Aug. 12, 1952 H. C. OTIS 2,606,616

WELL TREATING AND FLOW CONTROLLING DEVICE

Filed March 19, 1948 2 SHEETS—SHEET 1

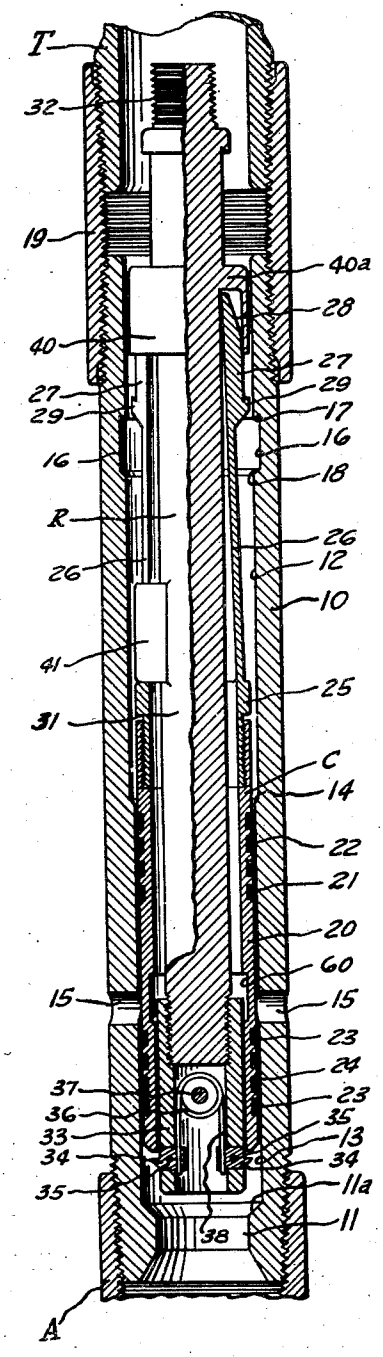

Fig. 1

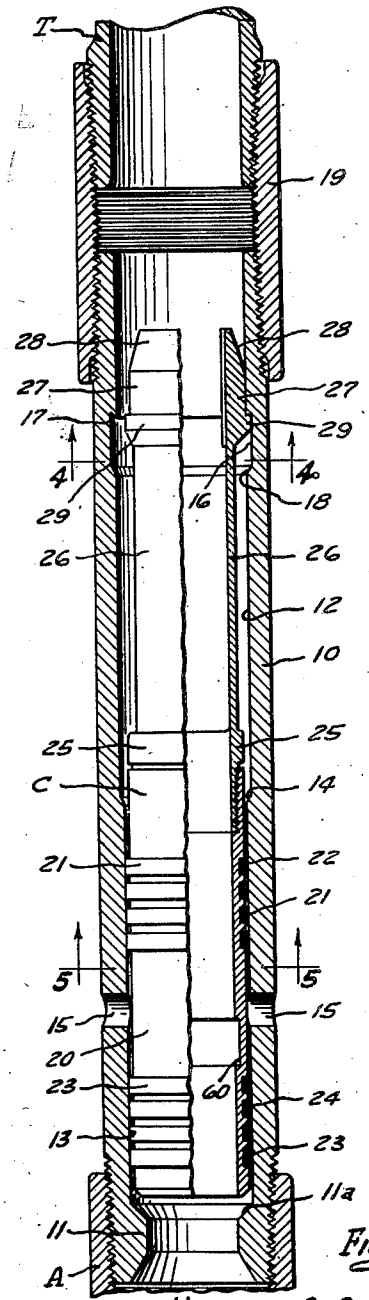

Fig. 2

HERBERT C. OTIS
INVENTOR.

BY Hastings Ackley

ATTORNEY

Aug. 12, 1952 H. C. OTIS 2,606,616

WELL TREATING AND FLOW CONTROLLING DEVICE

Filed March 19, 1948 2 SHEETS—SHEET 2

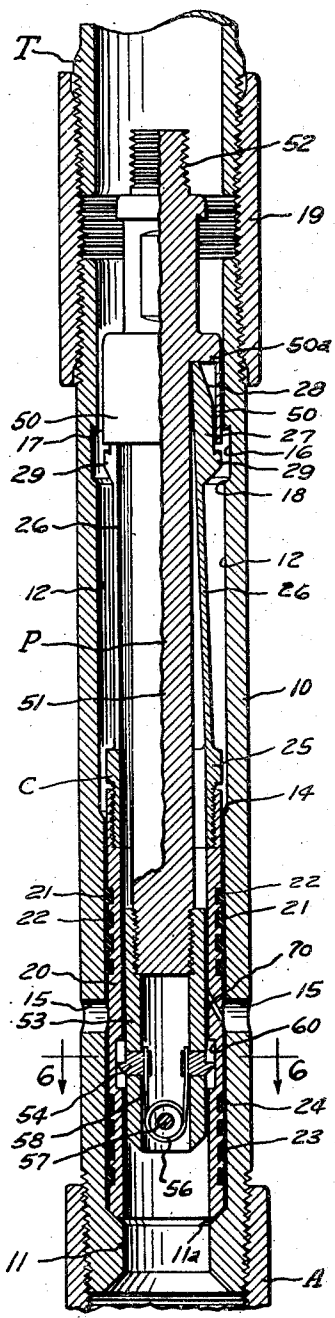

Fig. 3

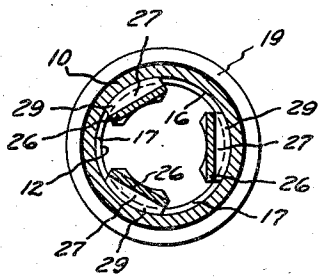

Fig. 4

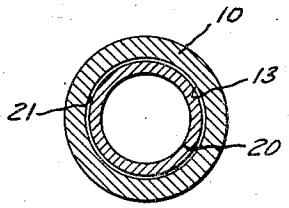

Fig. 5

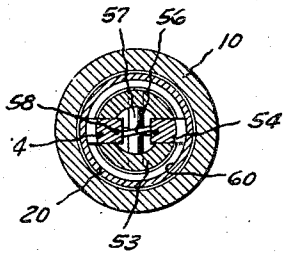

Fig. 6

HERBERT C. OTIS
INVENTOR.

BY Cartwright Ackley
ATTORNEY

Patented Aug. 12, 1952

2,606,616

UNITED STATES PATENT OFFICE

2,606,616

WELL TREATING AND FLOW CONTROLLING DEVICE

Herbert C. Otis, Dallas, Tex.

Application March 19, 1948, Serial No. 15,937

8 Claims. (Cl. 166—1)

1

This invention relates to new and useful improvements in well treating and flow controlling devices.

As oil and gas wells are drilled to greater depth, formations are encountered having increasingly higher formation fluid pressures. As a consequence, it is becoming more frequently customary and necessary, in modern oil and gas well production practice, to install packers between the well flow conductor or tubing and the bore of the well or the well casing for the purpose of sealing off the high pressures of such producing formations to prevent those high fluid pressures from acting against the casing connections at the well surface, and to preclude the application of such high fluid pressures to the long string of casing in place in the well bore, whereby the danger of leaks occurring through such casing is reduced. It is also becoming a more common practice to provide loading fluids, such as columns of water, or "mud" or the like, in the annular space between the well tubing and casing and above the packers, to counterbalance or exceed the upward force exerted against such packers by the high producing formation fluid pressure.

After the packer has been installed and the loading fluid provided in the annular space thereabove, it sometimes becomes necessary or desirable to establish circulation of fluids between the annular space and the bore of the well tubing for the purpose of removing the loading fluids, or for permitting removal of the packer, or when it is desired to "kill" the well. Heretofore, attempts have been made to utilize valve means, such as control head packers and the like, for establishing circulation of fluid between the annular space and the bore of the well tubing, but such valve means have very frequently proven unsatisfactory for many reasons. For example, the valves do not always positively close off, and so leak; the valves frequently cannot be reopened; in order to open the valve of the usual control head packer, it is necessary to employ heavy, expensive hoisting equipment for manipulation or movement of the tubing; some devices heretofore employed require such high pump pressure for operation as to create the danger of rupturing the casing or collapsing the tubing. In the past, when it has been impossible to open the valve or establish flow communication between the annular space and the bore of the tubing in any other manner, well operators have resorted to perforating the tubing or the flow conductor to establish circulation between the bore

2

of the conductor and the annular space between such conductor and the well casing. However, it is frequently difficult to accurately locate the perforations, and it is often extremely difficult if not impossible to perforate the flow conductor, and in some wells it is substantially impossible to perforate the flow conductor without penetrating the casing and creating a dangerous leakage condition.

It is, therefore, one object of this invention to provide a novel well treating and flow controlling device which may be installed in a well flow conductor, and which is initially closed but which may be opened without manipulation of the tubing to establish circulation between the annular space exteriorly of the flow conductor and the bore of the flow conductor.

Another object of the invention is to provide a device of the character described including a housing adapted to be connected in a well flow conductor and having a lateral opening establishing communication between the interior and exterior of the housing, in combination with a removable closure for said lateral opening and means for releasably locking said closure in position in the housing whereby flow from the annular space exteriorly of the housing into the bore of the housing through such lateral opening is completely prevented while the closure is in position in the housing, said closure being removable to establish communication between the bore of the housing and the annular space exteriorly thereof.

A particular object of the invention is to provide, in a device of the character described, means for minimizing the application of upward fluid pressure to the removable closure, whereby the upward force of such fluid pressure tending to move said closure upwardly out of the housing is reduced or substantially eliminated.

Still another object of the invention is to provide a device of the character described wherein the closure means is removable from the housing upon the application of an upward non-rotative force, whereby said closure means may be removed from the housing by means of a flexible line retrieving mechanism.

A further object of the invention is to provide a device of the character described which is so constructed and arranged that it may be utilized for controlling the admission and flow of fluids from the annular space exteriorly of the housing through the lateral opening into the bore of the housing to provide for auxiliary lifting of fluids from the producing formation, if desired.

A still further object of the invention is to provide, in a device of the character described, means for locking or anchoring the closure member in place in the housing, which means is so constructed and arranged as to be retractable from anchoring position to permit removal of the closure member from the housing; said locking or anchoring means also being so constructed and arranged as to be shearable or releasable upon the application of a predetermined upward force to said closure member to assure that the closure member may be removed from the housing in the event such locking means cannot be retracted in the usual manner.

A still further object of the invention is to provide, in a device of the character described, a housing having a cylindrical sealing surface provided in its bore above and below the lateral opening therein, whereby sealing means carried by the closure member may engage said sealing surface to prevent fluids from the lateral opening by-passing the closure member to the bore of the housing, and wherein the bore of the housing above said sealing surface is enlarged or relieved to facilitate insertion and removal of the closure member in the housing.

It is also an object of the invention to provide a device of the character described having a flow passage therethrough of as large a cross-sectional area as possible, whereby upward flow of fluids through the flow conductor at normal rates is not interfered with.

A particular object of the invention is to provide in a device of the character described a housing or landing nipple having a bore therethrough which is reduced at its lower end to provide a seat for limiting downward movement of the closure means in the housing, said seat being annular in form and projecting into the bore of the housing in such a manner that the bore through the seat or shoulder is equal to or preferably smaller than the bore of the closure member, so that fluid pressure reduction is effected across said seat or shoulder restriction and no substantial upward fluid pressure differential is applied to the closure member, whereby the closure member is prevented from being readily displaced upwardly out of the housing.

Additional objects and advantages of the invention will readily be apparent from the reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

Figure 1 is a view, partly in elevation and partly in section, of a device constructed in accordance with the invention and showing the closure member being lowered into place in the housing,

Figure 2 is a view similar to Figure 1, showing the closure member in anvhored position in the housing,

Figure 3 is a view, similar to Figure 1, showing the closure member in anchored position in the the housing,

Figures 4 and 5 are horizontal cross-sectional views taken on lines 4—4 and 5—5 of Figure 2, and

Figure 6 is a horizontal cross-sectional view taken on line 6—6 of Figure 3.

In the drawings, the numeral 10 designates an elongate tubular housing or nipple having external screw threads at each end. At its lower end, the bore of the nipple is provided with an internal annular flange 11 providing at its upper end a beveled seat 11*a* for receiving and limiting downward movement of the beveled lower end of a closure member C, as will hereinafter be more fully explained. The bore of the nipple has upper and lower sections 12 and 13 respectively, which are of slightly different diameter, the upper section 12 being the larger and forming a counter-bore or relief section. Between the upper and lower sections, the bore of the housing is inclined inwardly and downwardly at 14 so that packing elements may be run therepast without damage, as will hereinafter become obvious.

Substantially centrally of its lower smaller bore 13, the wall of the housing or nipple is provided with lateral openings or ports 15, which may vary in number from 1 to 4 or more as desired. The ports extend substantially radially through the wall of the housing and provide for communication between the exterior and interior of said housing.

Near the upper end of the enlarged upper portion 12 of its bore, the housing is provided with an internal annular recess 16, which is formed with an undercut locking shoulder 17 at its upper end for a purpose which will hereinafter be more fully explained. The shoulder 18 at the lower end of the locking recess is inclined downwardly and inwardly.

The housing or nipple 10 is connected at its upper end to a well flow conductor or tubing T by means of the usual coupling 19. At its lower end the housing may be screw threaded into the upper end of a well packer A of any desired type, or may also be connected by means of a coupling to the well tubing. Thus, the housing is connected in the well tubing string and forms a part thereof and may be lowered therewith into the bore of the well in the usual manner.

The closure or sealing member C includes an elongate tubular packing mandrel 20 having a plurality of rings of packing 21, of rubber, synthetic rubber, or any other suitable sealing material, securely mounted in external annular grooves 22 formed in the peripheral surface of the mandrel near its upper end. A similar series of packing rings 23 are mounted in a plurality of external annular grooves 24 formed in the peripheral surface of the packing mandrel near its lower end and spaced below the upper packing rings 21. The packing rings 21 and 23 are so positioned on the packing mandrel that they engage the wall of the lower smaller bore 13 of the housing or nipple above and below the lateral openings 15 when the closure device is in anchored position in the housing, as shown in Figure 2, the wall of the lower smaller bore of the housing constituting a sealing surface within the housing above and below the lateral ports 15.

A cylindrical bushing or sleeve 25 is screw threaded into the upper end of the bore of the packing mandrel 20, and this bushing or sleeve has provided thereon a plurality of integral elongate upstanding spring fingers 26 spaced substantially equally about the upper end of said sleeve or bushing.

At their upper ends, each spring finger 26 is formed with an external enlargement or protuberance 27 which is adapted to engage the upper larger bore 12 of the housing or nipple when the fingers are in a normal expanded position. The upper portion of the protuberance on each finger is inclined upwardly and inwardly to provide a wedge surface 28, for a purpose which will be hereinafter explained, and an outwardly projecting hook or catch 29 is formed at the lower end

of the protuberance on each finger and is adapted to engage in the annular locking recess 16 and under the locking shoulder 17 at the upper end of the recess to positively hold the closure device C in place in the nipple. The upper surface of each hook or catch 29 on the fingers is inclined upwardly and outwardly to correspond to the configuration of the undercut shoulder 17, whereby when the catches are in engagement with said locking shoulders the fingers are restrained against movement inwardly away from said locking shoulders and disengagement of the catches from the locking shoulders is restrained or substantially prevented.

The upper ends of the elongate spring fingers may be sprung inwardly toward each other to permit the catches 29 to be retracted from the locking recess 16, for permitting removal of the closure member from the housing as will be hereinafter more fully explained.

In use, the closure device C may be installed in place in the housing 10, in the manner illustrated in Figure 2, prior to lowering the housing into the bore of the well. In such event, the catches 29 at the upper end of the spring fingers 26 are engaged in the locking recess 16, and the packing rings 21 and 23 are in sealing engagement with the lower reduced or smaller portion 13 of the bore wall of the housing. Downward movement of the mandrel 20 in the housing is limited by the upwardly facing shoulder 11*a* at the lower end of the housing, and upward movement of the mandrel is limited by the engagement of the hooks or catches 29 in the locking recess 16. Thus, the closure member C is securely held in place in the housing with the sealing rings 21 and 23 preventing fluids from the lateral ports 15 flowing inwardly past the closure member to the bore of the housing. Therefore, the ports 15 are closed against the flow of fluids from the interior of the housing to the exterior thereof or in the reverse direction, and the flow conductor is usable or operable in the usual manner.

In the event the flow conductor having the housing 10 connected therein has been lowered into the well bore prior to the installation of the closure member C therein, said closure member may be lowered into the well tubing and positioned in the housing by means of a running or lowering tool R, illustrated in Figure 1, which is connected to a flexible line lowering and jarring mechanism (not shown) of any desired well-known type.

The running tool R includes an elongate stem 31 having screw threads 32 at its upper end, whereby it may be connected to the lower end of the wire line lowering and jarring mechanism (not shown). A cylindrical tubular foot piece 33 is connected by screw threads to the lower end of the stem 31, and a pair of opposed spring pressed latch members 34 are mounted in opposed radial openings in the lower portion of the foot piece. The latches 34 are held in the expanded position shown in Figure 1 by means of shear pins 35 which extend through an opening in the foot piece and in each of the latches. A spring wire 36, bent in a loop which extends around a transverse pin 37 mounted in the foot piece 33, has a pair of depending arms 38 which are secured to the inner ends of the latches 34 and urge said latches inwardly of the openings formed in the foot piece, whereby when the shear pins 35 are sheared the spring arms will retract the latches from supporting position inwardly toward the bore of the foot piece. The running

tool is of such a length that the latches in the foot piece are positioned below the lower end of the packing mandrel 20 of the closure member, in the manner shown in Figure 1, whereby the closure member is supported upon said latches. Near its upper end, the stem 31 of the running tool is provided with a downwardly extending skirt or sleeve 40 which is carried by an annular flange 40*a* and is spaced from the stem. The skirt is arranged to engage over the upper ends of the elongate spring fingers 26 to hold the fingers in a retracted non-engaging position, as shown in Figure 1. A plurality of spaced radially extending ribs 41 formed substantially centrally of the stem engage the upper end of the sleeve or bushing 25 between the spring fingers for forcing the closure member downwardly into the nipple or housing.

With the closure member C connected to the running tool R in the manner just described, the closure member may be lowered into the well conductor T and forced downwardly into the bore of the housing or nipple 10. The packing rings 21 and 23 will enter the large upper portion 12 of the bore of the housing and pass freely therethrough, and are adapted to engage the bore wall of the smaller lower portion 13 of the housing to provide an initial seal between said housing and the packing mandrel 20 of the closure member. The ribs 41 may be utilized to force the closure member downwardly, the sealing rings sliding along the bore wall of the reduced lower portion 13 of the housing until the beveled lower edges of the catches 34 of the running tool engage the beveled seat 11*a* at the lower end of the housing. Application of continued downward force to the running tool will force the latches 34 inwardly to shear the shear pins 35, whereupon the spring arms 38 retract the catches inwardly toward the bore of the foot piece 33 of the running tool and out of supporting position. Continued downward movement of the running tool brings the lower end of the packing mandrel 20 into engagement with the beveled shoulder or seat 11 in the housing, whereupon the catch members 29 at the upper end of the elongate spring fingers 26 are positioned in alignment with the locking recess 16 at the upper end of the housing. The frictional engagement of the sealing rings 21 and 23 with the bore wall of the reduced lower portion 13 of the bore of the housing restrains the closure member C against upward movement when the running tool is lifted, whereby the skirt 40 will slide off the tapered upper ends 28 of the spring fingers and permit said spring fingers to flex or spring radially outward until the catches 29 are engaged in the locking recess 16 at the upper end of the housing. The running tool R may then be completely withdrawn from the bore of the well conductor, and the closure member C is left anchored or locked in position in the housing in the manner clearly shown in Figure 2.

With the closure member C in the position illustrated in Figure 2, flow of fluids from the annular space between the well casing (not shown) and the flow conductor T to the bore of the flow conductor is prevented by the packing mandrel 20 and the sealing rings 21 and 23. Similarly, flow from the bore of the conductor or the housing 10 to the annular space exteriorly thereof is also prevented by the packing mandrel and sealing rings. Therefore, loading fluids, such as mud, water or the like, in the annular space exteriorly of the tubing and above the packer, are

prevented from flowing into the bore of the housing and the tubing.

It is particularly to be noted that the bore through the extreme lower end of the housing, which is the bore through the internal annular flange 11 formed at the lower end of the housing, is made equal to and preferably smaller than the bore through the packing mandrel 20 of the closure member. By providing this reduced bore through the internal flange 11 at the lower end of the housing, any pressure drop or pressure reduction caused by restriction of flow through the assembly is effected or taken across the internal flange 11, such bore being the smallest or most restricted flow passage through the entire assembly. Therefore, there is no upwardly acting fluid pressure differential applied to the packing mandrel 20 tending to urge said mandrel upwardly out of the housing. Also, sand or other extraneous matter accumulating in the flow conductor below the housing 10 cannot form a bridge or plug and flow upwardly in the conductor and act against the lower end of the packing mandrel of the closure member to displace the same upwardly from the housing, since any such bridge or plug would first engage the smaller bore through the internal annular flange 11 at the lower end of the housing and be reduced in size sufficiently to pass through the bore of the closure member.

It will also be noted that the closure member C does not further restrict the flow through the tubing or flow conductor T, since the bore of the internal flange 11 at the lower end of the housing constitutes the greatest restriction present in the assembly.

Should it become desirable or necessary to circulate the loading fluids from the annular space above the packer A, or to remove the packer, or to kill the well, or to open the ports 15 for any other reason, a suitable retrieving or pulling tool P may be lowered through the well flow conductor T to engage the closure member in the manner illustrated in Figure 3, whereupon an upward pull applied to the retrieving tool will lift the closure member from its position in the housing or nipple 10 and permit said closure member to be completely removed from the flow conductor. Removal of the closure member from the housing will open the lateral ports 15 in the housing and permit fluids to flow from the bore of the housing to the annular space exteriorly thereof or in the reverse direction.

The retrieving or pulling tool P is very similar to the running tool R, except that the stem 51 of the pulling tool is shorter than the stem 31 of the running tool, and the latches or catch members 54 are pressed outwardly by the arms 58 of the spring 56. Also, the ribs 41 are not found on the stem of the pulling tool, nor are there any shear pins provided for holding the latches in an extended or projecting position.

The pulling tool includes an elongate stem 51 having its upper end provided with screw threads 52, whereby it may be connected to the flexible line mechanism (not shown). A foot piece 53 is provided at the lower end of the stem, and catches 54 are mounted in opposed radial openings formed in the foot piece and are normally urged outwardly to project beyond the periphery of the foot piece by the arms 58 of a spring 56 which is formed with a central coil or loop which surrounds a pin 57 secured transversely of the foot piece. An external annular depending skirt 50 is formed at the outer edge of an annular flange 50a near the upper end of the stem 51 and is spaced annularly from said stem.

When the pulling tool is lowered into the well flow conductor, it enters the bore of the closure member and moves downwardly thereinto. The skirt 50 at the upper end of the pulling tool engages the tapered or inclined wedge surfaces 28 at the upper ends of the elongate spring fingers and moves the upper ends of the fingers inwardly to the position shown in Figure 3, when the pulling tool is moved downwardly with respect to the closure member. The extreme upper ends of the spring fingers abut against the underside of the flange 50a carrying the skirt member 50, whereby downward movement of the pulling tool with respect to the closure member is limited by such engagement. The spring pressed latch or catch members 54 are pressed inwardly by engagement with the inner bore wall of the closure member as the catches are moved downwardly within the bore of the closure member, the spring arms 58 permitting such inward movement of the catches.

An internal annular recess 60 is formed substantially centrally of the bore of the packing mandrel 20 of the closure member, and the latches or catches 54 on the pulling tool engage in this annular recess and under the shoulder at the upper end thereof when the flange 50a engages the upper ends of the spring fingers, whereby the closure member may be lifted by the engagement of the latches with said shoulder.

With the upper ends of the flexible spring fingers 26 held inwardly by the skirt member 50, whereby the catches 29 are retracted from the locking recess 16 at the upper end of the housing, and with the catches 54 at the lower end of the pulling tool engaged in the annular recess 60 in the bore of the packing mandrel of the closure member, the pulling tool may be lifted to lift the closure member from within the bore of the housing 10 and thence upwardly through the bore of the flow conductor to the surface of the well.

After the closure member has been removed from the housing, the ports 15 are opened and fluids may flow in either direction therethrough to establish communication between the bore of the flow conductor and the annular space exteriorly thereof.

In some instances it may be desired to provide a small flow opening or inlet 70 (Fig. 3) in the wall of the packing mandrel 20 in the closure member for the purpose of introducing an extraneous fluid from exteriorly of the housing into the bore of the housing, as for example when it is desired to employ a lifting fluid for providing for the auxiliary lifting of the well fluids to the well surface. In such event, the flow opening 70 would provide for the controlled admission of the lifting fluid for aeration and lifting of the fluids from the producing formation, in the customary or well-known manner.

In the event the pulling tool P does not retract the catch members 29 at the upper end of the spring fingers 26 of the closure member sufficiently to permit the catches to pass the undercut shoulder 17 at the upper end of the locking recess, the protruding tips of the catches 54 of the pulling tool may be sheared off by upward jarring or pulling of the pulling tool. The pulling tool P may then be separately removed from the bore of the well flow conductor. A suitable fishing spear (not shown) may then be lowered through the well flow conductor and engaged in

the bore of the packing mandrel **20**. An upward pull applied to the fishing spear would then tend to lift the closure member, such upward movement of the closure member being resisted by the engagement of the catches **29** at the upper end of the spring fingers **26** with the undercut shoulder at the upper end of the locking recess in the housing. However, a continued upward pull on the fishing spear, resulting in a continued upward force applied to the closure member, would cause the catches **29** to be sheared off, since they are relatively small in cross-sectional shear area.

When the catches **29** are sheared off, the spring fingers may move upwardly through the well flow conductor, the beveled upper ends of the fingers preventing the spring fingers from engaging or catching in any projection or recess in the flow conductor, such as the recess at the coupling between adjacent lengths of tubing. Thus, the small catches on the spring fingers may be sheared off to permit positive removal of the closure member from anchored position in the housing.

From the foregoing, it will be seen that a novel well treating and flow controlling device has been provided which may be installed in a well flow conductor and which is initially closed but which may be opened without manipulation of the tubing to establish circulation between the annular space exteriorly of the flow conductor and the bore of the flow conductor. It will also be seen that such a device is particularly adapted to be installed above a tubing-to-casing packer to provide for circulation of loading fluids between the annular space above the packer and the bore of the flow conductor. It will further be seen that the device includes a housing adapted to be connected in a well flow conductor and having lateral openings establishing communication between the interior and exterior of the housing, in combination with a removable closure for said lateral openings and means for releasably locking said closure in position in the housing, whereby flow from the annular space exteriorly of the housing into the bore of the housing through such lateral opening is completely prevented while the closure is in position in the housing, said closure being removable to permit the establishing of communication and fluid flow between the bore of the housing and the annular space exteriorly thereof.

It will particularly be noted that means has been provided in the well treating and flow controlling device for minimizing the application of an upward fluid pressure differential to the removable closure, whereby the upward force of said fluid pressure differential tending to move said closure upwardly out of the housing is reduced or substantially eliminated. The foregoing is accomplished by the provision of an internal annular flange at the lower end of the housing, the bore through said flange being reduced so as to be not greater than the bore through the flow conductor, and preferably smaller than the bore through the closure member, whereby fluid pressure reduction is effected across said flange or shoulder restriction and no substantial upward fluid pressure differential is applied to the closure member.

It will also be noted that the closure member is insertable into and removable from the housing upon the application of a straight longitudinal non-rotative force, whereby said closure member may be inserted into the housing or removed from the housing by means of a flexible line lowering and retrieving mechanism.

It will further be seen that the housing is provided with a cylindrical sealing surface in its bore above and below the lateral openings therein, whereby the sealing means carried by the closure member may engage said sealing surface to prevent fluids from the lateral opening by-passing the closure member to the bore of the housing, and that the bore of the housing above said sealing surface is enlarged or relieved to facilitate insertion and removal of the closure member. Furthermore, the anchoring or locking means on the closure member for holding said closure member in place in the housing is so constructed and arranged as to be retractable from anchoring position to permit removal of the closure member from the housing, and is also so constructed and arranged as to be shearable or releasable upon the application of a predetermined upward force to said closure member to assure that the closure member may positively be removed from the housing in the event such locking means cannot be retracted in the usual manner.

It will also be noted that the closure member may be provided with a lateral flow controlling opening in such manner that the closure member may be utilized for controlling the admission of fluids from the annular space exteriorly of the housing through the lateral opening into the bore of the housing to provide for auxiliary lifting or aeration of fluids from the producing formation, if desired.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

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

1. A well treating and flow controlling device including, an elongate tubular housing adapted to be connected in a well flow conductor and having a lateral flow opening in its side wall, said housing also having an internal annular locking recess near the upper end of its bore above the lateral opening providing a downwardly facing locking shoulder at the upper end of said recess, an internal annular flange forming a stop shoulder at the lower end of the bore of the housing spaced below the lateral flow opening in the wall of said housing, an elongate tubular closure member adapted to be removably positioned within the housing and having an axial bore not smaller than the bore through the internal flange at the lower end of said housing, sealing means carried externally by the closure member for sealing between the closure member and the bore wall of the housing above and below the lateral opening in the housing, said closure member being adapted to engage the stop shoulder of the annular flange at the lower end of the bore of the housing to position the sealing means in position for sealing between the closure member and housing above and below the lateral opening in the housing wall, elongate upwardly extending spring fingers extending upwardly from the upper end of the closure member and having outwardly projecting catch members at their upper ends adapted to engage under the locking shoulder at the upper end of said recess for limiting upward movement of the closure member in the housing, the stop shoulder on the internal annular flange at the lower end of the housing limiting down-

ward movement of the closure member in the housing, said elongate upwardly extending spring fingers being flexible inwardly so that the catches at the upper end of said fingers may be retracted from the locking recess to permit the closure member to be withdrawn from the housing.

2. A well treating and flow controlling device including, a tubular housing adapted to be connected in a well flow conductor and having a lateral opening therein, a tubular closure member adapted to be removably positioned within the housing for closing the lateral opening, sealing means carried by the closure member for sealing between the closure member and the bore wall of the housing for preventing flow in either direction through the lateral opening in the housing, the upper portion of the bore of the housing being enlarged to facilitate entry and removal of the closure member and sealing means in the housing, the upper enlarged portion of the bore of the housing having an internal annular locking recess formed therein with a downwardly facing locking shoulder at its upper end, upwardly extending spring fingers secured to the upper end of the closure member and having outwardly projecting catch members at their upper ends adapted to engage under the locking shoulder in the enlarged upper portion of the bore of the housing for limiting upward movement of the closure member in the housing, and an internal annular flange in the bore of the housing below the closure member for limiting downward movement of the closure member in the housing, the bore through said flange being not greater than the bore through the closure member whereby fluids flowing upwardly through the housing and closure member are prevented from displacing the closure member upwardly from the housing.

3. A well treating and flow controlling device of the character set forth in claim 2 wherein: the closure member is provided with an internal annular recess, whereby a retrieving tool extendable through said closure member may engage in said recess to lift the closure member from its position within the housing.

4. A well treating and flow controlling device including, an elongate tubular housing adapted to be connected in a well flow conductor and having the lower portion of its bore reduced to provide a sealing surface therein, said housing having a lateral flow opening formed in its wall substantially centrally of the sealing surface, said housing also having an internal annular recess in the upper portion of its bore above the sealing surface providing a downwardly facing locking shoulder at the upper end of said recess, a tubular closure member adapted to be removably positioned within the housing and having sealing means for sealing between said tubular closure member and the sealing surface of the housing for preventing flow in either direction through the lateral port in the housing wall, elongate upwardly extending spring fingers carried by said closure member and having projecting catch members at their upper end adapted to engage under the locking shoulder at the upper end of the recess at the upper end of the housing for limiting upward movement of the closure member in the housing, and an internal annular flange in the bore of the housing below the closure member for limiting downward movement of the closure member in the housing, the bore through said flange being not greater than the bore through the closure member.

5. A well treating and flow controlling device of the character set forth in claim 4 wherein, the elongate upwardly extending spring fingers are flexible in such a manner that the catches at the upper ends of said fingers may be retracted from the recess at the upper end of the housing to permit said catches to pass the locking shoulder at the upper end of said recess, whereby the closure member may be withdrawn from the housing.

6. A well treating and flow controlling device of the character set forth in claim 4 wherein, the tubular closure member is provided with an internal annular recess, whereby a retrieving tool may engage in said recess to lift the closure member from its position within the housing.

7. A well treating and flow controlling device of the character set forth in claim 4 wherein, the projecting catch members at the upper ends of the spring fingers are shearable to permit the closure member to be removed from the housing upon the application of a predetermined upward force thereto.

8. A well treating and flow controlling device retrievable by an elongated tool having a dependent annular flange adjacent its upper end and outwardly biased catches adjacent its lower end including, a tubular housing adapted to be connected in a well flow conductor and having a lateral opening therein, a tubular closure member adapted to be removably positioned within the housing for closing the lateral opening, said closure member being provided with an internal annular recess to receive and engage said catches of the retrieving tool, sealing means carried by the closure member for sealing between the closure member and the bore wall of the housing for preventing flow in either direction through the lateral opening in the housing, the upper portion of the bore of the housing having an internal annular locking recess formed therein, upwardly extending spring fingers secured to the upper end of the closure member and having outwardly projecting catch members at their upper ends adapted to enter into said locking recess for limiting upward movement of the closure member in the housing, said fingers having upper tapered portions engageable by said dependent flange of the retrieving tool for withdrawing said catch members from said internal annular locking recess whereby the closure may be withdrawn from the housing, and an internal annular flange in the bore of the housing below the closure member for limiting downward movement of the closure member in the housing.

HERBERT C. OTIS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,118,428	Chrisman	May 24, 1938
2,352,612	Boynton	July 4, 1944
2,447,546	Spencer	Aug. 24, 1948