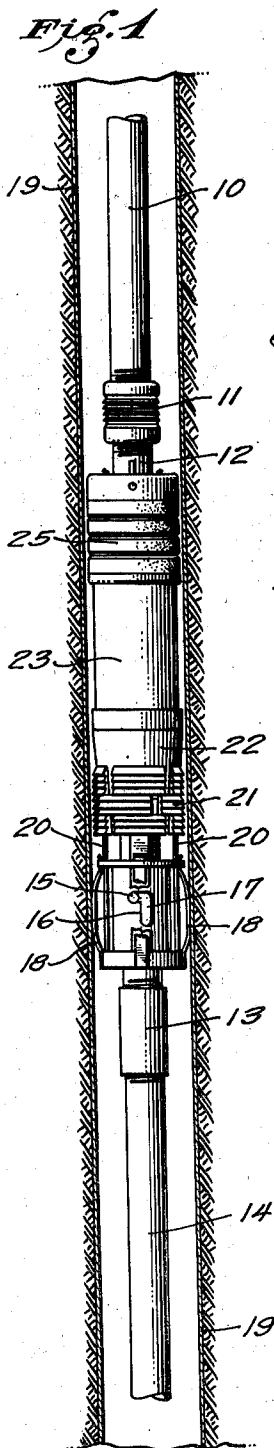
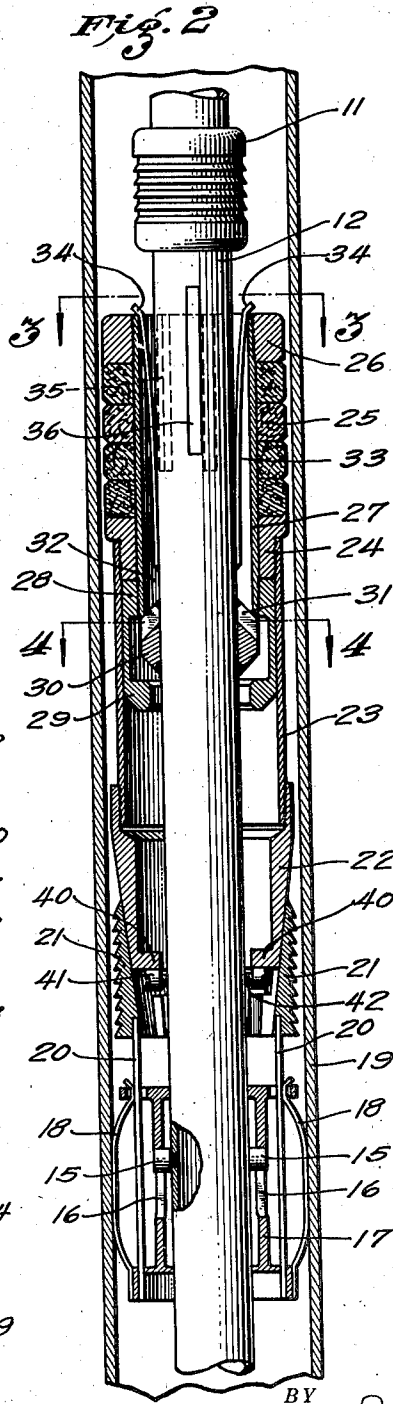
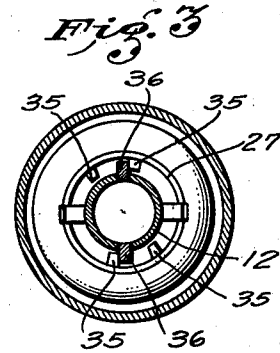
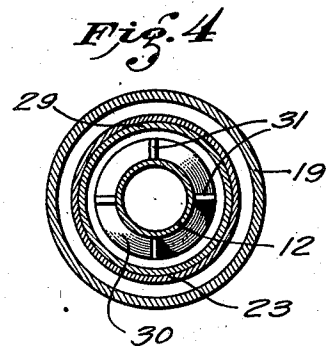


Oct. 20, 1936.

J. T. PHIPPS
CIRCULATION PACKER
Filed June 15, 1935

2,058,103

2 Sheets-Sheet 1



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Oct. 20, 1936.

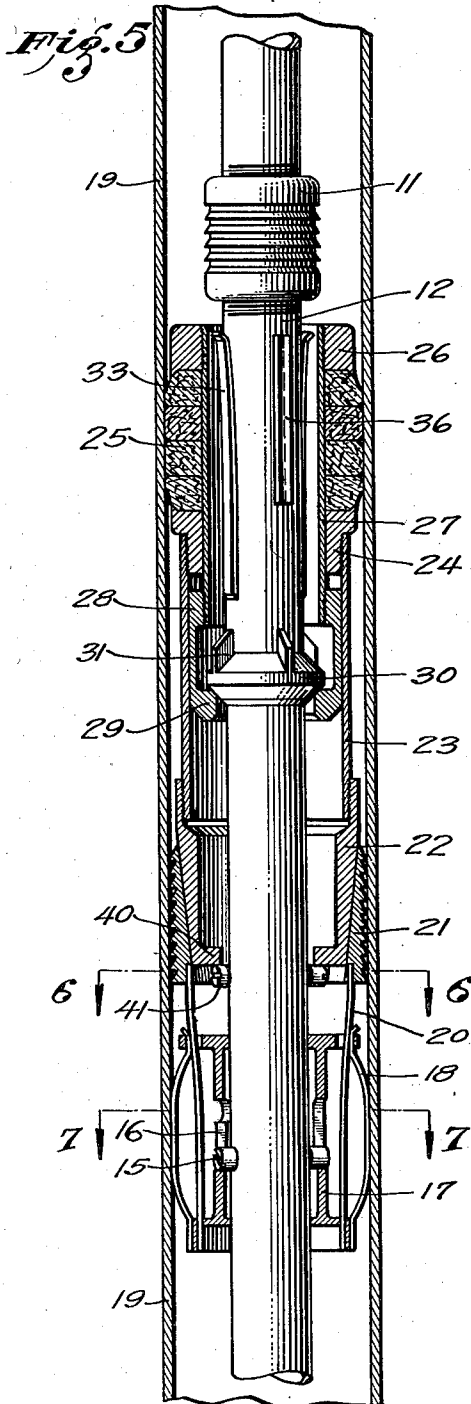
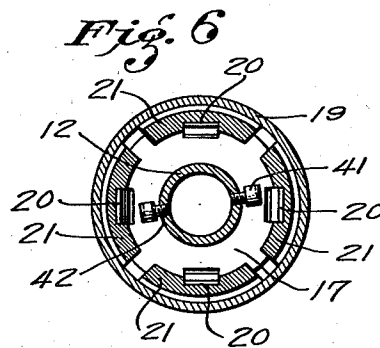
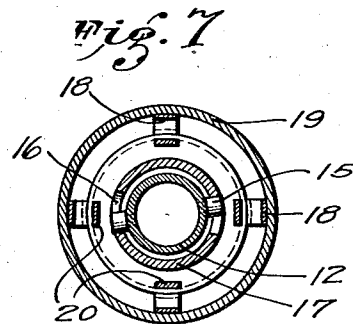
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2,058,103

CIRCULATION PACKER

Filed June 15, 1935

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,058,103

CIRCULATION PACKER

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Application June 15, 1935, Serial No. 26,806

14 Claims. (Cl. 166—12)

This invention relates to oil well drilling equipment and particularly pertains to a well packer.

In oil well drilling operations it is often necessary to pack off a certain section of a well for various purposes, as for example when fluid at the bottom of a well casing is packed off to permit a subsequent flow of fluid through a well drill string or well tubing. These packers are usually run into the hole on a drill string or tubing, and when they reach a desired point may be manipulated by the drill string or tubing to be set against movement and to expand a packing element within the casing or hole. Due to the character of the packing element, whereby it is capable of expansion, it often occurs that the pressure of the fluid in the well is sufficient to create an expansive action of the packing element as the packer is run into the hole so that it will engage the side wall of the hole before reaching the point at which it is to be set, and furthermore when a circulation passageway is provided through the packer this passageway is of necessity so small in sectional area and the means provided to hold the by-pass valve open act to prevent rapid lowering of the device through the fluid within the well. It is the principal object of the present invention, therefore, to provide means in a packer for maintaining the packing element in a non-compressible position as it is run into the hole, and at the same time providing an adequate unrestricted fluid circulation passageway through the packer and around the tube on which it is suspended to permit the fluid within the hole to readily bypass through the packer as it is lowered without becoming clogged or unduly restricted so that increased pressures will not be created by the packer as the packer is lowered, and which pressure would tend to compress the packing element longitudinally and thereby expand it against the wall of the hole at a time when this operation was not intended.

The present invention contemplates the provision of a packer adapted to be suspended on a drill string or well tubing, and which packer is provided with a packing element designed to permit a maximum free and unrestricted circulation of drilling fluid through it as the device is lowered in the hole, and at the same time to prevent an expansion and untimely setting of the packer against the wall of the hole as the packer is being run in. The invention further contemplates the provision of a longitudinal spring means for normally holding the by-pass valve open without unduly restricting the fluid passageway.

The invention is illustrated by way of example in the accompanying drawings in which:

Figure 1 is a fragmentary view in section and elevation showing the packer with its parts in the relationship they assume as the packer is being lowered into a well bore.

Fig. 2 is an enlarged view in longitudinal section, through the packer, showing the details of its construction, and its manner of assembly.

Fig. 3 is a view in transverse section through the packer as seen on the line 3—3 of Fig. 2 showing the packing element lock and by-pass valve locking means.

Fig. 4 is a view in transverse section through the packer as seen on the line 4—4 of Fig. 2, showing fluid circulation passageways.

Fig. 5 is a fragmentary view in section and elevation showing the packer as set within a casing and with the by-pass valve closed.

Fig. 6 is a view in transverse section through the packer as seen on the line 6—6 of Fig. 5, showing the slips in set position within the casing.

Fig. 7 is a view in transverse section through the packer structure as seen on the line 7—7 of Fig. 5, showing the manner in which the bow spring structure operates.

Referring more particularly to the drawings, 10 indicates a section of drill pipe or tubing provided with a coupling 11. Threaded into the coupling 11 is a tubular mandrel 12. This mandrel extends downwardly through the end of the device and is connected by a coupling 13 with a lower pipe or tubing section 14. The mandrel carries bayonet lock pins 15 which extend into J slots 16 formed in a sleeve 17 which is slidable upon the mandrel. This sleeve has mounted upon it a plurality of longitudinally extending bow springs 18 of conventional design, which springs yieldably and frictionally engage a well casing 19. Extending upwardly from the sleeve structure 17 is a plurality of longitudinally arranged straps 20 which yieldably support slips 21. The slips may be of any conventional design, but are preferably performed in accordance with the construction shown in my pending application entitled Packer and valve, filed by me on the 9th day of October, 1934, and bearing Serial No. 747,545.

The particular type of slips in that application are characterized by the fact that they have contact entirely around the inner circumferential face of the well casing at all times. The inner faces of the slips 21 are upwardly and outwardly tapered to receive an expanding cone 22 which extends downwardly between them. This cone is carried at the lower end of a tube 23. At the

upper end of the tube 23 a bottom collar 24 of a packing element 25 is provided. The bottom collar is threaded on to the sleeve 24, and provides a lower gripping member for the packing 25. An upper collar 26 provides an upper gripping member for the packing 25. This collar is mounted upon a tubular body member 27 through which the mandrel 12 extends. The lower end of the body member 27 is threaded into the upper end of a valve cage 28. The valve cage has a cylindrical body and terminates in an annular valve seat 29 through which the mandrel 12 extends. The opening through the valve seat is materially greater in diameter than the outside diameter of the tubular mandrel 12, so that fluid may circulate freely through it. The valve seat is designed to receive a conical valve member 30 which is carried on the tubular mandrel 12. A plurality of radial ribs 31 are disposed above the valve member and allow the fluid to circulate around the valve and upwardly into the annular passageway 32 which is formed between the outer face of the tubular mandrel 12 and the circumscribing face of the tubular body member 27. When the packer is in its lowermost position the valve 30 will seal the passageway through the valve member 29. In the position which it is run into the hole the valve 30 is held away from the seat 29. This is accomplished by a set of longitudinally extending spring fingers 33 which are carried on the mandrel and extend upwardly in the space 32 therearound, and terminate in inclined hooked portions 34 which overhang the upper edge of the tubular packer body 27, and maintain the packer structure in a temporarily fixed position with relation to its mandrel. These springs have the advantage over coil and other types of springs in that they occupy a relatively small space and since they extend longitudinally of the passageway through the sleeve 24 will not obstruct or catch material which would clog the same. Adjacent the upper end of the tubular packer body 27 longitudinally extending ribs 35 are provided. Between these ribs splines 36 are disposed, the splines being carried upon the circumferential faces of the mandrel 12. In this manner positive rotation of the packer structure may be had at all times. Attention is directed to the fact that due to the construction of packing rings here used and their arrangement on the sleeve 24 it is possible to obtain an unobstructed passageway of maximum cross sectional area through the packer without in any way weakening the parts of the device.

In operation of the present invention the packer is constructed as particularly shown in Figs. 2 and 5 of the drawings. When the device is to be lowered into a well bayonet lock pin 15 is disposed in the short leg of the J slot 16. When in this position the packer is disposed in its lowermost set position with relation to the mandrel so that the tubular body 27 of the packer will be engaged at its upper end by the overhanging portions 37 of the longitudinally extending springs 33. As previously explained this will hold the valve member 30 off of its seat 29 and will allow fluid from below the packer to pass up freely around the bow springs and in back of the slips 21, after which the fluid may pass upwardly through the large center bore of the cone 22 and then into the sleeve 23 within which the valve cage 28 is mounted. The fluid may then flow upwardly through the opening in the valve bore 29, thereafter passing around the valve member 30 and between the radial ribs 31 above the valve,

and thence the fluid will pass upwardly through the passageway 32 into and through the tubular valve body 27. The area of passageway 32 is such as to insure that fluid may flow freely through the packer as the tool is run in and out of the hole. This arrangement also makes it possible to wash the casing in both directions of flow. In this way the fluid will completely bypass the packer 25 without any undesirable pressure which would tend to slow down the lowering of the seat of the packer or expanding the packing element into the well bore or casing in a manner to restrict the fluid passageway space around the outside of the packer, and between it and the wall of the bore.

When it is desired to set the packer the drill pipe or tubing is rotated in a counter clockwise direction to move the pin 15 into register with the long leg of the J slot, after which a lowering movement on the drill string will force the expanding cone 22 downwardly and move the slips radially and into a wedging position with relation to the well bore of the casing. At the same time the valve 30 will move downwardly and forcefully engage the valve seat 29, thus sealing off the fluid in the bottom of the well and exerting pressure upon the valve cage 28, which will pull downwardly and expand the packing members 25 to make a seal in the well bore or casing.

In order to insure that the structure will remain in assembly, even though there might be some damage to the valve seat 29, or the valve 30, retaining lugs 40 are disposed upon the expanding cone 22 and may be engaged by the heads 41 of the screws 42 which are screwed radially into the wall of the tubular mandrel 12. By this arrangement it will be possible to withdraw the packer from the hole if parts break, and without possibility that the slips 21 will jam in the hole.

In the event the packer strikes an obstruction within the well bore or casing which might accidentally release the parts of the packer to force the mandrel and longitudinal springs downwardly it might be that the springs would release the packer. This can be overcome instantly by lifting the well string to restore the hooked ends 34 of the longitudinally extending springs to their locked position with relation to the packer sleeve 24.

Attention is also directed particularly to the fact that where heretofore packers have used valve springs of the coiled type, these structures have been easily clogged with mud and debris. Furthermore, with coiled springs or holding bolts the space occupied by these elements has restricted the dimension of the other parts to weaken them or has so restricted the area of the circulation passageway as to make it impossible to move the packer readily and to keep it from clogging.

It will thus be seen that the structure here disclosed provides simple means for insuring that circulation may be maintained through and around the packing element of a well packer as it is being lowered into a well, and that after it has been set circulation may be interrupted and the packer expanded, by a simple operating movement.

While I have shown the preferred form of my invention, as now known to me, it will be understood that various changes might be made in the combination, construction, and arrangement of parts by those skilled in the art without departing from the spirit of the invention as claimed.

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

1. A packer comprising a tubular mandrel, spring means mounted upon the mandrel to engage a well casing, slips associated with the spring means whereby they may be held in gripping relation to the casing, expanding means for the slips carried by the mandrel, a packing structure supported above the expanding means and through which the mandrel extends, a sleeve extending through the packing structure to engage a packing compression member, and cooperating means between the mandrel and the sleeve whereby a lowering motion of the mandrel will force the packing sleeve downwardly and exert an expansive action upon the packing to press it against the casing.

2. A well packer comprising a deformable packing sleeve, compression members at the opposite ends thereof between which said sleeve may be compressed and laterally expanded, an expanding cone in fixed association with the lower compression member of said packer, a casing slip structure adapted to be actuated by longitudinal movement of the expanding cone with relation thereto, a mandrel extending through the packer and carrying the casing slip structure, a valve member mounted upon the mandrel to control the flow of fluid through the packing structure and around the mandrel, and a member carrying a packing seat suspended from the upper compression member of the packing and adapted to be engaged by the valve member on the mandrel to interrupt the flow of fluid through the packing and to compress the packing.

3. A well packer comprising a deformable packing sleeve, compression members at the opposite ends thereof between which said sleeve may be compressed and laterally expanded, an expanding cone in fixed association with the lower compression member of said packer, a casing slip structure adapted to be actuated by longitudinal movement of the expanding cone with relation thereto, a mandrel extending through the packer and carrying the casing slip structure, a valve member mounted upon the mandrel to control the flow of fluid through the packing structure and around the mandrel, a member carrying a packing seat suspended from the upper compression member of the packing and adapted to be engaged by the valve member on the mandrel to interrupt the flow of fluid through the packing and to compress the packing, and means normally holding the valve and its seat in open relation to each other.

4. A well packer comprising a deformable packing sleeve, compression members at the opposite ends thereof between which said sleeve may be compressed and laterally expanded, an expanding cone in fixed association with the lower compression member of said packer, a casing slip structure adapted to be actuated by longitudinal movement of the expanding cone with relation thereto, a mandrel extending through the packer and carrying the casing slip structure, a valve member mounted upon the mandrel to control the flow of fluid through the packing structure and around the mandrel, a member carrying a packing seat suspended from the upper compression member of the packing and adapted to be engaged by the valve member on the mandrel to interrupt the flow of fluid through the packing and to compress the packing, and engaging means between the packing structure and the mandrel for permitting rotation in unison of said elements.

5. A well packer comprising a tubular mandrel, a sleeve through which the mandrel extends and through which a circulating passageway occurs, an upper compression element fixed to the sleeve, a lower compression element slidable on the sleeve, a deformable packing carried between said compression elements, an expanding cone in fixed association with the lower compression element, a slip structure mounted upon the tubular mandrel and cooperating with the expanding cone to set the packer in a well casing, cooperating means between the packing sleeve and the mandrel whereby downward pressure of the mandrel when the slip structure is set will exert a downward pull on the packing sleeve and the upper compression member to longitudinally compress and laterally expand the packing.

6. A well packer comprising a tubular mandrel, a sleeve through which the mandrel extends and through which a circulating passageway occurs, an upper compression element fixed to the sleeve, a lower compression element slidable on the sleeve, a deformable packing carried between said compression elements, an expanding cone in fixed association with the lower compression element, a slip structure mounted upon the tubular mandrel and cooperating with the expanding cone to set the packer in a well casing, cooperating means between the packing sleeve and the mandrel whereby downward pressure of the mandrel when the slip structure is set will exert a downward pull on the packing sleeve and the upper compression member to longitudinally compress and laterally expand the packing, and optionally controlled means between the mandrel and the slip structure for normally holding said members against movement with relation to each other, and for releasing said members from their held position.

7. A well packer comprising a tubular mandrel, a sleeve through which the mandrel extends and through which a circulating passageway occurs, an upper compression element fixed to the sleeve, a lower compression element slidable on the sleeve, a deformable packing carried between said compression elements, an expanding cone in fixed association with the lower compression element, a slip structure mounted upon the tubular mandrel and cooperating with the expanding cone to set the packer in a well casing, cooperating means between the packing sleeve and the mandrel whereby downward pressure of the mandrel when the slip structure is set will exert a downward pull on the packing sleeve and the upper compression member to longitudinally compress and laterally expand the packing, and yieldable means normally holding said cooperating means in disengaged relation to each other.

8. A well packer comprising a tubular mandrel, a sleeve through which the mandrel extends and through which a circulating passageway occurs, an upper compression element fixed to the sleeve, a lower compression element slidable on the sleeve, a deformable packing carried between said compression elements, an expanding cone in fixed association with the lower compression element, a slip structure mounted upon the tubular mandrel and cooperating with the expanding cone to set the packer in a well casing, cooperating means between the packing sleeve and the mandrel whereby downward pressure of the mandrel when the slip structure is set will exert a downward pull on the packing sleeve and the upper compression member to longitudinally compress and laterally expand the packing, said cooperating

means including a valve member on the mandrel, and a valve seat carried by the sleeve whereby engagement of said members to produce compression of the packing will simultaneously interrupt the flow of fluid through the packing sleeve and around the mandrel.

9. A well packer comprising a central mandrel, a sleeve slidable thereon, spring means carried by the sleeve for yieldably engaging a casing into which the packer is set, lock means normally holding the sleeve and the mandrel against motion with relation to each other and releasable by manipulation of the mandrel to permit the mandrel to slide through the sleeve, a plurality of casing slips yieldably supported by the sleeve for engagement with the well casing, an expanding cone through which the mandrel extends and by which the slips may be moved to their gripping positions, a lower compression member fixed with relation to said expanding cone, an upper compression member, a valve seat disposed at the lower end of said sleeve and through which the mandrel extends, the opening through said seat being sufficiently large to permit a flow of fluid through the mandrel, a valve member fixed upon the mandrel above said seat and adapted to be moved down into engagement therewith when the slips are in gripping engagement with the well casing, said valve member acting against the seat to exert a downward pressure upon the upper compression member and set the packer.

10. A well packer comprising a central mandrel, a sleeve slidable thereon, spring means carried by the sleeve for yieldably engaging a casing into which the packer is set, lock means normally holding the sleeve and the mandrel against motion with relation to each other and releasable by manipulation of the mandrel to permit the mandrel to slide through the sleeve, a plurality of casing slips yieldably supported by the sleeve for engagement with the well casing, an expanding cone through which the mandrel extends and by which the slips may be moved to their gripping positions, a lower compression member fixed with relation to said expanding cone, an upper compression member, a packing interposed between the two pressure members, a tubular sleeve fixed to the upper compression member and extending downwardly through the packing and the lower compression member, a valve seat disposed at the lower end of said sleeve and through which the mandrel extends, the opening through said seat being sufficiently large to permit a flow of fluid through the mandrel, a valve member fixed upon the mandrel above said seat and adapted to be moved down into engagement therewith when the slips are in gripping engagement with the well casing, said valve member acting against the seat to exert a downward pressure upon the

upper compression member and set the packer, and spring means mounted upon the mandrel to yieldably hold the valve seat out of engagement with the valve member whereby a flow of fluid through the valve and the packing will take place until the packing is set.

11. In a well packer, a packing sleeve, a mandrel extending therethrough and providing an annular fluid circulating space through the sleeve and around the mandrel, a valve seat carried by the sleeve, a valve member carried by the mandrel, and longitudinally extending springs carried by the mandrel and engaging the packing sleeve whereby the valve and its seat will be held normally out of register.

12. In a well packer, adapted to be set within a well casing, a packing sleeve, deformable packing means thereon, a mandrel extending through the packing sleeve and adapted to reciprocate relative thereto, said sleeve and mandrel combining to provide an annular fluid passageway through the sleeve and around the mandrel, a fluid valve seat carried by the sleeve, a fluid valve element carried by the mandrel, and longitudinally extending flat leaf springs secured to the mandrel and extending lengthwise of the fluid passageway therearound, said springs acting to yieldably hold the mandrel and packing sleeve with the valve and valve seat out of engagement.

13. In a well packer, adapted to be set within a well casing, a packing sleeve, deformable packing means thereon, a mandrel extending through the packing sleeve and adapted to reciprocate relative thereto, said sleeve and mandrel combining to provide an annular fluid passageway through the sleeve and around the mandrel, a fluid valve seat carried by the sleeve, a fluid valve element carried by the mandrel, and longitudinally extending flat leaf springs secured to the mandrel and extending lengthwise of the fluid passageway therearound, said springs acting to yieldably hold the mandrel and packing sleeve with the valve and valve seat out of engagement, lock ends being formed on the springs to engage the sleeve.

14. In a well packer, a central mandrel, a packing sleeve through which said mandrel extends and whereby an annular fluid passageway will be formed through the sleeve and around the mandrel, a deformable packing structure carried by the sleeve, a valve seat carried by the sleeve, a valve mounted on the mandrel and adapted to be moved to a seated position against the valve seat and to thereby simultaneously compress the packing, and longitudinally extending leaf springs secured to the mandrel at their lower ends and flaring outwardly at their upper ends to engage the packing sleeve and to yieldably hold the mandrel and sleeve with the valve and its seat in an opened position.

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