

July 15, 1952

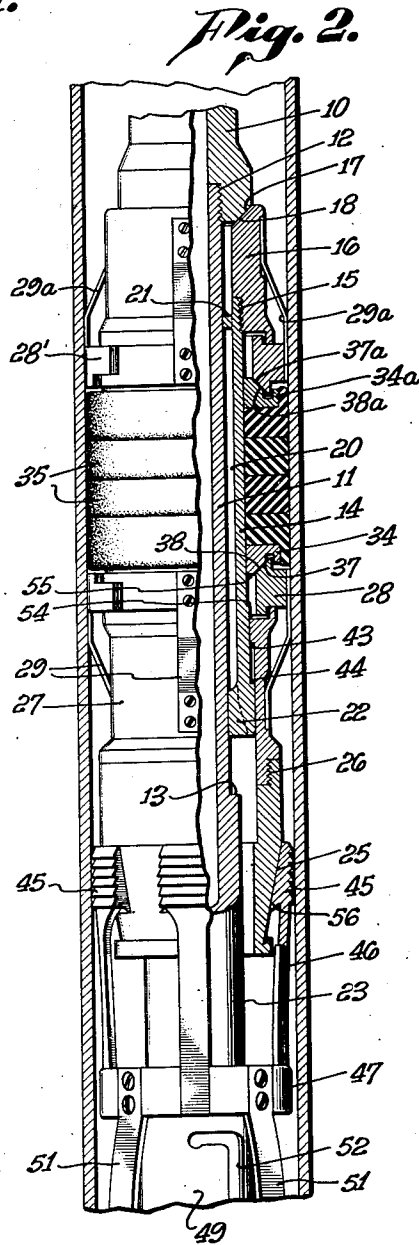
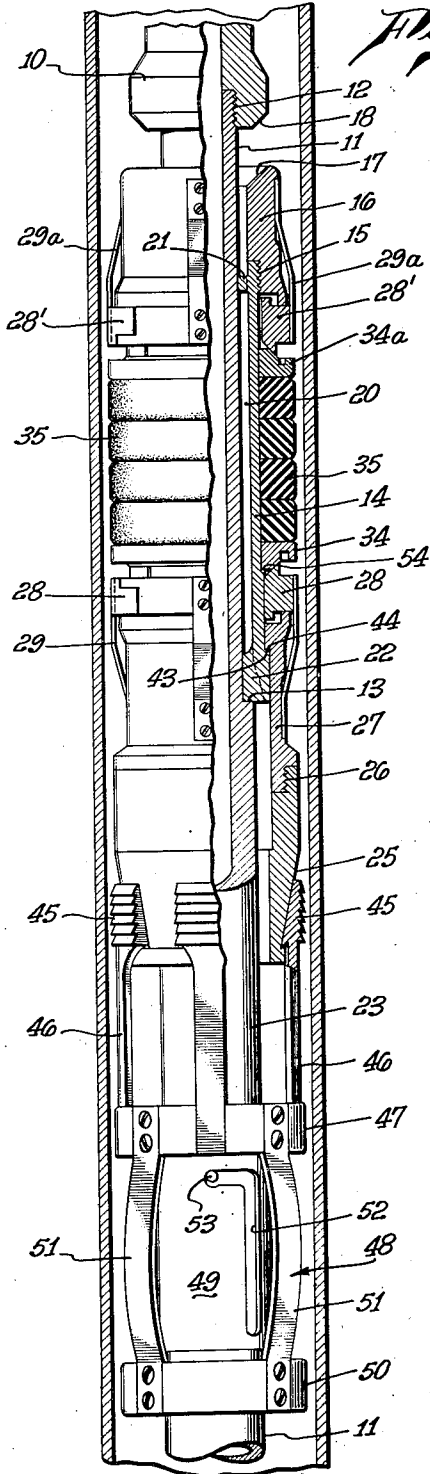
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2,603,294

WELL PACKER

Filed Dec. 21, 1945

3 Sheets-Sheet 1



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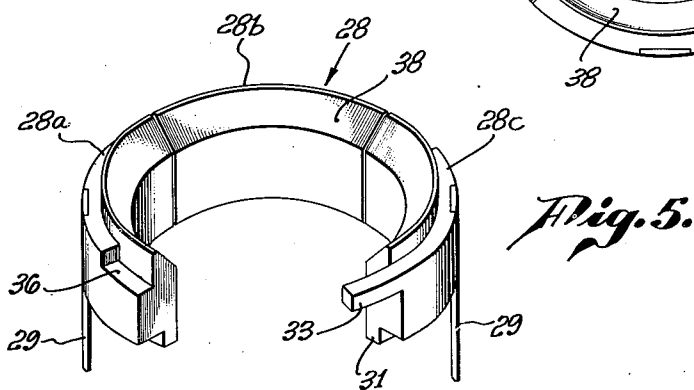
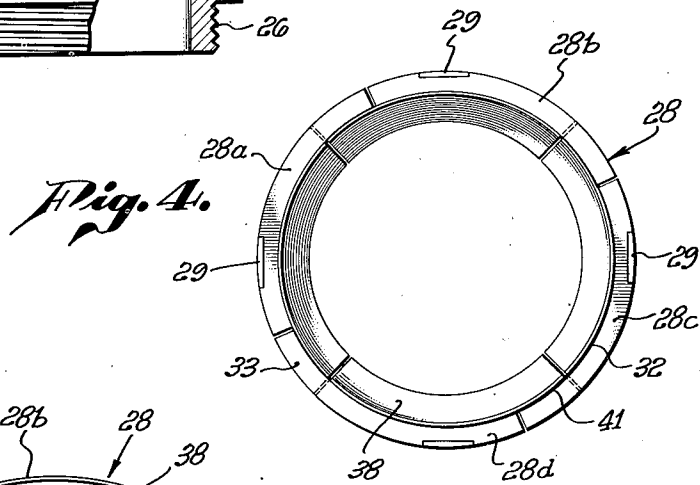
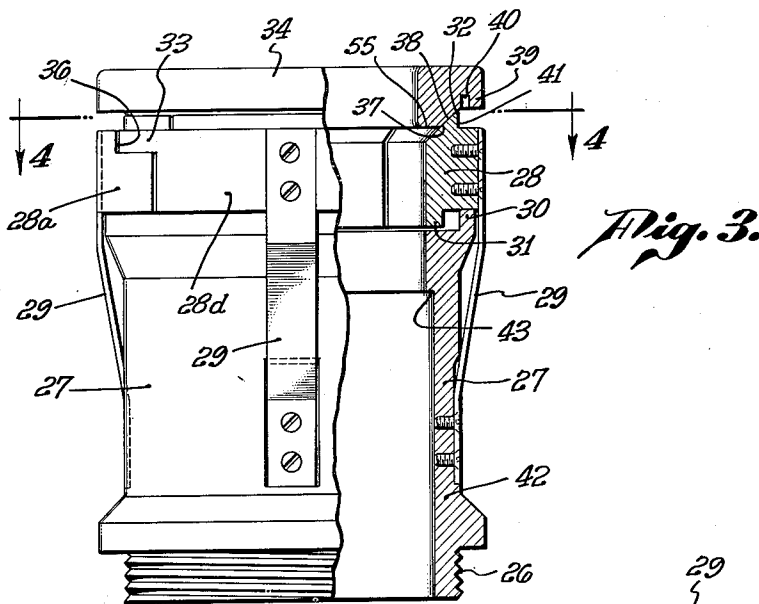
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Fig. 6.

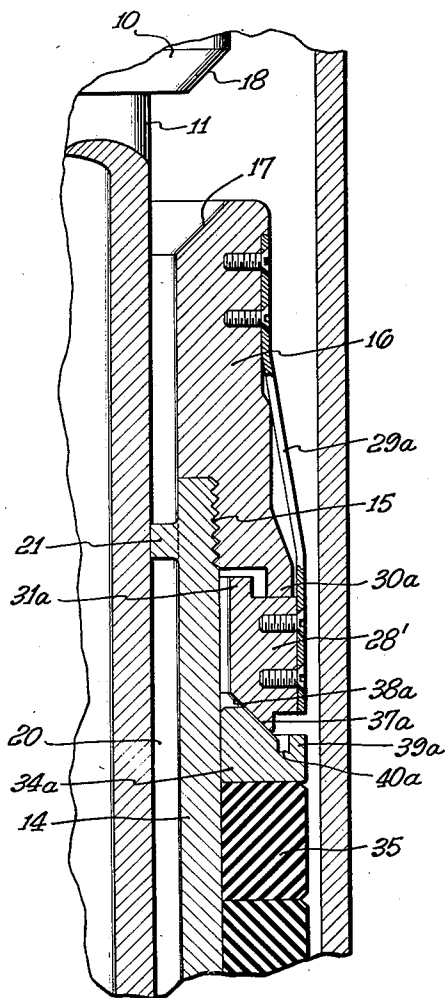
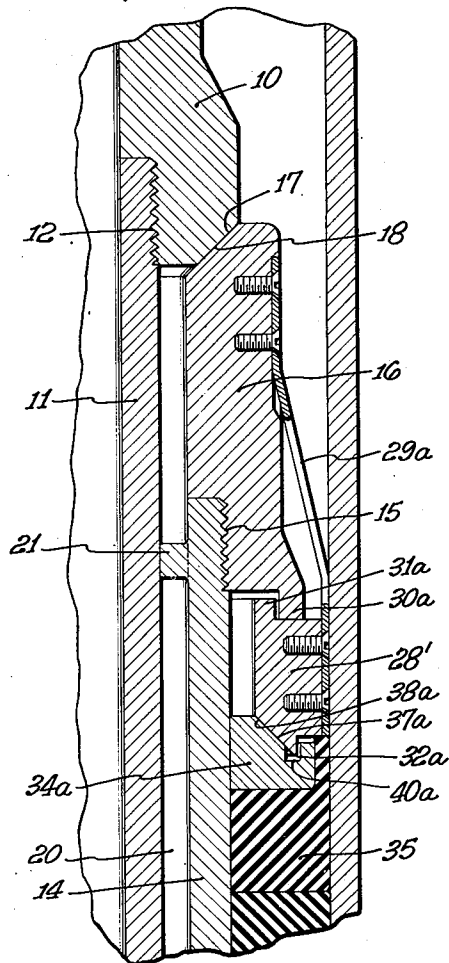


Fig. 7.



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2,603,294

WELL PACKER

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7 Claims. (Cl. 166—12)

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This invention relates to packing devices for wells and finds its principal application and use in deep oil wells where severe temperature and pressure conditions are encountered.

It has been demonstrated that the conventional packers and other types of well packer devices currently being used and which employ resilient material, such as rubber, neoprene, and the like materials to "pack-off" to form fluid type seals at any desired point in the well between two concentric casing strings or between a tubing and casing string, will not long withstand the severe temperature and pressure conditions usually encountered in the deep, high pressure oil wells now being drilled.

It has been found that the ability of the conventional packer to withstand high pressure differentials over a long period of time is dependent largely upon the hardness and the so-called "cold flow" resistance of the resilient packing element employed. When the resilient packing elements are sufficiently hard to render them capable of long life under the high temperature and pressure conditions encountered in the well, they are then usually so non-pliable or rigid as to be impracticable of being set with reasonable packer expansion forces, while, on the other hand, if the packing elements are soft or pliable enough to be readily set, they are then susceptible to so-called "cold flow" or extrusion under high differential pressures into and through the annular clearances between the inside surface of the casing and the outside surface of the packer body. Such extrusion eventually results in escape of sufficient of the packing material to reduce the packing pressure upon the surrounding surfaces against which it is intended to seal, to allow leakage with eventual cutting and channeling of the packing to the point of complete failure.

From the foregoing, it is seen to be obviously desirable to employ, and it is accordingly a principal object of this invention to provide a packer device employing resilient packing elements which are sufficiently soft, resilient and pliable to effect the satisfactory fluid tight seal under moderate packer compression pressures, while, at the same time, preventing the undesirable "flow" and extrusion action usually associated with such desirable packer characteristics.

It is a further object of this invention to provide an improved sealing means to confine the packing and to prevent the extrusion of resilient packing material from the packing elements, while under pressure, into the adjacent clearance spaces between the packer compression elements

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and the inside surface of the casing or pipe with which the seal is to be maintained.

Another object of this invention resides in improved means for releasing or breaking loose previously set packing elements from sealing engagement with a surrounding casing or pipe whereby the packer may readily be removed from the well, or, if desired, readily relocated and reset at a new position within the well.

The objects of this invention are, broadly speaking, accomplished in an embodiment of the invention comprising a resilient rubber-like packing element or sleeve adapted to be deformed by the application of longitudinal pressure there-to sufficient to expand it radially into sealing engagement between the packer and a surrounding casing or pipe and with closure ring means provided in association with the packing compression means in such relation as to close the clearance spaces at the end of the packer sleeve element between the packer and surrounding casing to prevent escape by extrusion or flowing action of the packing while under pressure.

The embodiment of the invention also comprises mechanical means to release the packing element, and the compression and packing retainer means, to break the packer element seal and to release the casing gripping means in proper sequence, whereby the previously set packer may be readily removed from its previously set position.

These and other objects, advantages, and features of novelty will be evident hereinafter.

In the drawings, which show by way of illustration, a preferred embodiment of the invention and in which like numerals designate the same or similar parts of the several views:

Figure 1 is an elevational view, in partial longitudinal section of a packer embodying the apparatus of this invention, said packer being shown suspended in an unset position within a well casing.

Figure 2 is a partial elevational view, in partial longitudinal section of the packer of Figure 1 set in the well casing.

Figure 3 is an enlarged, detail view of the packing compression and retainer mechanism.

Figure 4 is an end view of the packing retainer mechanism taken on line 4—4 of Figure 3.

Figure 5 is an enlarged perspective view of a portion of the retainer ring member of the compression and retainer mechanism of Figure 3.

Figure 6 is an enlarged fragmentary, detail view of a portion of Figure 1.

Figure 7 is an enlarged fragmentary, detail view of a portion of Figure 2.

Referring now primarily to Figures 1 and 3 to 6, inclusive, 10 is a conventional packer head element which may be attached to and suspended in the well by a suitable string of pipe or tubing and to which a conventional tubular mandrel 11 may be threadedly coupled as shown at 12. The mandrel 11 carries a lower portion 23 of increased diameter forming an annular shoulder 13 which, when the packer is suspended in the well in the unset condition as shown in Figure 1, engages and supports the lower end of a cylindrical packing support or packer sleeve 14. On the upper end of the packer sleeve 14 and threadedly coupled thereto at 15 is an annular-shaped collar member 16 which serves as the lower half of a packer circulation by-pass valve having formed at its upper end an inwardly bevelled valve seat 17 adapted to receive, when in the closed position, a bevelled valve surface 18 formed on the lower end of the beforementioned packer head 10. The packer sleeve 14, and the collar 16 are spaced concentrically with respect to the mandrel 11 to form an intermediate, annular clearance space 20 between the outside surface of the mandrel 11 and the inside surface of the said packer sleeve 14, said concentric spacing being effected by means of a plurality of radial webs located at the upper and lower ends of the sleeve as shown at 21 and 22, respectively. When the packer is in the set position as shown in Figure 2, and as hereinafter more fully explained, the mating bevelled valve surfaces 17 and 18 of the collar seat and the tubing head are moved longitudinally and forced into sealing engagement with one another, thus acting as a valve to close the upper end of the beforementioned annular circulation space 20.

Supported below the mandrel seat or shoulder 13 and slidably positioned on the enlarged portion 23 of the mandrel 11 is a slip-expanding cone 25. The slip-expanding cone 25 makes threaded connection at 26 at its upper end with the lower end of a spool-shaped coupling or collar member 27 which, as best shown in Figure 3, carries at the upper end thereof a segmented packing retainer ring 28. This packing retainer ring 28 is composed of a plurality of step-wise-cut, overlapping, arcuate segments joined end to end circumferentially, with each such arcuate segment attached to the beforementioned sleeve 27 with limited freedom for radial expansive movement by means of a leaf spring as shown at 29.

In Figure 3 and elsewhere in the drawings, the expansible packing retainer ring 28 is illustrated as being composed of 4 identical circumferential or arcuate segments 28a, 28b, 28c, and 28d, but obviously, any number of such arcuate segments may similarly be employed as best suited to the diameter of the casing in which it is to be set, and the degree of perfection of the retaining action it is desired to attain.

The upper end of the sleeve 27 is provided at its outer edge with an upstanding annular lip 30, and the inner edges of the lower ends of the arcuate segments 28 of the packer retainer ring are formed with corresponding, downwardly extending interlocking, arcuate segmental tongues as shown at 31. Upon outward radial movement of the arcuate segments of the retainer ring 28 to increase the effective diameter of the retainer ring as a whole, the segmental tongues 31 may be brought into limiting locking engagement with the beforementioned encircling lip 30.

The inside of the spool-shaped sleeve 27 is

formed with a lower portion 42 of increased inside diameter to provide a shoulder 43 from which it may be supported upon a corresponding shoulder 44 on the lower end of the packer sleeve 14, as hereinafter described in connection with its operation.

The opposite upper ends of the segments of the ring 28 are formed with inwardly facing, downwardly converging, conical surfaces as shown at 38 around the inner edge thereof, terminating at an upper edge 32 by intersection with an outwardly facing cylindrical surface 41. Each retainer ring segment 28a-28d is provided with an arcuate tongue 33 extending circumferentially from one side thereof and a step-shaped mating groove 36 extending circumferentially into the opposite side thereof and adapted to receive in circumferentially sliding fit the corresponding tongue of an adjacent retainer ring segment. The tongue of each segment, thus in turn, makes sliding fit into the mating groove of its next adjacent segment in the series of circumferential segments thereby forming in effect an expansible ring having a plurality of overlapping step-cut segments which remain in sealing contact with one another. Upon expansion, the overlapping elements of the segments slide upon one another to permit an increase in effective circumference and diameter of the ring.

Referring again primarily to Figure 3, a packer compression ring is shown at 34, carried on the top of and in sliding engagement with the upper conical end surfaces 38 of the plurality of segments of the retainer ring 28. As thus shown in Figure 3, the packing compression ring 34 is formed with an outwardly diverging, frusto conical bearing surface as shown at 37 which is adapted to fit and to contact in sliding relationship with the before described correspondingly bevelled upper end surfaces 38 of the beforementioned segments of the packing retainer ring 28. The ring 34 is provided, adjacent the conical surface 37, with an encircling annular lip 39, separated from the beforementioned bevelled surface 37 by an intervening annular spacing groove 40. Upon the application of longitudinal force through the ring 34 to the segments of the retainer ring 28, the resultantly induced sliding and wedging action between the mutually contacting conical surfaces 37 and 38 will result in radial forces causing the segments 28a-28d of the retainer ring 28 to move radially outward against the resistance of the leaf springs 29. The compression ring 34, together with the expansible retainer ring 28 thus together serve to close the annular space between the packer sleeve and a surrounding casing in the manner shown in Figures 2 and 7. As a limiting condition, in the absence of a surrounding casing or in case the casing is too large, the beforementioned outer cylindrical faces 41 on the ends of the segments of the retainer ring 28 opposite the bevelled surfaces 38 may, by the application of longitudinal force therethrough, be brought into restraining contact with the inside surface of the lip 39 and to a position within the annular recess 40 of the compression ring substantially as illustrated in Figure 7. The relative position of the lips 30 and 39 and the tongues 31 and surfaces 41, respectively, at the lower and upper ends of the retainer ring segments are then such that unless otherwise restrained, such as by contacting a surrounding casing, as beforementioned, the maximum outwardly expansive movement of the

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segments and thereby the maximum diameter of the sealing ring 28 are thereby limited.

Referring again primarily to Figure 1, the packer sleeve 14 is provided with another annular shoulder 54, located a short distance above the beforementioned shoulder 44, and formed by a slight reduction in diameter in the upper portion of the said packer sleeve 14. The shoulder 54 is adapted to contact the inner lower surface of the packing compression rings 34 at 55 and is located at such a distance above the shoulder 43 as to support the said compression ring 34 and remove axial forces from the retainer ring 28 when the packer assembly is hanging in the unset condition as shown in Figure 1.

A resilient, expansible packing 35 is carried on the packer sleeve 14 between a pair of oppositely facing packing compression rings 34 and 34a, ring 34a being of the same or similar form to that of ring 34 hereinbefore described.

On the end portions of the packer sleeve 14 and adjacent the outer faces of the compression rings 34 and 34a are segmental retainer rings 28 and 28', retainer ring 28' being also of the same construction as ring 28 hereinbefore described.

The circulation valve sleeve 16 terminates at its lower end adjacent the threaded connection 15, in the same form as that shown for the upper end of the retainer ring supporting spool 27 and carries a plurality of leaf springs 29a, similar to those shown at 29 for holding the segments of the retainer ring 28' in assembled position.

Slidably supported on the outer frusto-conical surface of the slip-wedging cone 25, are a plurality of conventional, wickered slips, as shown at 45. The wickered slips are supported in the usual manner by means of flexible reins 46 which extend between the slips 45 and a collar 47 of a slip cage 48. The slip cage 48 comprises a tubular sleeve 49 terminating at its upper ends in the collar 47 and having a separate lower collar 50, the whole being slidably supported upon the lower portion of the mandrel 11. A plurality of outwardly bowed cage springs extend between and resiliently interconnect the slip-cage collars 47 and 50 as shown at 51, and these springs 51 are adapted to make sliding frictional contact with the inside surface of a well casing. A J slot 52 of usual design is provided through the wall of the cage sleeve 49 and is adapted to make sliding and limited rotational fit with a screw or pin 53 extending into the J slot from the tubing mandrel 11. As illustrated in Figure 1, the slip cage 48 is initially locked by means of the screw 53 in the upper end of the J slot 52 in the position which retains the slips 45 in their retracted positions relative to the slip cone 25. While conventional cone and slips means for engaging a casing is herein illustrated, any other suitable casing engaging means may be employed which will perform the same function.

The resilient packing 35 may be of any suitable type, such as for example, a single annular or sleeve-shaped member of suitable size or as illustrated here composed of a plurality of separate annular-shaped packing rings, as shown at 35, surrounding and supported coaxially in end to end position upon the beforementioned packer sleeve 14, and adapted to be compressed longitudinally and thereby expanded radially between the beforementioned packer compression rings 34 and 34a.

Having hereinbefore described the apparatus of the invention, its operation is as follows:

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Referring first primarily to Figure 1, the packer device is first lowered by means of piping or tubing or the like suitable means into the well to a position within the well casing at which it is desired to set the packer. During the lowering and just prior to setting, the several parts of the packer assembly will occupy the relative positions illustrated in Figure 1. During the lowering of the packer in the casing, the lower packing compression ring 34 and the resilient packing 35 and upper compression ring 34a carried by it are initially supported upon the annular shoulder 54 of the packer sleeve 14, the slip cone 25 and spool 27 hang suspended with the inner annular shoulder 43 of the spool element 27 bearing upon the shoulder 44 of the lower end of the packer sleeve 14, and the packer sleeve 14 is, in turn, supported at the lower end upon the shoulder 13 on the mandrel 23. The resilient packing 35 and the packing retainer rings 28 and 28' are thus relieved of any substantial longitudinal weight or force which would tend to expand them into contact with a surrounding casing during the lowering operations.

The slips 45 are retained in the retracted position shown in Figure 1 by means of the pin 53 which, as before mentioned, makes latching engagement with the upper left hand end of the horizontal portion of the J slot 52. Any tendency for the cone 25 and the attached mechanism to ride upward on the mandrel during rapid lowering operations, is prevented by the hooks 56 on the lower ends of the slips 45.

When the packer has been positioned within the casing to the point at which it is desired to set the packer, the supporting tubing and the mandrel 11 connected therewith is given a slight, left-hand rotation through an angle sufficient to carry the pin 53 across the horizontal top portion of the J slot from the position shown in Figure 1 to a position at the top of the longitudinally extending arm of the J slot. Tubing 10 and mandrel 11 are then again lowered and by reason of the frictional engagement of the cage springs 51 with the inside surface of the casing, the slips 45 are carried upward relative to the slip cone 25 into wedging engagement between the slip cone and the inside surface of the surrounding casing as shown in Figure 2.

Further downward motion of the tubing and the mandrel 11 after thus setting the slips, results in first lowering the shoulder 44 of the packer sleeve away from the shoulder 43 of the spool member 27, thus transferring the weight of the expansible retainer ring 28, member 27, and cone 25 to the slips 45. Next, with continued downward motion of the mandrel 11 and packer sleeve 14, the shoulder 54 of the packer sleeve is lowered away from the lower surface of the compression ring 34, thus transferring the weight of the compression ring 34a, packing body 35 and compression ring 34 to the expansible retainer ring 28 which is, in turn, supported through spool member 27 by the cone 25 and slips 45. Next, with still further continued downward travel of the mandrel 11, the shoulder 13 of the mandrel 11 will be lowered away from supporting contact with the lower end of the packer sleeve 14 thus transferring the weight of the packer sleeve 14, and collar 16 through the upper expansible retainer ring 28' to the compression ring 24a and thence through the packing body 35 to the lower com-

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pression ring 34, lower expandable retainer ring 28 and thence on to the slips 45 as before described. Finally, further downward motion of the mandrel carries the bevelled surfaces 18 and 17 of the mandrel head 10 and collar 16, respectively, into closed contact as shown in Figure 2, after which continued downward pressure applied to the mandrel 11 from the tubing transmits longitudinal compressive force and motion through the sleeve 16 to the segmental retainer ring 28' and thence through the mutually contacting conical surfaces 37a and 38a to the packer compression ring 34a. The force thus applied to compression ring 34a is transmitted longitudinally through the packing body 35 to the opposite compression ring 34 through the segmental retainer ring 28, through the spool member 27 and slip cone 25 to the slips which, as before stated, are in wedging engagement with the inside surface of the casing.

The force thus applied to the segmental retainer rings 28 and 28' causes the segments thereof, to slide outwardly radially over the conical surfaces of contact with the compression rings 34 and 34a, respectively, until they are brought into engagement with the inside surface of a casing as shown in Figure 2.

In the completely set condition, the packing retainer rings 28 and 28' are shown thus expanded into closing engagement with the inside surface of a casing and by reason of the internal pressure, a portion of the packing may be caused to flow longitudinally into the annular clearance space between the packer compression rings 34 and 34a and the inside surface of the casing until it is stopped by the closing or retaining action of the overlapping segments of the expandable retainer rings 28 and 28' as best shown in Figure 7.

For clarity and convenience in the drawings, only the initial stage of the longitudinal flow of the packing material 35 between the compression rings 34 and 34a and the surrounding casing toward the retainer rings 28' and 28 is illustrated in Figure 2. A more complete flow condition is illustrated in Figure 7.

Longitudinal flow-by and loss of packing material is thus checked and prevented by the confining action of the sealing rings 28 and 28'. One of the advantageous features of the construction of this packer resides in the positiveness and facility with which it can be broken loose from packing engagement with a surrounding casing in a well and freely moved for resetting or withdrawal from the well without the difficulties usually encountered with conventional packers under such conditions. After having been set as shown and illustrated in Figure 2, the packer may be released from the set condition by elevating the tubing and the mandrel 11 and when this is done the free release of the packer from the casing is accomplished by and is the result of the following consecutive steps. First, the valve 17-18 is opened by the upward movement of the packer head 10 and the mandrel 11 relative to the collar member 16, after which the shoulder 13 of the mandrel 23 is carried upward into engagement with the lower end of the packer sleeve 14, thereby lifting the packer sleeve 14 carrying the valve sleeve 16 and retainer ring 28' off the top of the compression ring 34a and packing 35, thus relieving a large portion of the longitudinal expansive pressure on the packing rings 35 and expandable retainer ring 28. Next, upon further upward motion of the mandrel 11, the shoulder

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54 is carried upward into supporting engagement with the lower surface 55 of the compression ring 34, thus removing all of the longitudinal loading from the lower expandable retainer ring 28 permitting it to contract fully from contact with the surrounding casing. Continued movement applies sufficient upward force through the ring 34 to the packing 35 to break it loose from the inside surface of the casing and to allow it to contract to its approximate original diameter as shown in Figure 1. Next, upon still further upward movement of the mandrel 11, the shoulder 44 of the packer sleeve 14 is finally carried upward into engagement with the shoulder 43 on the inside of the spool member 26, which, in turn, lifts the slip cone 25 upward free of the slips 45, after which the whole packer assembly, again supported from the mandrel as shown in Figure 1, may be elevated freely in the casing and removed from the well. If, however, it is desired to reset the packer at a lower position in the casing, the tubing and the mandrel suspended therefrom is given a slight, right-hand rotation while it is being elevated, sufficient to move the pin 53 into latching position in the left-hand end of the upper horizontal arm of the J slot 52, as shown in Figure 1, after which the whole packer may then again be lowered freely through the casing to the desired resetting position without carrying the slips 45 into wedging engagement between the slip cone 25 and the inside surface of the surrounding casing. Upon thus lowering or raising the packer to the desired new position, it can be reset in the same manner as hereinbefore described in connection with the original setting operations.

The action of the packing retainer rings 28 and 28', as hereinbefore described, are such as substantially to close off the annular space between the packer sleeve 14 and the inside surface of the surrounding casing at the ends of the packer to form in effect, a closed annular chamber containing the resilient packing material. Upon application of longitudinal compressive force to the retainer rings 28 and 28' and to the packing material therebetween, the packing material is subject, in effect, to a hydraulic pressure which causes it to be expanded radially and to flow both radially and longitudinally into intimate contact between the packer sleeve 14 and the inside surface of the surrounding casing. End-wise flow with resultant extrusion or leakage of the packing material which is thus, in effect, subject to hydraulic pressure, is prevented by the obstructing action of the overlapping segments of the expanded retainer rings 28 and 28'.

The packing material being thus, in effect, confined within a fluid tight annular chamber at the time of its compression, may be composed of a relatively soft and pliable rubber-like material which would, otherwise, be too soft to be retained in proper sealing engagement with the casing. The packing material thus confined may also be subject to temperatures which are substantially in excess of those heretofore possible and which have the effect of softening the packing material.

To prevent bailing action during raising or lowering operations of the packer in a well-containing fluid prior to setting or after releasing from a set position, provision is made for free flow through the packer by way of the flow channel comprising the valve 17-18, circulation passage 29 between the mandrel 11 and packer sleeve 14 and the annular space between the inner bore of the slip expander cone 25 and the mandrel 11.

Such construction as this, making provision for so-called circulation through the packer is common practice in present packer designs, but is not entirely necessary for the construction and operation of this invention. For example, where the packer is to be employed for either permanent or temporary plugging operations, the bypass circulation ducts or central flow passages may be omitted and the packer elements 14 supported directly on a central cylindrical mandrel. Such construction incorporating a suitable bypass flow passage, however, is a preferred one, particularly in a production type packer, in order to permit the retainer rings, packer sleeve and other parts of the packer to be constructed with minimum clearances inside the casing in which it is to be employed, and yet permit rapid movement of the packer through a fluid-filled well bore hole or casing. Such minimum clearances reduce the radial travel and degree of expansion required in the expansible retainer rings which results in their better mechanical construction and increased effectiveness of operation.

Such minimum clearances thus permitted, also are reflected in reduced part sizes and reduced ranges of motion of the various parts of the packer required for the setting or releasing operations.

It is to be understood that the foregoing is illustrative of but one apparatus, and that the invention is not limited thereby, but may include various modifications and changes made by those skilled in the art without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In a well packer, in which an annular shaped, resilient packing element is mounted on a packer body and is expanded by longitudinal compressive force to form a seal between said packer body and a surrounding casing, an expansible packing retainer means on said packer body adjacent one end of said packing element between said body and a surrounding casing and operative to prevent longitudinal flow of said packing element when under compressive force, said packing retainer means comprising: a plurality of rigid, arcuate segments positioned substantially end to end; a circumferentially extending tongue on each of said segments; a circumferentially extending recess on each of said segments, the tongue of each segment being positioned in the recess of the next adjacent segment in overlapping sliding engagement with one another to form a circumferentially variable, radially expansible, segmented ring structure; a collar member positioned on said packer body substantially coaxial with said segmented ring structure; individual resilient means joining each of said arcuate segments coaxially to and adjacent one end of said collar member, said individual arcuate segments being thus adapted to be substantially longitudinally immovable but with freedom for radial motion adjacent an end surface of said collar member; a coaxial frusto-conical bearing surface on an inner portion of said segmented ring structure; a second ring slidably encircling the packer body next adjacent said packing element and having a frusto-conical wedging surface on an outer portion thereof in sliding wedging engagement with said frusto-conical bearing surface on said segmented ring and operable to simultaneously move all said segments radially outward upon application of longitudinal force through said second ring to said segments.

2. In a well packer apparatus according to

claim 1 in which the said individual resilient means joining each of said arcuate segments to the collar member comprises a longitudinally directed flexible leaf spring.

3. In a well packer, apparatus according to claim 1 in which means are provided on said arcuate segments engageable with means on said ring and on said collar to limit the radial movement of said segments and thus to determine a maximum diameter of said segmented retainer ring structure.

4. In a well packer, in which an annular shaped, resilient packing element is mounted on a packer body and is expanded by longitudinal compressive force to form a seal between said packer body and a surrounding casing, an expansible packing retainer means on said packer body adjacent an end of said packing element between said body and a surrounding casing and operative to prevent longitudinal flow of said packing element when under compressive force, said packing retainer means comprising: a plurality of arcuate segments positioned substantially end to end with portions thereof in overlapping sliding engagement with one another to form a continuous, circumferentially variable, radially expansible segmented ring structure; a collar member positioned on the packer body substantially coaxial with said segmented ring structure; individual resilient means attached to each of said arcuate segments and joining them coaxially to an adjacent end of said collar member, said individual arcuate segments being thus adapted to be individually supported with freedom for radial motion at the end surface of said collar member; and a frusto-conical wedge means slidable on said body next adjacent said packing element and slidably engaging said arcuate segments and operable to simultaneously move all said segments radially outward upon application of longitudinal force through said frusto-conical wedge means and said segmented ring structure.

5. In a well packer, in which an annular shaped, resilient packing element is mounted on a packer body member and is expanded by longitudinal compressive force to form a seal between said packer body member and a surrounding casing, an expansible packing retainer means on said packer body member adjacent an end of said packing element between said body member and a surrounding casing and operative to prevent longitudinal flow of said packing element when under compressive force, said packing retainer means comprising: a plurality of arcuate segments positioned substantially in end to end overlapping, circumferentially sliding engagement with one another to form a circumferentially variable, radially expansible segmented ring structure encircling said packer body member; a collar member positioned on said body member substantially coaxial with and adjacent to said segmented ring structure; resilient means joining said arcuate segments coaxially to said collar member, said individual arcuate segments being thus supported with freedom for limited radial motion on one end of said collar member; and annular means slidable on said body next adjacent said packing element and slidably engaging said arcuate segments and operable to simultaneously move all said segments radially outward upon application of longitudinal force therethrough.

6. In a well packer, the combination comprising: a cylindrical support; a pliable, annular packing element on said support; a circum-

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ferentially expansible packing retainer means encircling said support; a compression ring encircling said support intermediate said expansible retainer means and one end of said packing element; coengaging inclined surfaces formed on said retainer means and said compression ring to expand said expansible retainer means upon application of longitudinal compressive force therethrough; a slip-expanding cone member slidably mounted on said support beyond said retainer means and said compression ring from said one end of said packing element, said cone member having a surface for engagement with said packing retainer means; a slip slidable on said cone member between a non-wedging and a wedging position between said cone member and a surrounding casing; and packer setting means carried by said support to compress said packing element longitudinally on said support to expand said packing element and said packer retaining means radially between said support and a surrounding casing after said slip is in wedging position between said cone member and a surrounding casing.

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7. Apparatus as defined in claim 6 having a second compression ring and a second packing retainer means at the opposite end of said packing element from said cone member, said second packing retainer means having a surface for engagement with said packer setting means.

CHARLES H. BARNES.

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