July 13, 1943. R. E. FULKERSON 2,323,989

CONTROL HEAD PACKER

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Fig. 1.

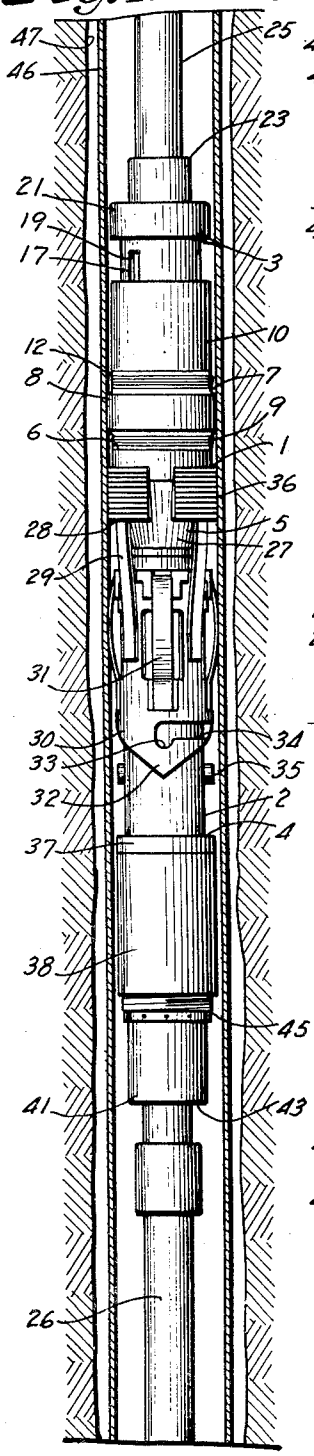


Fig. 2.

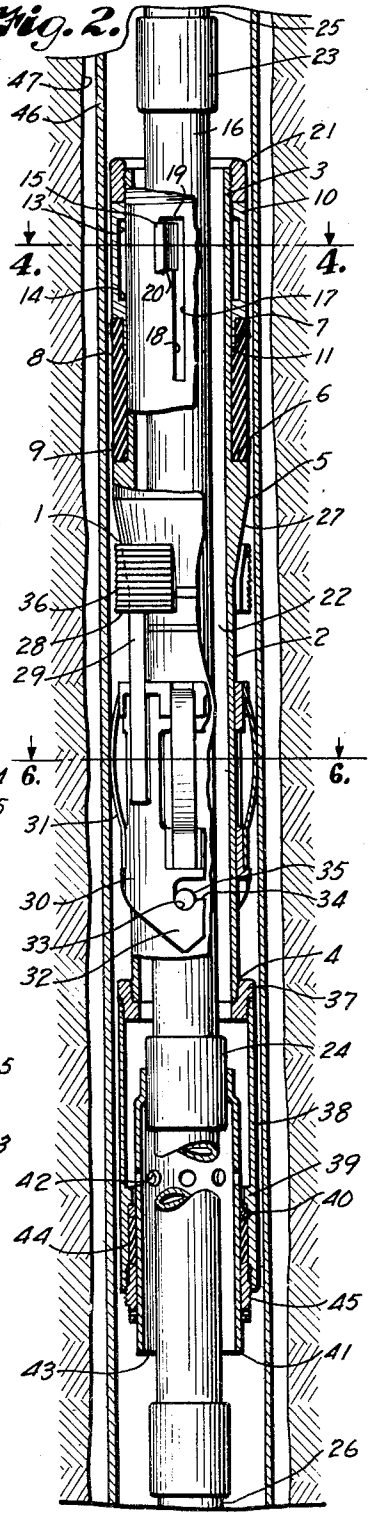
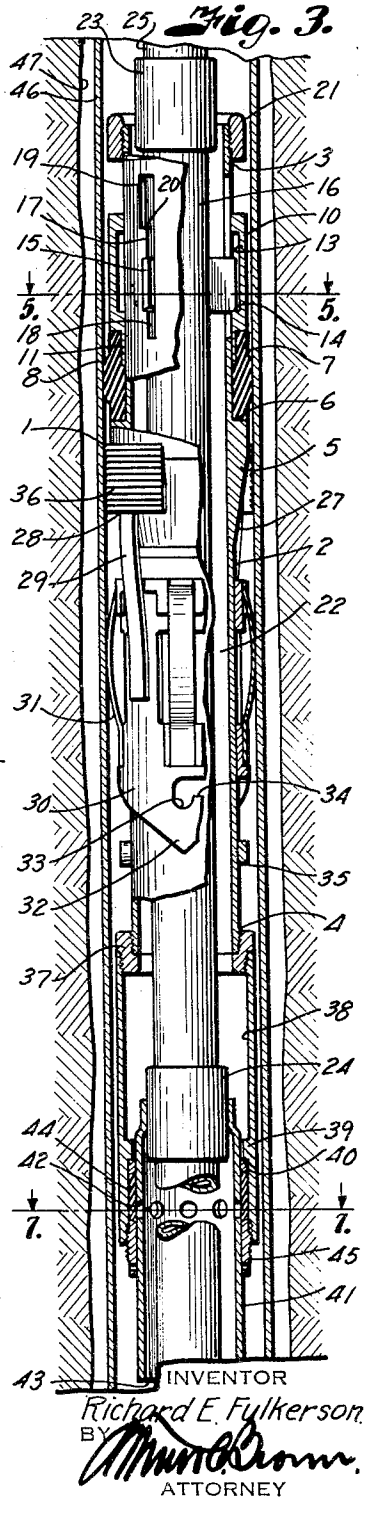


Fig. 3.



INVENTOR
Richard E. Fulkerson
BY
ATTORNEY

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Fig. 4.

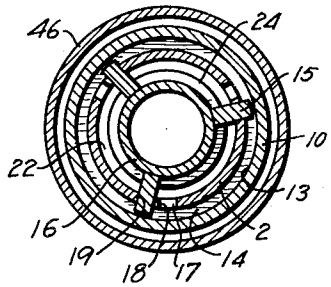


Fig. 5.

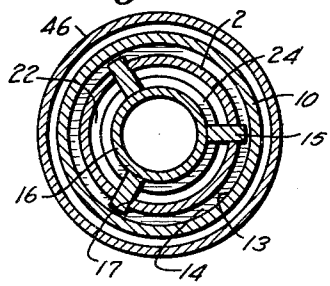


Fig. 6.

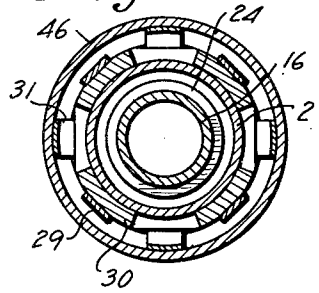


Fig. 7.

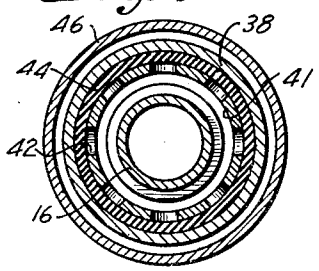


Fig. 8.

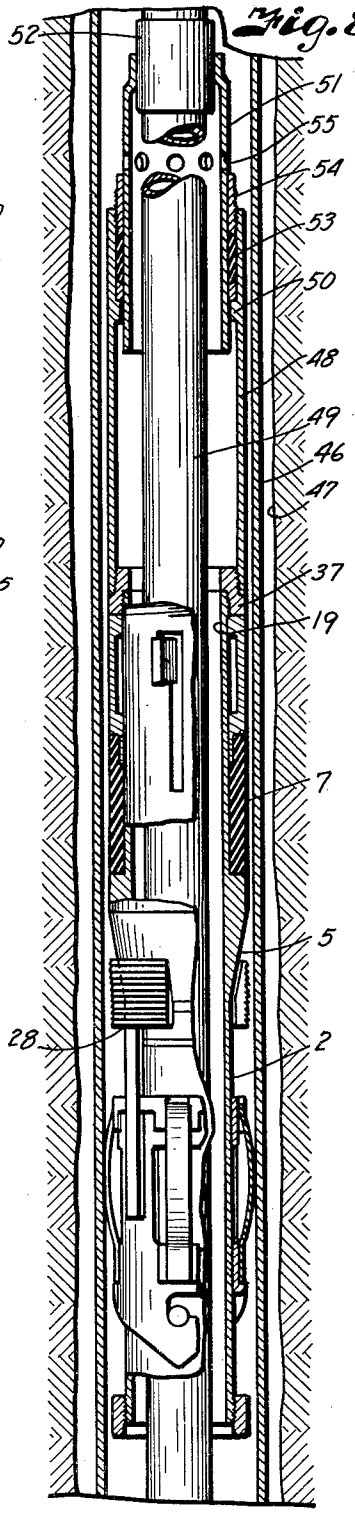
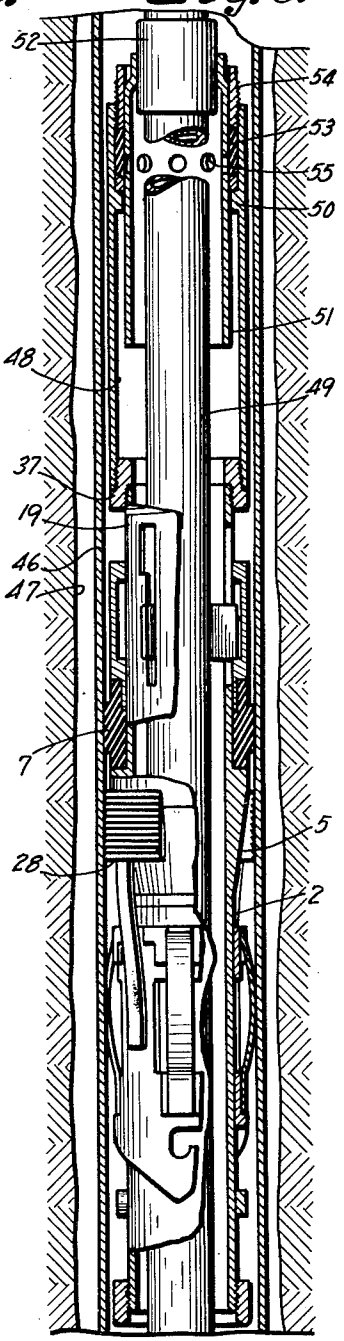


Fig. 9.



INVENTOR
Richard E. Fulkerson.
BY
ATTORNEY

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Fig. 10.

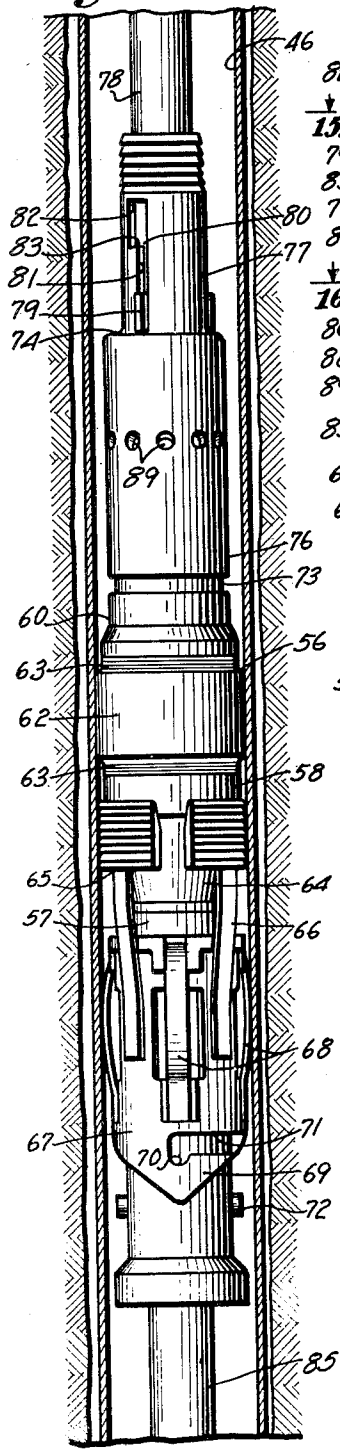


Fig. 11.

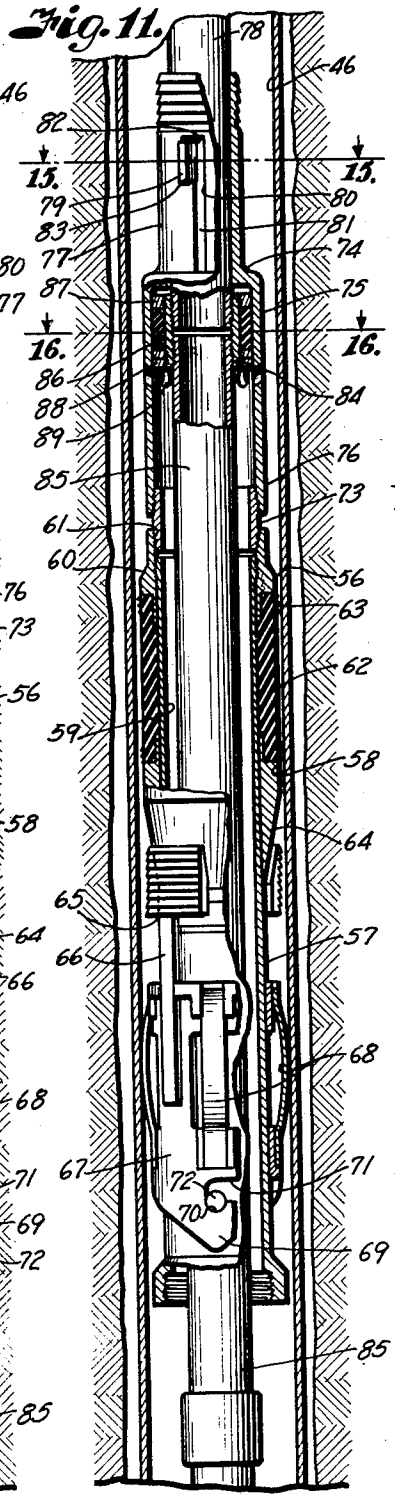
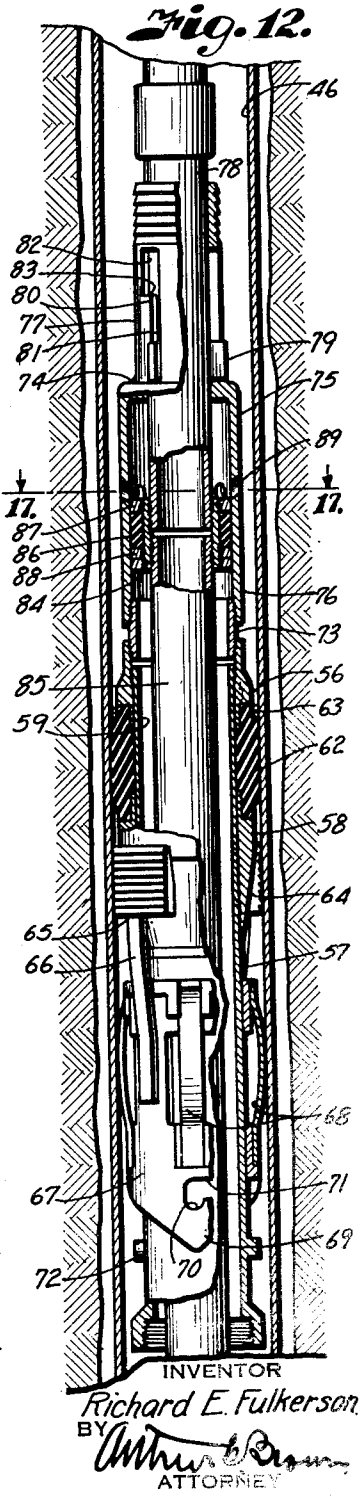


Fig. 12.



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Richard E. Fulkerson
BY
ATTORNEY

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Fig. 13.

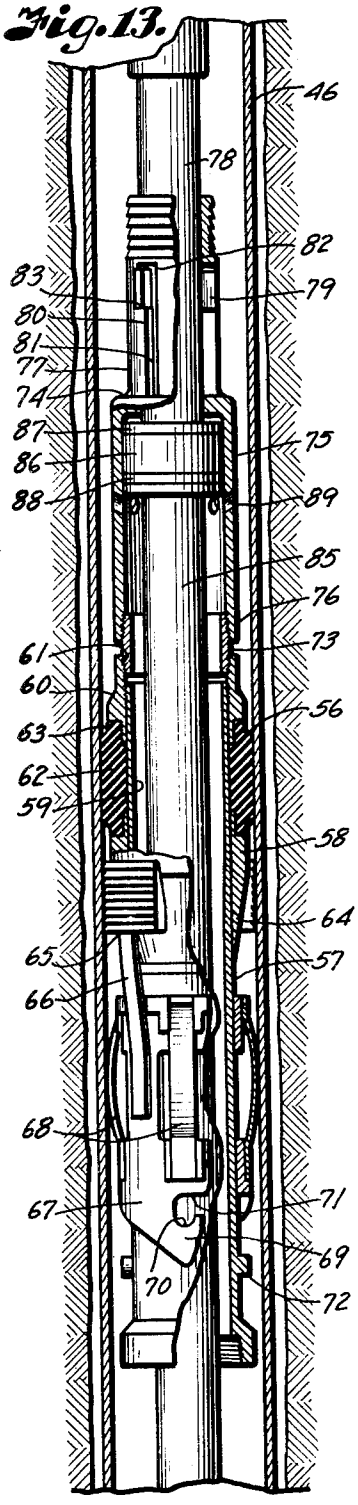


Fig. 14.

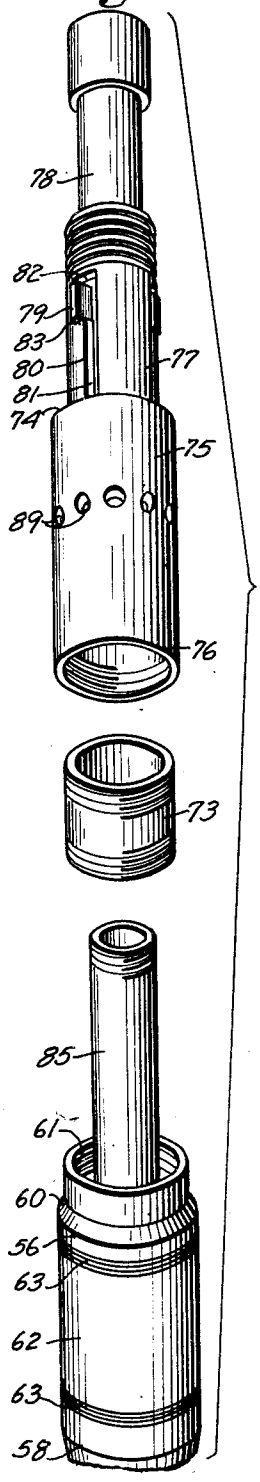


Fig. 15.

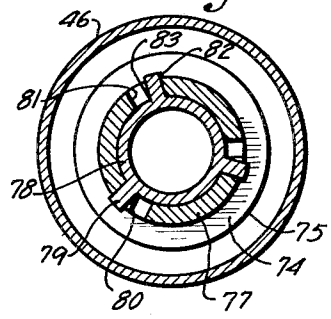


Fig. 16.

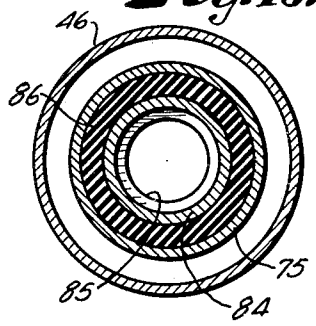
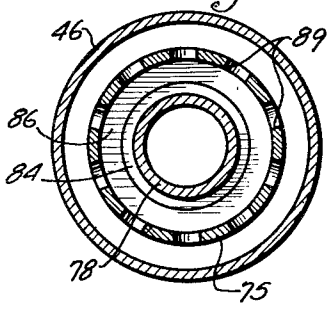


Fig. 17.



INVENTOR
Richard E. Fulkerson.
BY
ATTORNEY

Patented July 13, 1943 2,323,989

UNITED STATES PATENT OFFICE

2,323,989

CONTROL HEAD PACKER

Richard E. Fulkerson, Coffeyville, Kans., assignor to The Exner-Dodge Packer Company, Coffeyville, Kans., a corporation of Kansas

Application November 4, 1940, Serial No. 364,209

5 Claims. (Cl. 166—12)

This invention relates to packers, particularly those used for facilitating flow of a well under formation pressure. Usually it is necessary to run and set packers of this character against well pressures and through liquid standing in or flowing through the well casing. Since these packers must closely conform to the cross-sectional area of the casing in which they are set, there is insufficient room between the packer and the casing for by-passing the well fluids and pressures, consequently the packers are difficult to set. Various forms of tubing disk packers have been provided for this purpose but they have not proved satisfactory for the reason that the by-passed fluids contain large quantities of granular and slimy material which collects upon the seating surfaces of the valve elements and prevent proper seating thereof so that leakage occurs after the packer is set.

It is, therefore, a principal object of the present invention to provide a packer of this character equipped with a valve structure which is effective and positive in operation in that it is self-cleaning incidental to the wiping action of the movable element of the valve relatively to the fixed element.

It is also an object of the invention to provide a packer with means which gives sufficiently large by-pass capacity so that the packer is readily lowered through the well fluids and pressures.

Another object of the invention is to provide a valve assembly that permits of swabbing or washing of the well through the tubing and packer.

In accomplishing these and other objects of the invention, as hereinafter pointed out, I have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawings, wherein:

Fig. 1 is a vertical section through a portion of a well showing a packer embodying the features of the invention as it appears when set in the well casing.

Fig. 2 is a similar but slightly enlarged section showing the packer being lowered through the well casing, parts of the packer being broken away and shown in section to better illustrate the construction thereof.

Fig. 3 is a view similar to Fig. 2, but showing the packer in set position.

Fig. 4 is a cross-section through the packer on the line 4—4 of Fig. 2, showing the lugs on the well tubing in latched engagement with the bayonet slots of the packer body.

Fig. 5 is a similar section on the line 5—5 of Fig. 3 showing the position of the lugs moved from latched position as when the packer is set.

Fig. 6 is a cross-section taken through the slip carrier on the line 6—6 of Fig. 2.

Fig. 7 is a horizontal section through the control elements of the packer on the line 7—7 of Fig. 3.

Fig. 8 is a vertical section through a portion of a well showing a modified form of packer being run into the well.

Fig. 9 is a similar view of the modified form of packer in set position.

Fig. 10 is a vertical section through a portion of a well showing a further modified form of the invention wherein a control valve unit is connected with a conventional type packer, the packer being shown as set in the well casing and the valve closed.

Fig. 11 is a vertical section through the modified form of the invention showing the apparatus being lowered through the well casing.

Fig. 12 is a similar section showing the apparatus in set position and the control valve closed.

Fig. 13 is a similar section but showing the control valve open.

Fig. 14 is a perspective view of the parts of the control valve in disassembled spaced relation.

Fig. 15 is an enlarged cross-section on the line 15—15 of Fig. 11.

Fig. 16 is an enlarged cross-section on the line 16—16 of Fig. 11.

Fig. 17 is a cross-section on the line 17—17 of Fig. 12.

Referring more in detail to the drawings:

1 designates a packer constructed in accordance with the present invention and which includes a tubular body 2 having threaded ends 3 and 4 and an intermediate, cone-shaped collar 5. The base of the collar 5 forms a shoulder 6 for seating the lower end of a packing unit 7. The packing unit 7 includes a resilient, sleeve-like body 8 engaged over the upper end of the packer body and having its lower end secured thereto in abutting relation with the shoulder 6 by a wrapping 9.

The packing unit also includes a sleeve 10 substantially conforming in diameter to the packing sleeve 8, and which is freely slidable upon the body of the packer. The sleeve 10 preferably has a reduced neck portion 11 engaging within the upper end of the packing sleeve 8 and to which the packing is attached by a wrapping 12 as shown in Fig. 2. The inner surface of the sleeve 10 is recessed, as at 13, intermediate the ends thereof, to form an inner, annular stop shoulder 14 adapted to be engaged by lugs 15 that project radially from a tubing section 16, and through bayonet slots 17 in the body of the packer. The bayonet slots 17 are arranged so that the elongated portions 18 thereof extend parallel with the axis of the packer and with the enlarged portions 19 thereof uppermost to provide lug latching shoulders 20 against which the lugs 15 will seat when the packer is run into a well, as later described.

The packing unit including the resilient packing element 8 and sleeve 10, is retained in position on the packer body by a ring 21 engaging the threads 3 and contacting the upper end of the sleeve 10 as shown in Fig. 2. The tubing section 16 extends axially through the body of the packer and is of smaller diameter to form an annular passageway 22 therebetween which extends from the top to the bottom of the packer to form a by-pass for the well fluids through which the packer is to be lowered. The ends of the tubing section carry couplings 23 and 24 whereby the packer is connected to adjacent sections 25 and 26 of a tubing string, with which the packer is lowered into the well and which forms a flow passage for the well fluid when the packer is set.

The face portion 27 of the conical collar 5 tapers downwardly toward the tubular body of the packer to wedge slips 28 against the wall of the casing when the packer is to be set. The slips 28 are supported in sliding contact with the wedging surface 27 of the collar 5 by flexible arms 29 having their lower ends attached to a carrier sleeve 30 which is slidably mounted upon the body portion of the packer. The carrier 30 includes a sleeve having bow-shaped springs 31 fixed to the periphery thereof for frictionally engaging the wall of a casing so as to support the slips and resist rotation of the carrier when the packer is to be set. The lower end of the carrier sleeve is shaped to provide hooks 32 having pin engaging seats 33 at the base of arcuately extending slots 34 opening from the sides of the hooks to seat pins 35 projecting from the body portion of the packer.

The pins 35 are so related with respect to the slip wedging face that when the pins are engaged with the seats of the hooks the slips are in contracted position and the teeth 36 thereof correspond with the circumference of the packing unit so that the packer may be readily lowered through a given sized casing. Mounted on the lower end of the packer body and engaging the threads 4 is a bushing 37 having threaded connection with a depending sleeve 38 that preferably conforms in diameter to the packing unit and has an inwardly extending annular shoulder 39 spaced from the lower end thereof to form a packing seat 40. Fixed to the periphery of the coupling 24 is a tubular valve member 41 that is adapted to move through the collar 39 and which has a plurality of openings 42 spaced circumferentially and so located that when the hooks 32 are engaged with the pins 35 and the lugs 15 engaged with the seats 20 of the bayonet slots, the openings are above the collar 39, whereby well fluid entering the lower opening 43 of the valve member and around the tubing may pass freely through the openings into the interior of the sleeve 38, and through the passageway 22 to the top of the packer.

Sleeved over the lower end of the valve member and engaging the seat 40 is a sleeve-like packing 44 retained in sealing contact with the valve member by a packing gland 45 which is rotatable about the valve member and threadedly engaged in the lower end of the sleeve 38, whereby a seal is effected between the periphery of the valve member and its cooperating sleeve 38. The packing element 44 is of sufficient length and located so that when the hooks 32 are disengaged from the pins 35 and the lugs 15 move to the lower portion of the bayonet slots, the openings 42 will be closed by the packing or will have moved therethrough so that the packing seals with the valve element above the openings as shown in Fig. 3, thereby shutting off flow of well fluid to the passageway 22 by way of the openings 42.

In using a packer constructed and assembled as described, and assuming that it is of proper diameter to be lowered through a given size casing 46 of a well hole 47, the couplings 24 and 23 are connected between adjacent sections of a well tubing so that the packer may be run into the well. As soon as the packer enters the open upper end of the casing it substantially fills the well casing, but the well fluids are free to flow through the packer by way of the open end 43 of the valve member, openings 42, the passageway between the valve member and the packing carrying member, and passageway 22 to the top of the packer. It is thus obvious that any fluids or pressure trapped below the packer have free access therethrough and the packer may be readily lowered through the well to setting position. When the packer is being lowered through the well the arch-shaped springs 31 frictionally engage the inner face of the casing so that when the packer reaches setting position the springs frictionally support the anchoring slips during manipulation of the tubing, whereby the pins 35 are disengaged with the hooks 32 and the lugs 15 from the latching shoulders 20. This is effected by rotating the tubing to the right so that the lugs 15 are in position to enter the elongated portions of the bayonet slots and the pins pass through the arcuate slots 34 of the hooks. Lowering of the tubing 25 then causes the lugs to move downwardly in the elongated portions of the bayonet slots to engage the shoulder 14 of the sleeve 10, whereupon the body of the packer is again moved downwardly with the tubing so that the wedging portion of the collar 5 forces the slips into anchoring engagement with the wall of the casing and further downward movement of the packer body is interrupted as soon as the slips engage so that further lowering of the tubing causes the lugs 15 to expand the packing sleeve 7 radially into sealing relation with the wall of the casing, as shown in Fig. 3. During relative movement of the tubing with respect to the body of the packer, the openings 42 are carried into the packing sleeve 44 so that flow is interrupted therethrough and the packer is effective in packing off well fluid from flowing between the well tubing and the casing, therefore, any pressure carried in the formation acts upon the well fluid to effect flow thereof through the tubing.

Should any gritty or slimy material contained in the well flow become deposited upon the valve member 41 during setting of the packer, it will be readily removed from the exterior surface thereof as it slides through the collar 39 and packing 44, and therefore will not interfere with effective contact of the packing sleeve with the periphery of the valve member. Since the openings have passed into or through the packing, as shown in Fig 3, they are effectively closed thereby and no leakage can take place through the body of the packer.

The modified form of packer construction is substantially the same as that illustrated in the preferred form with the exception that the valve elements of the packer are mounted at the head of the packer rather than the lower end thereof. This is effected by reversing the bushing 37 with respect to the retaining ring 21. A packing car-

rying sleeve 48 is threadedly supported on the bushing and extends upwardly about the periphery of the tubing section 49. The upper end of the sleeve 48 therefore carries the annular seating shoulder 50 through which the tubular valve member 51 is slidably supported. The valve member 51 is attached to the tubing coupling 52 and has its skirt portion depending through the collar 50. The packing element 53 is engaged in the space between the valve member 51 and retained against its seat by a packing gland 54 threaded into the upper end of the sleeve member 48. When the valve elements are in open position, that is, when the packing element and slips of the packer are in retracted position, the openings 55 are positioned above the packing gland, as shown in Fig. 8. However, when the packer is set, as described in connection with the preferred form of the invention, the valve member 51 is moved relatively to the packing 53 so that the openings 55 are closed thereby to prevent flow through the body of the packer.

The form of the invention disclosed in Figs. 10 to 17, inclusive, utilizes a conventional packer which in the illustrated instance is a hook wall packer 56. The packer includes a tubular body 57 forming a passageway 58. Threaded upon the upper end of the body 57 is a coupling 60 having an internal annular thread 61 to connect a tubing or the like, as in customary practice. The coupling 60 has a flange to which the ends of a packing sleeve 62 are connected by a wrapping 63, the packing sleeve being engaged over the tubular body 57. Also sleeved on the body 57 is a collar 58 tapering downwardly to form a wedge 64 for moving slips 65 outwardly into gripping engagement with the inner surface of the casing 46. This collar also has a flange to which the lower end of the packing sleeve is secured by a wrapping 63. The slips 65 are supported by flexible arms 66, having their lower ends attached to a carrier sleeve 67 which is slidable upon the lower body portion of the packer. The carrier has bow-shaped springs 68 fixed to the periphery thereof for frictionally engaging the wall of the casing, so as to support the slips and resist rotation of the carrier when the packer is to be set. The lower end of the carrier sleeve is provided with hooks 69 having pin engaging seats 70 at the base of slots 71 opening from the sides of the hooks to seat pins 72 projecting laterally from the body 57 of the packer. The pins 72 are positioned with respect to the wedge 64 so that when the pins are engaged with the seats of the hooks, the slips are in retracted position at the bottom of the wedge and the teeth thereof are within the circumference of the packing unit so that the packer may be freely lowered through a given size casing.

Connected with the coupling 60 is a nipple 73 to which a valve assembly 74 is connected. The valve assembly includes a sleeve-like body 75 having a lower cylindrical portion 76 connected with the nipple 73 and having an upper reduced neck portion or guide 77 slidably engaging the lower end of a tubing 78 by which the apparatus is lowered into the well. Projecting outwardly from opposite diametrical sides of the tubing 78 are lugs 79, similar to the lugs 15 previously described, and which project through bayonet slots 80 that are formed longitudinally in the guide 77. The bayonet slots 80 are arranged so that the elongated portions 81 thereof extend parallel with the axis of the packer, and the enlarged portions 82 extend arcuately to provide lug latching shoulders 83 against which the lugs 79 seat when the packer is being run into the well, as later described.

Threaded on the lower end of the tubing 78, and located within the enlarged portion 76, is a coupling 84 which connects a lower tubing section 85 that extends through the sleeve-like body of the packer as shown in Fig. 11. Mounted on the coupling 84 is a packing sleeve 86, which is retained thereon by rings 87 and 88 which are threaded on the ends of the coupling to expand the packing sleeve into sealing contact with the inner surface of the cylindrical body 75. Formed in the wall of the cylindrical body, at a point below the lowermost ring 88, is a plurality of fluid outlet openings 89 which are open when the lugs 79 are engaged in the enlarged portions of the bayonet slots and closed by the packing sleeve 86 when the lugs 79 are moved downwardly in the elongated portions of the bayonet slots to close flow through the packer.

In assembling the valve unit, the section of tubing 78 is slipped through the neck portion or guide 77 of the valve body 75 and threaded into the coupling sleeve 84 which carries the packing sleeve 86. The tubing sleeve 78 is then moved retractively to bring the lowermost packing retaining ring 88 above the openings 89. The lugs 79 are then inserted through the enlarged portions of the bayonet slots and welded to the tubing section 78.

In using the control valve just described, it is attached to the nipple 73 of the packer 56. When it is desirable to run tubing 85 below the packer, it is threaded into the coupling sleeve 84. The assembly is then lowered through the casing of the well with the lugs 79 engaging the shoulders 83 and the pins 72 of the hook wall packer engaging the seats 70. In this position the packing sleeve 86 is retained above the openings 89 and the slips are in retracted position, as shown in Fig. 11, so that the assembly may be readily lowered into the well against any fluid or pressure contained therein. During lowering of the packer, the fluid is passed through the tubular body of the packer and transferred through the openings 89 into the interior of the casing. When the assembly reaches the point at which the packer is to be set, the tubing 78 is rotated to move the lugs 79 so that they engage the sides of the bayonet slots opposite the shoulders 83, whereupon the lugs pick up the tubular body of the valve and move it in a corresponding direction. Since the springs 68 of the slip carrier are frictionally engaged with the walls of the casing, the slips and slip carrier lag, and the pins 72 are moved out of engagement with the seats 70 of the hooks 69. The packer is then set by moving the tubing downwardly so that the lugs 79 acting against the bottoms of the slots 81 exert a downward movement on the body of the packer, causing the wedge 64 to move into the slips and force them outwardly into gripping engagement with the wall of the casing. Upon setting of the slips, further downward movement compresses the packing sleeve 62 between the collar 58 and the coupling 60, and forces it outwardly into sealing contact with the casing, as shown in Fig. 12. Upon setting of the packer, the packing 86 on the tubing slides over the openings 89 to close off flow through the packer. If desired, flow may be again effected through the packer by raising the tubing so that the packing sleeve 86 returns to the position shown in Fig. 11. The weight of the tubing may again be established on the packer by

rotating the tubing so that the lugs **79** engage the shoulder **83**.

When washing the well, it may be desirable to reestablish flow through the packer while the packer is in set position. This is readily effected by returning the tubing to its original position so that the movable element of the valve uncovers the openings **89** as shown in Fig. 13. The friction of the slips and the packer on the wall of the casing is greater than that between the valve elements so that the packer retains its set position during movement of the tubing. However, if it is desired to remove the packer, further upward movement of the tubing causes the lugs **79** to pick up the valve unit which, being connected with the packer, disengages the packing sleeve from the casing and removes the slip wedge from engagement with the slips. Reverse rotation of the tubing then imparts a similar rotation to the packer to reengage the pins **72** with the hook of the packer so that the assembly unit may be withdrawn from the well.

The form of the invention shown in Figs. 10 to 17 may be used in connection with an anchor packer as well as the hook wall packer illustrated. The invention functions the same with exception of the difference in setting the packer, as in a hook wall packer setting is effected by a stand of pipe suspended from the packer. When the lower end of the stand engages the bottom of the well and the weight of the tubing above the packer is applied to the upper end of the rubber sleeve to compress the sleeve therebetween, the relative movement between the tubing and packer causes closing of the openings **89** as in the instance above described.

From the foregoing it is obvious that I have provided a packer with a control valve which may be readily lowered through the well casing against well pressure and fluids and when set, positively effects closure of the flow passages through the valve elements.

What I claim and desire to secure by Letters Patent is:

1. A control head for a packer having a tubular body to relieve pressure below the packer when running and setting the packer in a well, a sleeve member having ports intermediate the ends thereof, a valve member having sliding contact with the sleeve member, a tubing, means connecting one of said members with the tubing and the other with the tubular body member of the packer, a tubing guide encircling the tubing with the tubing extending slidably therethrough and having a longitudinal slot provided with a notch at the upper end thereof, and a lug on said tubing adapted to engage in said notch when running in and setting the packer to support the valve member from covering relation with said ports, said lug being movable into said slot responsive to partial rotation and longitudinal movement of the tubing to bring the valve member in valving relation to said ports.

2. A control for a packer having a tubular body for relieving pressure below the packer when running and setting the packer in a well, a sleeve member adapted to be threadedly connected with said tubular body of the packer and having ports intermediate the ends thereof, a piston type valve slidable in said sleeve member from a position above said ports to a position closing flow from the tubular body of the packer through said ports, a tubing guide on said sleeve member having a longitudinal slot provided with a lateral notch at its upper end, a tubing extending slidably through said guide and having a lower end connected with said piston type valve, and a lug projecting from said tubing and engageable in said notch to prevent relative movement of the tubing and sleeve member when running and setting the packer and movable out of said notch into the slot for permitting the tubing to be shifted relative to the packer for causing the piston type valve to move in valving relation to said ports.

3. A control for a packer having a tubular body for relieving pressure below the packer when running the packer into a well, a sleeve member adapted to be threadedly connected with said tubular body of the packer and having ports intermediate the ends thereof, a piston type valve slidable in said sleeve member from a position above said ports to a position closing flow through the tubular body through said ports, a reduced neck on said sleeve member forming a tubing guide and having a longitudinal slot provided with a lateral notch at its upper end, a tubing extending slidably through said neck and into the sleeve member to connect with said piston type valve, and a lug projecting laterally from a side of said tubing and engageable in said notch to prevent relative longitudinal movement of the tubing and sleeve member when running and setting the packer and movable out of said notch into the slot for permitting the tubing to be shifted relative to the packer for causing the piston type valve to move in closing relation to said ports.

4. A control for a packer having a tubular body for relieving pressure below the packer when running in and setting the packer in a well, a sleeve member adapted to be threadedly connected with said tubular body and having ports intermediate the ends thereof, a tubing guide on said sleeve member and having a longitudinal slot provided with a notch at the upper end thereof, a tubing extending slidably through said guide and terminating within the tubular body, a sleevelike valve body threaded on the terminal end of said tubing, a packing sleeve on said valve body and having sliding contact with the sleeve member, said valve body having an internally threaded lower end for connecting a continuation of said tubing, and a lug on said tubing engageable in said notch to support the tubing in fixed longitudinal relation with the packer during running in and setting thereof and shiftable into said slot to permit movement of the tubing relative to said packer to bring the packing sleeve into valving relation with said ports.

5. A control for a packer having a tubular body for relieving pressure below the packer when running and setting the packer in a well, a tubing extending through the packer, a tubing guide carried by the packer and having a longitudinal slot provided at its upper end with a lateral notch, a lug on the tubing and seated in said notch, a sleeve member adapted for connection with one end of the packer, and a sleeve member fixed to the tubing and having sliding support in the sleeve member, one of said sleeve members having ports and the other a packing slidably engaging the ported sleeve member to close flow through the ports when the lug is moved from said notch and shifted downwardly through said slot upon partial rotation and downward movement of the tubing relatively to the packer.

RICHARD E. FULKERSON.