 between the abutment and casing wall and allowing no gap or gaps through which the packing material can flow. In expanding outwardly toward the casing, the segments 18, 19 separate to a slight arcuate extent (see Figure 2), but in view of the overlapping of the lower segment portions 19 from one upper segment 18 to the next upper segment, no open spaces are provided through which the packing material may flow, since the arcuate gap between adjacent lower segments 19 is closed by the upper segment 18 thereabove.

When the packing 12 is to be retracted from the well casing A, the tubular body 10 is lowered with respect to the ring abutment 15 to move the packing actuator 11 away from the latter, allowing the packing sleeve 12, through its inherent elasticity, to assume its original elongate shape, and permitting the retractor spring 30 to move the segments 18, 19 along the inclined surfaces 21, 27 inwardly away from the wall of the casing to their initial retracted position.

The angle of inclination 35 of the abutment expander surfaces 21, 27 and cooperable segment surfaces 20, 28 is so chosen with respect to the tension of the encircling coil spring 30 and the distortion characteristics of the rubber or rubber-like packing 12, that the segments 18, 19 are expanded outwardly against the wall of the casing A, by the upward force transmitted through the packing sleeve, before the rubber or similar packing material would tend to flow upwardly through the clearance space 17 between the exterior of the segmental ring 14, when in retracted position, and the wall of the casing. The angle of inclination 35 of the abutment and segment surfaces should also be so chosen with respect to the tension of the encircling coil spring 30 as to insure the retention of the segments 18, 19 in retracted position while the tool is being lowered through the well casing. Otherwise, if the angle of inclination to the vertical were too little and the coil spring too light, the force of the fluid passing the exterior of the packing 12 and the ring segments 18, 19 might shift the latter upwardly along their cooperable expander 15 and out against the casing A, causing potential hanging up or stopping of the well packer in a casing coupling space.

The inclination angle 35 and the tension of the coil spring 30 must be chosen to prevent this undesirable result from occurring, and their proportions must also be so selected as to insure outward expansion of the segments 18, 19 against the casing A before the packing material might otherwise tend to flow through the annular space 17 between the exterior of the segments, when in retracted position, and the casing wall. The angle 35, as a practical matter, could vary between 45° and 75° to the packing axis. In the specific design shown in the drawings, the angle is about 60° to the packing axis, with a comparatively strong spring encircling the segments and with the packing sleeve made of synthetic rubber having a Shore hardness number of about 75 to 80.

The upper and lower inclined surfaces 21, 20 and 27, 28 on the expander abutment 15 and segmental ring 14 provide stability and ease of operation to the expanding mechanism in moving to and from retracted position. They also provide spaced surfaces for transmitting the compressive load on the packing to the expanders 15, 16 and slips (not shown), and supply a much greater load transmitting contact surface area than could be available with a single pair of cooperating inclined surfaces. In moving the well packer from the casing in an upward direction, the segmental ring 14 tends to move down the incline and remain in a retracted position, assisted by the coil spring 30. However, the extent of downward movement is positively limited by engagement of the inwardly directed portions 24 on the upper segment 18 with the shoulder 25 on the external abutment flange 22. Thus, the segments are prevented from moving downwardly during upward movement of the tool beyond a limited extent, and cannot exert a downward force on the packing sleeve 12, tending to expand it outwardly against the wall of the casing.

It is apparent that a comparatively simple flow preventing device has been provided which can be readily assembled as part of the packer or dismantled therefrom. The arrangement is such

as to permit the use of a simple packing sleeve structure or shape, which, as shown in the drawings, has its ends at right angles to its axis. This particular shape is molded very readily and can be assembled easily in the packer body and in cooperation with the segmental ring.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A packing structure, including a non-metallic packing, abutment means at one end of said packing having a groove bound by a flange forming part of said means and by a surface on said abutment means inclined outwardly in a direction leading away from said packing, said flange having a surface parallel to said first-mentioned surface, and a segmental ring engageable with said end of said packing and having an inwardly directed portion within said groove and spaced inclined surfaces companion to and engageable with said surfaces on said abutment means and flange.

2. A packing structure, including a non-metallic packing, abutment means at one end of said packing having a groove bounded by a flange forming part of said means and by a surface on said abutment means inclined outwardly in a direction leading away from said packing, said flange having a surface parallel to said first-mentioned surface, a segmental ring engageable with said end of said packing and having an inwardly directed portion within said groove and spaced inclined surfaces companion to and engageable with said surfaces on said abutment means and flange, and means circumscribing said ring for urging said ring toward retracted position on said abutment means.

3. A packing structure, including a body, a non-metallic packing on said body, abutment means on said body at one end of said packing and having a groove bounded by a flange forming part of said means and by a surface on said abutment means inclined outwardly in a direction leading away from said packing, said flange having a surface parallel to said first-mentioned surface, and a segmental ring engageable with said end of said packing and extending inwardly to said body when in retracted position, said ring having an inwardly directed portion within said groove and spaced inclined surfaces companion to and engageable with said surfaces on said abutment means and flange, and spring means circumscribing said ring for urging said ring toward retracted position on said abutment means.

4. A packing structure as defined in claim 3, wherein said segmental ring comprises upper and lower abutting segment portions arranged in overlapping relation so that the lower segment portions extend across the ends of adjacent upper segment portions.

5. A packing structure, including a packing, abutment means at one ultimate end of said packing having a plurality of longitudinally spaced inclined annular surfaces, and a segmental ring adjacent and engageable with said ultimate end of said packing and having a plurality of longitudinally spaced inclined surfaces engageable with said surfaces on said abutment means, said ring encompassing said abutment means and movable laterally with respect thereto, said ring being a unit separate from said packing, no portion of said packing being disposed within said abutment means.

6. A packing structure, including a normally retracted non-metallic packing adapted for outward expansion into engagement with the wall of a confining enclosure, abutment means at one ultimate end of said packing having a plurality of longitudinally spaced annular surfaces each of which is inclined outwardly in a direction leading away from said packing, and a segmental ring engageable with said ultimate end of said packing and having a plurality of longitudinally spaced inclined surfaces engageable with said surfaces on said abutment means, said ring being a unit separate from said packing, said ring encompassing said abutment means and movable laterally with respect thereto, no portion of said packing being disposed within said abutment means.

7. A packing structure, including a normally retracted non-metallic packing adapted for outward expansion into engagement with the wall of a confining enclosure, abutment means at an ultimate end of said packing having a plurality of longitudinally spaced parallel annular surfaces inclined outwardly in a direction leading away from said packing, a segmental ring encompassing said abutment means and movable laterally with respect thereto, said ring having a plurality of longitudinally spaced inclined parallel surfaces companion to and engageable with said surfaces on said abutment means, said segmental ring being separate from said packing and having a surface engageable with said ultimate end of said packing and disposed substantially at right angles to the axis of said packing structure, no portion of said packing being disposed within said abutment means.

8. A packing structure, including a body, a normally retracted non-metallic packing on said body, abutment means around said body at an ultimate end of said packing and having a plurality of longitudinally spaced annular surfaces inclined outwardly in a direction leading away from said packing, an expansible segmental ring encompassing said abutment means and movable laterally with respect thereto, said ring being engageable with said ultimate end of said packing and having a plurality of longitudinally spaced inclined surfaces companion to and engageable with said surfaces on said abutment means, said segmental ring extending inwardly to a location closely adjacent said body when in retracted position, no portion of said packing being disposed within said abutment means.

9. A packing structure, including a packing, abutment means at an ultimate end of said packing having an inclined annular surface, and a segmental ring adjacent to and engageable with said ultimate end of said packing and having an inclined surface engageable with said surface on said abutment means, said ring encompassing said abutment means and movable laterally with respect thereto, said ring being a separate unit free from attachment to said packing, no portion of said packing being disposed within said abutment means.

10. A packing structure, including a body, a normally retracted non-metallic packing on said body, abutment means around said body at an ultimate end of said packing and having an annular surface inclined outwardly in a direction leading away from said packing, an expansible segmental ring encompassing said abutment means and movable laterally with respect thereto, said ring being engageable with said ultimate end of said packing and having an inclined surface companion to and engageable with said surface on said abutment means, said segmental ring extending inwardly to a location closely ad-

jacent said body when in retracted position, no portion of said packing being disposed within said abutment means.

11. A packing structure including a packing, abutment means adjacent said packing, a ring engageable with said packing and abutment means, said ring comprising a plurality of separable segments, laterally movable means encircling said segments for retracting said segments, and means passing through said laterally movable means for securing a portion of said laterally movable means to said ring.

12. A packing structure, including a packing, abutment means at one end of said packing, a ring at the end of said packing adjacent said abutment means, said ring comprising a plurality of separable segments, spring means embracing said segments and having adjacent ends, and means passing through the ends of said spring means for securing the ends of said spring means to each other, said securing means also being attached to said ring.

13. A packing structure, including a packing, abutment means adjacent said packing, a ring between said packing and abutment means and engageable therewith, said ring comprising a plurality of separable segments, a coil spring circumscribing said segments and having adjacent ends, and a pin passing through the ends of said spring for securing the ends of said spring to each other, said pin also being attached to one of said segments.

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