This invention relates to well devices, and more particularly to well packers designed to be set in sealed-off condition within well bores. It is sometimes desirable to employ well packers of the retrievable type in the performance of squeeze cementing, acidizing, testing, or other operations within the well bore, to obviate the necessity for drilling out the particular packer after the well operation has been completed.

An object of the present invention is to provide an improved packer of the character indicated capable of being set at the proper point in the well bore by the direct application of hydraulic pressure to its gripping members, release of the packer from its set condition occurring automatically upon release of the hydraulic pressure, in order to enable the tool to be reset at the same or another point in the well bore, or to permit its withdrawal as a unit to the surface of the bore hole.

A further object of the invention is to provide a well packer of the retrievable type in which its casing gripping and packing members are in retracted position during movement of the tool through the casing, both before and after it has been set in sealed-off condition therewithin, the gripping and packing elements being actuated directly by hydraulic pressure to expand and hold them against the casing.

Still another object of the invention concerns a retrievable well packer adapted to be anchored to the casing through the application of pressure internally of the tool, in which the packer can remain in anchored position even though the internal pressure is relieved. In this connection, the invention contemplates the provision of a selective control mechanism for determining the application of pressure to the gripping members of the tool, the control functioning selectively to permit or prevent fluid under pressure from acting upon these members.

A further object of the invention is to provide a well packer adapted to be set hydraulically, in which premature setting of the tool by fluid under pressure can be prevented.

In certain types of well packers, the gripping or packing elements are maintained in engagement with the casing by fluid under pressure acting directly thereupon. If the internal and external pressures were to substantially equalize, these elements would be forced from engagement with the casing and no longer function to secure the well packer to the casing in leak-proof relation. To prevent this action from occurring, it has heretofore been proposed to provide a back-pressure valve at the outlet end of the tool, which is set to open at a predetermined pressure in order that the pressure internally of the tool be materially in excess of that externally thereof. That is, sufficient pressure must be exerted within the tool to expand the packer elements into engagement with the casing before the back-pressure valve can open, and this pressure differential will be maintained at all times during displacement of fluids through the tool.

Despite the provision of such back-pressure devices in obtaining the required pressure differential within the tool, during actual operations within the well bore the pressures internally and externally of the tool sometimes seem to equalize during the displacement of fluids into the formation, causing the casing engaging elements to be released and allowing the entire tool to be urged up the well bore by virtue of pressure below the tool.

Therefore, it is another object of the present invention to provide a well packer, especially of the retrievable type, which is set hydraulically and in which any equalization of the pressure internally and externally of the tool has no effect in producing its release from the casing or in causing leakage between the packer and casing. More specifically, the invention contemplates an arrangement whereby the pressure below and externally of the tool, instead of releasing it from its set position within the casing, actually increases the sealing action of the tool against the casing.

Still another object of the invention is to provide a well packer embodying a back-pressure valve at its outlet end for the purpose of producing a greater pressure internally of the tool than externally thereof, in which the valve is prevented from closing for the purpose of automatically filling up or draining the tubing string as the tool is lowered in or elevated from the well bore.

Still a further object of the invention is to provide a comparatively compact well packer of the retrievable type in which both the casing gripping and packing elements are constructed and arranged as a unit, being designed for substantially simultaneous expansion against the casing when the tool is to be set therewithin and contraction therefrom when the tool is to be released.

Because of the clearance that must be allowed between a body of a tool and the wall of the casing in which it is run, the packing member designed to effect a seal between this body and
casing may be forced through this clearance space and even completely dissipated by the action of pressure, particularly of the high magnitudes encountered in the operation of well packers within casing or bore holes. Still another object of the invention is to provide a well packing engaging gripping members adapted to anchor the tool in a well casing and a packing member which is prevented from flowing through the space between the body of the tool and casing by these gripping members.

This invention has other objects that will become apparent from a consideration of the embodiment shown in the drawings accompanying and forming part of the present specification. This form will now be described in detail to illustrate the general principles of the invention, but it is to be understood that such detailed description is not to be taken in a limited sense, since the scope of the invention is best defined by the claims appended hereto.

Referring to the drawings:

Figure 1 is a longitudinal view through a well casing, illustrating the well packer with its casing engaging elements in retracted position;

Figure 2 is a view similar to Figure 1, with the packer anchored in packed off condition against the casing;

Figure 3 is a view similar to Figure 2 of the lower portion of the tool, disclosing the entrapment of fluid therewithin for the purpose of holding the packer anchored in packed off condition against the casing;

Figures 4, 5 and 6 are cross-sections taken along the lines 4—4, 5—5 and 6—6, respectively, in Figure 1.

The well packer A disclosed in the drawings is adapted to be run in a well casing B on the lower end of a tubular string C to be set in packed off condition therewithin in such manner as to resist upward movement of the packer by hydraulic force from below.

The tool includes a support comprising an outer runner body member 10, in which is telescoped a generally tubular body member 11. The runner body member 10 is threaded to a collar 11 coupled to an upper sub 12 screwed on the tubing string C, while the tubular body member 11 is threaded along a thread 13 in the runner body 10. This tubular body member 11 has a guide 15 screwed on its lower end, and is provided with a head 16 engageable with the thrust collar 14 to limit the extent of downward movement of the body member. A combined elastic packing and actuator 11 for a plurality of gripping segments 18 is mounted on the tubular body 13, with its lower end held on the body and within the guide 15 by means of an inwardly directed flange 19 on the latter interlocking with a cooperable external flange 20 projecting from the lower end of the packing member 17. The upper end of the elastic member is similarly secured against the body 13 and the thrust collar 14 surrounding the body by its upper external flange 21 interlocking with an interturned flange 22 depending from the collar. This latter member 14 normally abuts the head 16 at the upper end of the body, but permits the body to move upwardly with respect to it, in accomplishing a specified purpose described below.

The gripping segments 18 are arranged circumferentially in juxtaposed position around the elastic actuating member 17. Each segment includes a body 23 extending lengthwise of the elastic member and bearing against its exterior. Its lower end terminates in a foot 24 seated within an annular groove 25 provided within the lower casing engaging packing portion of the actuating member in order to prevent its inadvertent removal from the elastic member 17, and to assist in retraction of the segments 18 from the casing 26. The upper portion of each segment body abuts the underside 25a of the upper flange 22, being provided with a neck 26 extending lengthwise across the exterior of this flange and merging into an inwardly extending head 27 seated within an annular groove or recess 28 formed between the collar 14 and runner body 10. Under surface 28a of the collar flange and the bottom 29a of the recess 28 serve as guides in directing the movement of the gripper segments 18 substantially in a straight line to and from engagement with the casing. The extent of this outward movement is limited by an upwardly extending ear 30 on each segment engageable with an annular stop 31 depending from the runner body 10, while return inward movement of the gripper segments to retracted position is assisted by encircling upper and lower coil retractor springs 32, 33 fitted within external grooves 34, 35 at the upper and lower ends of the gripper segments.

The lower portion 17a of the elastic actuating member 17 is designed as a packing for effecting an annular seal between the body 13 and wall of the casing B. This portion projects radially outward to substantially the same extent as the gripping teeth or wickers 36 on the exterior of the segments, extending around the depending feet 26 of these segments to hold them in proper assembled position on the tool. The exterior face of the packing section 17a is preferably formed with ribs 36 for the purpose of producing a plurality of separate annular seals against the casing, and, therefore, offer greater assurance against leakage of fluid between the packing and casing.

Both the gripper segments 18 and packing 17a are moved by hydraulic means radially from their retracted positions into engagement with the casing, fluid under pressure passing from the interior of the body 13 through the body ports 31 into the interior of the elastic actuating member 17. Leakage of fluid between this member and the body is prevented by the opposed lip seals 38. 39 formed adjacent the engaging end of member 17. Sufficient pressure is applied to the actuating member to overcome both its inherent elasticity resisting deformation, and the remaining force exerted by the retractor springs 31, 32. The actuating member 17 is expanded outwardly in generally balloon fashion to force the gripper segments 18 and packing 17a into engagement with the wall of the well casing. So long as this pressure is maintained within the elastic member 17, the tool is held anchored in packed off condition within the casing. Of course, as the pressure within the actuating member increases, the greater is the force embedding the segment wickers 36 into the casing and holding the packing 17a thereagainst. As a result, fluid pressure acting directly upon the gripping segments and packing holds them against the casing and prevents pressure from below the tool from forcing it upwardly within the casing or leaking around it.

The gripper segments 18 are relatively narrow and engage one another when in retracted position. In view of their relatively small width, a comparatively large number are employed to encompass the flexible actuating member 17.
while in retracted position. Upon being expanded, the segments are separated from one another by small distances, leaving spaces that are insufficient in area extent to permit the cold or plastic flowing of the rubber or rubber-like material from which the actuating member is preferably formed. Not only is radial flowing of this rubber material between the segments incapable of occurring, but the packing member is also prevented from flowing and dissipating longitudinally in an upward direction, since, as was just stated, the separations between adjacent segments are of too small an extent to permit the occurrence of this detrimental effect. As a result, the gripping elements are not only capable of anchoring the well packer to the casing, but they also function to prevent cold or plastic flowing of the packing member from its intended sealing region between the body and casing, even under high pressure and temperature operating conditions, and in the presence of hydrocarbons in the well bore, which ordinarily have a very deleterious effect upon rubber and similar packing materials.

To accomplish this, the body 10 and packing elements 17a securely against the casing, the pressure within the actuating member 17 must be greater than the pressure externally thereof by an amount which at least equals that required to overcome the resistance of the retractor springs 31, 32 and the tension of the rubber actuating member 17 resisting its expansion outwardly toward the casing. This pressure differential may be maintained within the tool by various expedients as are shown or evidenced in the drawings for accomplishing this purpose, a back-pressure valve 40, which is so adjusted as not to open until the pressure within the tool has been increased to a value causing proper engagement of the gripper segments 18 and packing 17a with the wall of the casing.

The valve device 40 includes a spider-like valve cage 41 threaded in the lower end of the guide 45. This cage possesses a valve seat 42 screwed in its upper end for engagement by a valve head 43 screwed in the stem 44 forced by a lock nut 48. This stem 44 is slidable received within a valve guide 46 threaded in the lower end of the valve cage 41 for the purpose of adjusting the tension of a helical spring 47 received within an anchor collar 48 in the guide and bearing against the valve head 43 for the purpose of forcing it upwardly into engagement with its cooperating seat 42. The valve guide 46 is threaded within the cage 41 to enable the tension in the spring 47 to be varied for the purpose of determining the pressure required to open the valve. This guide is held in its adjusted position by means of a lock nut 48 bearing against the cage.

Despite the provision of the spring loaded back-pressure valve 40, under some conditions encountered in well bores, the pressures still seem to equalize internally and externally of the flexible actuating member 17 while pressure is being imposed upon the fluid within the tool and therebelow. Whenever this occurs, a slight leakage takes place around the tool, as indicated by fluid returns received at the surface of the well bore. In the present instance, effective sealing of the packing 17a between the body and casing is not entirely dependent upon the pressure differential of the fluid internally of the actuating member. In addition to this sealing force, pressure below the tool is availed of to maintain the packing in proper sealing position.

After the gripping segments 18 have been anchored to the well casing and the packing 17a moved outwardly against the casing by fluid pressure internally of the actuating member 17, a back-pressure valve 40 opens against the action of its spring 47 and the fluid pressure below the tool acts upwardly over the entire cross-section of the lower guide 16 and body 13, forcing them upwardly and compressing the packing 17a between the segments 18 and the guide 15. This action can occur since the gripping segments 18 are held stationary in anchored condition against the wall of the casing, but the tubular body 13 is free to slide upwardly along the thrust collar 14, which is held fixed by the segments 18. The resultant relative movement effects a shortening of the distance between the collar 14 and guide 15, and produces compression of the packing member 17a. The packing off force due to upward movement of the guide and body with respect to the gripper segments is relatively large, since, as above stated, the pressure below the tool is acting upwardly over a comparatively large cross-sectional area of both the guide 15 and tubular body 13.

In addition to this sealing force, pressure below the tool is availed of to maintain the packing 17a and the guard member securely against the casing, the pressure within the actuating member 17 must be greater than the pressure externally thereof by an amount which at least equals that required to overcome the resistance of the retractor springs 31, 32 and the tension of the rubber actuating member 17 resisting its expansion outwardly toward the casing. This pressure differential may be maintained within the tool by various expedients as are shown or evidenced in the drawings for accomplishing this purpose, a back-pressure valve 40, which is so adjusted as not to open until the pressure within the tool has been increased to a value causing proper engagement of the gripper segments 18 and packing 17a with the wall of the casing.

The valve device 40 includes a spider-like valve cage 41 threaded in the lower end of the guide 45. This cage possesses a valve seat 42 screwed in its upper end for engagement by a valve head 43 screwed in the stem 44 forced by a lock nut 48. This stem 44 is slidable received within a valve guide 46 threaded in the lower end of the valve cage 41 for the purpose of adjusting the tension of a helical spring 47 received within an anchor collar 48 in the guide and bearing against the valve head 43 for the purpose of forcing it upwardly into engagement with its cooperating seat 42. The valve guide 46 is threaded within the cage 41 to enable the tension in the spring 47 to be varied for the purpose of determining the pressure required to open the valve. This guide is held in its adjusted position by means of a lock nut 48 bearing against the cage.

Despite the provision of the spring loaded back-pressure valve 40, under some conditions encountered in well bores, the pressures still seem to equalize internally and externally of the flexible actuating member 17 while pressure is being imposed upon the fluid within the tool and therebelow. Whenever this occurs, a slight leakage takes place around the tool, as indicated by fluid returns received at the surface of the well bore. In the present instance, effective sealing of the packing 17a between the body and casing is not entirely dependent upon the pressure differential of the fluid internally of the actuating member. In addition to this sealing force, pressure below the tool is availed of to maintain the packing in proper sealing position.
lower ends of the springs and suitably secured to the runner body.

Due to the resistance offered by these friction springs to the movement of the tubular body 13, the valve sleeve 51 may be shifted longitudinally within this body from the surface of the bore by raising or lowering the tubing string C. If the sleeve is elevated until its lower portion 34 is positioned above the lower seal 53, fluid under pressure may pass downwardly from the tubing string C, through the subs 12, 52a and sleeve 51, around the lower end 51a of the latter, through the annular space between the sleeve 51 and body 13, and into the ports 37 for action upon the elastic actuating member 17, which will expand to force the gripper segments 18 and packing 17a against the casing in the manner described above.

Conversely, lowering of this valve control sleeve 51 until its outer cylindrical surface again engages the lower seal 53 prevents passage of fluid between the interior of the sleeve 51 and actuating member 17.

The depending valve sleeve 51 is also employed for controlling the operation of the valve 40 at the outlet end of the tool. This control is obtained by securing a winged spider 58 to the upper end of the valve stem 44, as by means of the opposite lock slots 59, and providing an extension 60 of the sleeve 51 in engagement with this spider. This extension 60 is reduced in external diameter so as not to seal with the lower sealing ring 55 when the sleeve 51 is elevated to allow fluid to pass into the actuating member 17. When the sleeve 51 is lowered sufficiently with respect to the tubular body 13 and guide 15, its extension 60 engages the spider 58 and holds the valve head 43 from the seat 42 against the force of the helical spring 47. Upon the other hand, upon elevation of the valve sleeve 51, the spring 47 may engage the head 43 with the seat.

Various control positions of the valve sleeve are obtainable with the present device. For the purpose of positively determining these positions from the surface of the well bore, a locking device is provided to hold the valve sleeve 51 in several positions of adjustment with respect to the outlet valve 40 and the body seat 52. This locking device is a lock collar 11, formed of a sleeve 51a of a stepped L or J-slot 62 formed in the lock collar 11. This slot enables the locking pin 61, and consequently the controlled valve sleeve 51 secured thereto through the subs 12, 52e, to have three main positions, namely, a first position in which the valve head 43 is held off its seat 42 and fluid prevented from passing through the body ports 37, a second position in which the valve head 43 can engage its seat 42, but the fluid under pressure is trapped or held within the actuating member 17 to hold it expanded and maintain the segments 18 and packing 17a against the casing B.

As illustrated in Figure 1, the tool A is in position for movement through the well casing, in which the valve sleeve 51 is in its lowestmost position to prevent passage of fluid around the lower sealing ring 53 and through the ports 37, and in which the valve head 43 is positively held off its seat 42. The sleeve is prevented from moving from this position until desired by engagement of the lock collar 11 with the underside of the lowermost step 63 of the slot 62 in the collar 11.

With the parts in this position, the tool may be run in the well bore, without fear of its premature setting, since any fluid pressure developed within the tool is incapable of passing through the ports 37 to expand the gripping segments and packing. Moreover, the tubing string C is automatically filled up with fluid since the back-pressure valve 40 is held in open position. Circulation through the tool can be established at any time for the performance of a washing or other operation without fear of setting the tool.

When the tool is to be set in the casing, the tubing string is rotated a partial revolution in a clockwise direction, to allow elevation of the tubing string C for the purpose of raising the valve control sleeve 51 upwardly to a position in which the back-pressure valve 40 may close and fluid pass through the ports 37 into the actuating member. The friction springs 54 hold the various bodies and collars of the tool stationary to permit such rotation and longitudinal elevation to occur, until the lock pin 61 is engaged with the uppermost shoulder 64 of the lock collar (see Figure 2). Fluid under pressure within the tool may now pass around the end 51a of the control sleeve and into the ports 37 to expand the elastic actuating member 17 and force the gripper segments 18 and packing 17a against the casing. Increase in the fluid pressure within the tool, to a predetermined value opens the outlet valve 40 against the action of its spring 47 and allows fluid, such as cement slurry, jells, acids and the like, to be forced into the formation. As stated above, this pressure also acts upon and elevates the valve guide 15 and tubular body 13 to pack off the tool more securely.

Upon release of the pressure within the tool, and with the valve sleeve in the position disclosed in Figure 2, the gripper members 18 and packing 17a retract from the casing to their initial position, the inherent elasticity and retraction tendencies of the rubber actuating member 17 operating upon the feet 24 of the segments to move them toward the packer body, which action is assisted by the encircling coil springs 31, 32. However, should it be desired to hold the packer anchored and sealed off in the casing upon relieving of the pressure within the tool, the valve control sleeve 51 is lowered sufficiently with the tubing string C to reengage its external surface with the lower sealing ring 53, before pressure within the tool is relieved, to entrap the fluid under pressure within the actuating member 17.

This lowering of the sleeve 51 with respect to the tool bodies can occur to its fullest extent for the purpose of holding the outlet valve 40 open (as in the Figure 1 position), or the valve sleeve 51 may be shifted to occupy some intermediate position in which its external surface seals with the lower ring 53 but its extension 60 is spaced from the spider 58 to permit the spring engagement of the valve head 43 with its cooperate seat 42 (as in the position disclosed in Figure 3). This last-mentioned relationship of parts can be positively determined at the surface of the bore by lowering the sleeve 51 and turning it to the right of the slot (as seen in Figure 2), until the lock pin 61 engages with the under surface of the intermediate step 65 in the lock collar 11.

After the desired operation is performed at the point in the well casing, the pressure within the actuating member 17 may be relieved to enable the parts to return to their initial retracted positions, and the tubing string C lowered and rotated until the lock pin 61 again is
in position to engage the underside of the lower step 68, in which location the sleeve extension 69 extends thereunder. 50 The elevation of tool to some other setting point or its entire withdrawal to the surface of the bore hole can now occur, while permitting fluid to drain automatically from the tubing string into the casing. Moreover, since the valve sleeve 51 is again in sealing engagement with the lower sealing ring 53, any pressure forces within the tool are incapable of inadvertently setting it against the casing and preventing its withdrawal.

I claim:

1. A well packer, including body means adapted to be lowered in a well bore on the end of a tubular string, a flexible sleeve carried by said body means, a plurality of circumferentially juxtaposed casing gripping members disposed around said sleeve and extending longitudinally thereof substantially parallel to the axis of said well packer, and means for directing fluid under pressure from the interior of said body means into said sleeve to expand the latter and bodily translate said gripping members radially toward engagement with the wall of a casing.

2. A well packer, including generally tubular body means adapted for attachment to a tubular string for lowering in a well casing, an elastic sleeve surrounding said body means with its ends secured thereto, a plurality of narrow circumferentially juxtaposed segmental casing gripping members completely encircling said sleeve and extending longitudinally thereof substantially parallel to the axis of said well packer, means on said body means for guiding each of said gripping members in a straight line path generally radial of the axis of said packer, and means for directing fluid under pressure from the interior of said body means into said sleeve to engage the latter and bodily translate each of said gripping members along said guiding means into engagement with the wall of a casing.

3. A well packer, including generally tubular body means adapted for lowering in a well casing on a tubular string, a pliant, elastic sleeve surrounding said body means with its ends secured thereto in leak-proof relation, a plurality of circumferentially juxtaposed casing gripping members completely encircling said sleeve and extending longitudinally thereof substantially parallel to the axis of said well packer, said members having elements therein embedded within said sleeve, and means for directing fluid under pressure into said sleeve to expand it and bodily translate said gripping members radially towards engagement with the wall of said casing, said sleeve moving said gripping members from such engagement upon decrease in the fluid pressure therewithin.

4. A well packer, including generally tubular body means adapted for lowering in a well casing on a tubular string, a pliant, elastic sleeve surrounding said body means with its ends secured thereto in leak-proof relation, a plurality of circumferentially juxtaposed casing gripping members completely encircling said sleeve and extending longitudinally thereof substantially parallel to the axis of said well packer, said sleeve comprising a packing member adapted to form an annular seal between said body means and wall of a casing, and means for directing fluid under pressure from the interior of said body means into said sleeve to expand said pack-

5. A well packer, including inner and outer body members adapted for lowering in a well casing on a tubular string, said inner member being telescoped within said outer member, a flexible sleeve surrounding one of said body members, a plurality of circumferentially juxtaposed casing gripping members encircling said sleeve and secured to one of said body members, a casing engageable packing one of said body members having one end prevented from longitudinal movement by said gripping members and the other end secured to the outer said body members, and means for directing fluid under pressure into said sleeve to shift said gripping members into engagement with said casing, said gripping members serving to anchor their connected body member to said casing, wherein its companion body member is moveable longitudinally thereof under the influence of fluid pressure to compress said packing into firm sealing engagement with said casing.

6. A well packer, including inner and outer body members adapted for lowering in a well casing on a tubular string, said inner member being telescoped within said outer member, a plurality of circumferentially juxtaposed casing gripping members encircling said sleeve and secured to one of said members, said sleeve comprising a packing member adapted to form a seal with the wall of the casing, and means for directing fluid under pressure into said sleeve to expand said packing into engagement with said casing and bodily translate said gripping members radially into engagement with said casing, said gripping members serving to anchor their connected body member to said casing, whereby its companion body member is moveable longitudinally thereof under the influence of fluid pressure to compress said packing into firm sealing engagement with said casing.

7. A well packer, including inner and outer body members adapted for lowering in a well casing on a tubular string, said inner member being telescoped within said outer member, a flexible sleeve surrounding said inner body member, a plurality of circumferentially juxtaposed casing gripping members encircling said sleeve and secured to said outer body member, casing engageable packing means on said inner body member having one end abutting said gripping members and the other end secured to said inner body member, and means for directing fluid under pressure into said sleeve to shift said gripping members into engagement with said casing, said gripping members serving to anchor said outer body member to said casing whereby said inner body member is moveable longitudinally therewithin under the influence of fluid to compress said packing means into firm sealing engagement with said casing.

8. A well packer, including an outer body member, an inner body member telescoped within said outer body member, a pliant, elastic sleeve surrounding said inner member with one of its ends secured thereto and its other end secured to said outer member, a plurality of circumferentially juxtaposed casing gripping members secured to said outer member and encircling
said sleeve, said sleeve having a packing member therewith adapted to form a seal with the wall of a casing, and means for directing fluid under pressure into said sleeve to expand said packing against said casing and bodily translate said gripping members radially into engagement with said casing, whereby said inner member is movable longitudinally throw within the influence of fluid pressure to compress said packing into firm sealing engagement with said casing.

9. A well packer, including a body adapted for lowering in a well casing on a tubular string, means for anchoring said body to said casing, hydraulically operated means for moving said anchoring means into engagement with said casing, means for directing fluid between the interior of said body and said hydraulically operated means, means engageable with said casing prior to engagement of said anchoring means with said casing for resisting movement of said body within said casing, and valve means connected to said body and extending within said body, said valve means being connectable to said tubular string and movable with respect to said body by manipulation of said tubular string for opening and closing said directing means.

10. A well packer, including a body adapted for lowering in a well casing on a tubular string, hydraulically actuated means carried by said body for engaging with said casing, means for directing fluid between the interior of said body and said hydraulically actuated means to actuate the latter, a valve for maintaining an excess of pressure within said body over that externally thereof, and a slidable sleeve connected to said body and extending within said body, said slidable sleeve being connectable to said tubular string and movable with respect to said body by manipulation of said tubular string for selectively opening and closing said directing means to the passage of fluid and for selectively holding said back-pressure valve open or allowing it to close.

11. A well packer, including a body adapted for lowering in a well casing on a tubular string, hydraulically actuated means carried by said body and adapted for engagement with said casing, means for directing fluid between the interior of said body and said hydraulically actuated means to actuate the same, a back-pressure valve for maintaining an excess of pressure within said body over that externally thereof, and valve means connected to said body and extending within said body, said valve means being connectable to said tubular string and movable with respect to said body by manipulation of said tubular string for selectively opening and closing said directing means to the passage of fluid and for selectively holding said back-pressure valve open or allowing it to close.

12. A well packer, including a body adapted for lowering in a well casing on a tubular string, hydraulically actuated means carried by said body and adapted for engagement with said casing, means for directing fluid between the interior of said body and said hydraulically actuated means to actuate the same, a back-pressure valve for maintaining an excess of pressure within said body over that externally thereof, and valve means connected to said body and extending within said body, said valve means being connectable to said tubular string and movable with respect to said body by manipulation of said tubular string for selectively opening and closing said directing means to the passage of fluid and for selectively holding said back-pressure valve open or allowing it to close.

13. A well packer, including a body adapted for lowering in a well casing on a tubular string, hydraulically actuated means carried by said body and adapted for engagement with said casing, means for directing fluid between the interior of said body and said hydraulically actuated means to actuate the same, a back-pressure valve for maintaining an excess of pressure within said body over that externally thereof, and valve means connected to said body and extending within said body, said valve means being connectable to said tubular string and movable with respect to said body by manipulation of said tubular string for selectively opening and closing said directing means to the passage of fluid and for selectively holding said back-pressure valve open or allowing it to close.
selectively controlling opening and closing of said valve, and means connected to said sleeve and engageable with said body for positively locating said sleeve within said body in various selected positions of adjustment with respect to said directing means and valve.

17. A well packer, including a body adapted for lowering in a well casing on a tubular string, hydraulically actuated means carried by said body and adapted for engagement with said casing, means for directing fluid between the interior of said body and said hydraulically actuated means to actuate the latter, a valve for maintaining an excess of pressure within said body over that externally thereof, a slidable sleeve within said body movable by said tubular string for selectively opening and closing said directing means to the passage of fluid and for selectively controlling opening and closing of said valve, and means connected to said sleeve and engageable with said body for positively locating said sleeve within said body in various selected positions, comprising a first position wherein said valve is held open and said directing means is closed to the passage of fluid, a second position wherein said valve is permitted to close and said directing means is open to the passage of fluid, and a third position wherein said valve is permitted to close and said directing means is open to the passage of fluid from within said body.

REUBEN C. BAKER.

CERTIFICATE OF CORRECTION.


It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 53, for "restraining" read --restraining--; page 5, second column, line 12, claim 5, for "one one" read --on one--; line 65, claim 7, after "fluid" insert --pressure--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of August, A. D. 1945.

Leslie Frazer
(Seal) First Assistant Commissioner of Patents.
selectively controlling opening and closing of said valve, and means connected to said sleeve and engageable with said body for positively locating said sleeve within said body in various selected positions of adjustment with respect to said directing means and valve.

17. A well packer, including a body adapted for lowering in a well casing on a tubular string, hydraulically actuated means carried by said body and adapted for engagement with said casing, means for directing fluid between the interior of said body and said hydraulically actuated means to actuate the latter, a valve for maintaining an excess of pressure within said body over that externally thereof, a slideable sleeve within said body movable by said tubular string for selectively opening and closing said directing means to the passage of fluid and for selectively controlling opening and closing of said valve, and means connected to said sleeve and engageable with said body for positively locating said sleeve within said body in various selected positions, comprising a first position wherein said valve is held open and said directing means is closed to the passage of fluid, a second position wherein said valve is permitted to close and said directing means is open to the passage of fluid, and a third position wherein said valve is permitted to close and said directing means is open to the passage of fluid from within said body.

REUBEN C. BAKER.

CERTIFICATE OF CORRECTION.

Patent No. 2,373,005.

April 3, 1945.

REUBEN C. BAKER.

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