Nov. 4, 1952 A. L. ARMENTROUT 2,616,503

CIRCULATION CONTROL FOR WELLS AND ACTUATOR THEREFOR

Filed Sept. 30, 1948

Fig. 1.

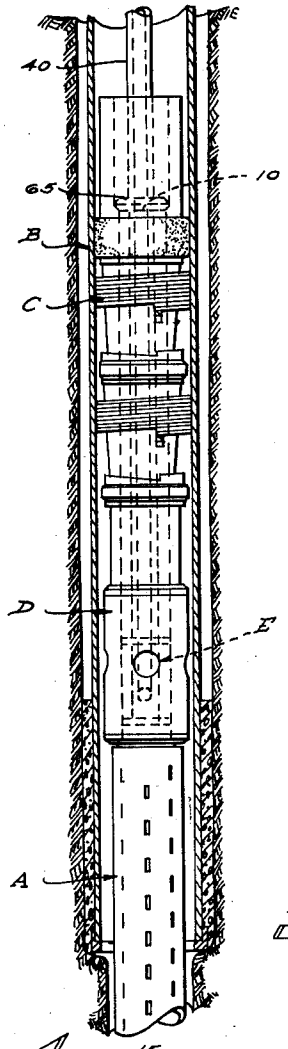


Fig. 2.

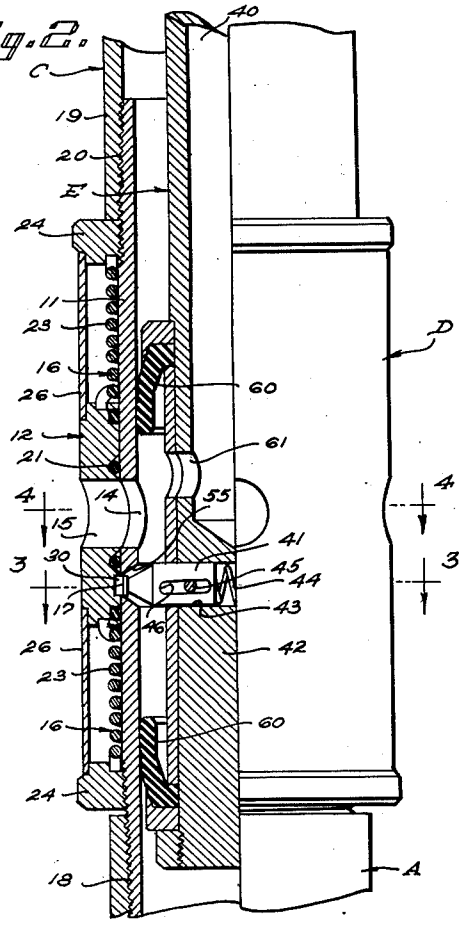


Fig. 3.

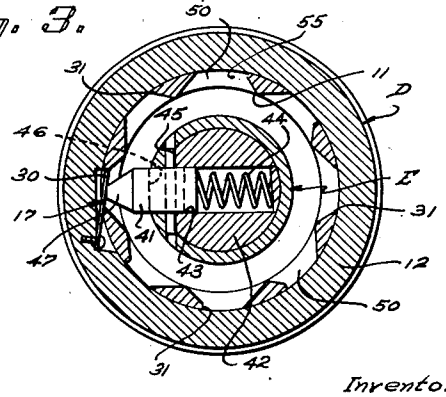
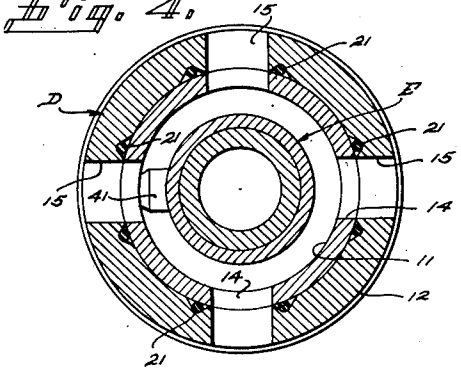


Fig. 4.



Inventor
Arthur L. Armentrout
By W. Wheatley
Attorney

Patented Nov. 4, 1952

2,616,503

UNITED STATES PATENT OFFICE

2,616,503

CIRCULATION CONTROL FOR WELLS AND ACTUATOR THEREFOR

Arthur L. Armentrout, Long Beach, Calif.

Application September 30, 1948, Serial No. 52,036

16 Claims. (Cl. 166—11)

1

This invention is concerned with a circulation control for wells and an actuator therefor, it being a general object of the invention to provide a tool or device applicable to structure located in a well to control flow of fluid in the well. The device embodying the present invention is to be regulated or controlled in a well. However, it is particularly applicable to a well liner and hanger therefor, and may be used to advantage as a coupling between such parts. When used in connection with a liner and hanger the structure of the present invention may be employed so that flow into the well above the hanger is confined to the liner or so that such flow bypasses the liner.

It is a general object of this invention to provide a structure of the general character referred to which is mechanically operated and is under control of an actuator so that it can be opened and closed at will.

A further object of the invention is to provide a structure of the general character referred to embodying spring means to supply the actuating force for opening and closing the device. The preferred form of the invention involves torsional springs normally tending to operate the device and the structure is such as to alternately open and close if it is operated under the influence of the springs.

Another object of the invention is to provide a structure of the general character referred to combined with an actuator and including means acting to release the control for operation and including an operating string which may be tubular and such as to handle fluid passed by the control structure.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a longitudinal detailed view of a typical well showing a liner supported therein through a hanger and showing a flow control embodying the present invention coupling the hanger and liner. Fig. 2 is an enlarged view of a portion of the structure shown in Fig. 1 with parts broken away to illustrate the details of construction. Fig. 3 is a plan section taken as indicated by line 3—3 on Fig. 2, and Fig. 4 is a plan section taken as indicated by line 4—4 on Fig. 2.

The structure provided by the present invention is shown in a typical operating combination, that is, it is shown combined with a liner A supported in a well casing B by means of a hanger C. The device or control D embodying the present invention is shown serving as a coupling connecting the hanger and liner. The particular liner hanger C illustrated in the drawings is of the general type that is more fully described and which is claimed in my copending application entitled "Line Hanger And Actuator Therefor" Serial No. 52,037, filed on even date herewith. The particular liner hanger referred to is characterized by a fixed internal shoulder 10 which may be employed to advantage in positioning or orienting the actuator E provided by the present invention.

2

The structure embodying the present invention is characterized by two main elements 11 and 12 which are shiftable relative to each other and which form a valve construction subject to being opened and closed through shifting of said elements relative to each other. In the particular form of the invention shown the element 11 is a tubular body while the element 12 is more properly a valve member and rotates relative to the body. More specifically the valve member 12 is shown as a sleeve rotatable on the body and the desired valve action is obtained by providing cooperating ports 14 and 15 in the body 11 and valve 12, respectively. In the case illustrated there is an annular series of lateral ports 14 in the body 11, the ports being equally spaced around the body as clearly shown in Fig. 4 of the drawings. The valve member 12 is provided with an annular series of ports 15 spaced in the same manner as the ports 14. In the case illustrated there are four ports 14 and four ports 15 and the body and valve with the ports therein are so proportioned and related that the valve can be rotated between positions where the ports 14 and 15 register and positions where the ports are out of register. Where there are four ports 14 and four ports 15 movement of the valve 12 through an angle of 45° effectively moves the valve from one position to the other, that is, from an open to a closed position or from a closed to an open position.

The structure provided by the present invention involves, in addition to the main elements 11 and 12, means 16 normally yieldingly urging the valve sleeve 12 so that it tends to shift or operate relative to the body 11, and a releasable control 17 for the valve 12 subject to operation by the actuator E.

The body 11 is preferably a simple elongate tubular element and in its preferred form it has the liner A coupled to its lower end while its upper end is joined to the hanger C. In the

case illustrated the liner A is shown directly coupled to the body 11 by a threaded connection 18 while the upper end of the body is joined to the hanger by a suitable coupling 19 which is joined to the body by a threaded connection 20.

The valve 12 which is in the form of a sleeve surrounding the body 11 is freely rotatable on the body and has suitable ports 15 cooperating with the ports 14 of the body in the manner above described. In practice it is desirable to provide sealing means 21 between the valve 12 and the body 11 to prevent leakage between these elements. It is to be understood that in practice any suitable form of sealing or packing means may be incorporated in the structure to gain the desired fluid-tight relationship between the body and valve.

The means 16 is a mechanical means wholly contained in the structure characterized by the body 10 and valve 12. In the preferred form of the invention the means 16 embodies one or more springs so coupled with or between the body and valve as to normally tend to rotate the valve about the body. In the particular case illustrated the means 16 includes two helical springs 23 which surround the body 10 above and below the valve 12. Each spring 23 has one end anchored or made fast to one end of the valve 12 while the other end is anchored to a stop or flange-like element 24 fixed on the body 11 a suitable distance beyond or spaced from the valve 12. In the particular case illustrated the stop flanges 24 are threaded on the body although, in practice, they may be engaged with the body in any desired manner so that they are rigid therewith.

In practice tubular housings 26 encase the springs 23 and extend between the valve 12 and the stop flanges 24. The housing members 26 serve to effectively protect or encase the springs and they also hold the valve 12 in the desired position lengthwise of the body, as will be apparent from Fig. 2 of the drawings.

The means 17 releasably holding the valve sleeve 12 against operation relative to the body is preferably a latch means. In the form of the invention illustrated the means 17 is shown as a spring latch construction involving a spring latch 30 carried by one of the elements and cooperatively engaging latch shoulders 31 on the other element. In the arrangement shown the spring latch 30 is carried by the valve sleeve 12 while the shoulders 31 are provided on the body 12 being circumferentially spaced around the body in an annular series. The latch 30 normally yieldingly assumes a position where it engages a shoulder 31, as shown in Fig. 3 of the drawings, and in the particular form of the invention illustrated the shoulders 31 are spaced around the exterior portion of the body so that when the latch engages a shoulder the valve 12 is either in a full open position or a full closed position. Where there are four ports 14 in the body and four corresponding ports 15 in the body it is desirably that there be eight shoulders 31, four of which are located to stop the valve in position where the ports 14 and 15 are out of register.

The actuator E provided by the present invention is adapted to be engaged in the structure just described from the upper end of the well, and in the form illustrated it is shown as including an operating string 40 and a latch actuator 41 carried by the string to cooperate with the latch 30. In the particular form of actuator E illustrated in the drawings the string 40 is tubular and is provided at its lower end with a head 42 carrying the latch actuator 41. The latch actuator is shown as a plunger slidably carried in a laterally disposed guide opening 43 in the head 42 and a spring 44 behind the plunger normally yieldingly urges it outwardly while a stop spring 45 operates in a longitudinal opening 46 extending transversely through the plunger to limit the movement of the plunger in the guide opening 43. The outer end or tip portion 47 of the plunger is beveled so that as the actuator E is lowered into the well obstructions engaged by the plunger do not damage the plunger but merely cause it to be moved inwardly in the guide opening against the resistance of the spring 44.

With an actuator E having a spring pressed element such as the plunger 41 engageable into the body 11 to a position such as is shown in Fig. 10 it is desirable to provide the body 10 with access openings 50 at or adjoining the stop shoulders 31 as shown in Fig. 3 of the drawings. With an access opening 50 adjoining each stop shoulder 31 the actuator E can be lowered into the structure to the point where its plunger 41 enters the access opening adjacent the shoulder engaged by the spring latch 30. The spring 44 is made stronger than the spring of the latch 30 so that when the plunger 44 engages the spring latch 30 the latch is depressed, freeing the sleeve valve 12 from the body 11 so that the springs 23 are free to act and rotate the valve relative to the body. It is to be understood, of course, that the sleeve or valve 12 has been initially rotated relative to the body 10 in such manner as to put the springs 23 under tension so that they have the desired action when the latch 30 is released. When the latch 30 has been released in the manner above described the valve 12 rotates to a position where the latch engages the next latch shoulder 31, in which position the structure will remain until the latch is again released.

Any operation of the valve 12 as just described will cause the valve either to open or to close, depending upon the position of the valve when the operation was initiated. It may be that it is desired to leave the structure in the position that follows release of the latch 30, in which case the actuator E may be removed, the walls 55 of the access openings 50 being inclined or pitched so that the plunger 41 is depressed when the actuator is moved either up or down from a position where the plunger is engaged in an access opening. If it is desired to follow one actuation of the latch 30 by another actuation thereof without removing the actuator E it is merely necessary to rotate the actuator causing the plunger 41 to move from one access opening to the next, or to the access opening where the latch is located. It will be apparent from Fig. 3 of the drawings how the walls of the access openings 50 are inclined or beveled so that the plunger 41 is depressed as it moves from one opening to the next.

The particular actuator E shown in the drawings includes a tubular string 40 and the head 42 carries spaced packers 60 that slidably engage in the body 11 so that flow passed by the registering ports 14 and 15 above described may enter the actuating string 40 through a passage 61 provided in the head between the packers. It is to be understood that the flow can be in either direction, that is, either down through the operating string 40 and out through the ports 14 and 15, or in through ports 14 and 15 and into the operating string 40 through the passage 61.

When the actuator E is employed in connection with a hanger C having a stop shoulder 10, a stop member or flange 65 may be provided on the actuator to engage and be stopped against the shoulder 10 when the plunger 41 of the actuator has advanced into the body 11 to a point opposite the access openings 50, whereupon it is merely necessary to rotate the operating string 40 until the plunger 41 reaches the access opening at which the latch 30 happens to be located. Through this relationship of parts it is a very simple matter to operate the structure and the force or power required to turn the valve need not be applied through the actuator E or from any other external source, but is wholly contained in the structure itself. It will be apparent that the springs 23 that supply the necessary power may be of such size, strength and form as to operate the valve successively as many times as normal circumstances will require.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claims.

Having described my invention, I claim:

1. A device for controlling flow in a well and applicable to a structure in a well including, two relatively rotatable sections, spring means tending to rotate one of the sections relative to the other, and a releasable control for the said means adapted to normally hold the sections against relative rotation, the control including a member normally engaged between the sections and adapted to be released from one section by a member inserted into the device through the well, one section being a body with a port and the other being a sleeve valve rotatable to and from position where it closes the port.

2. A device for controlling flow in a well and applicable to a structure in a well including, two relatively rotatable sections, mechanical means normally tending to rotate one of the sections relative to the other, and a latch control normally holding the sections against operation by the said means and including a latch member normally engaged with each section and adapted to be released from one section by a member inserted into the device through the well, one section being a body with a port and the other being a sleeve valve rotatable to and from a position where it closes the port.

3. A device for controlling flow in a well and applicable to a structure in a well including, two relatively rotatable sections having cooperating ports, one section being a tubular body and the other a valve sleeve surrounding the body and rotatable thereon, an operating spring acting between the body and sleeve turning the sleeve relative to the body, and a latch releasably holding the sleeve against operation.

4. A device for controlling flow in a well and applicable to a structure in a well including, two relatively rotatable sections having cooperating ports, one section being a tubular body and the other a valve sleeve surrounding the body and rotatable thereon, means holding the sleeve against axial movement on the body, an operating spring acting between the body and sleeve to rotate the sleeve on the body, and a latch releasably holding the sleeve against operation.

5. A device for controlling flow in a well and applicable to a structure in a well including, two relatively rotatable sections having cooperating ports, one section being a tubular ported body and the other a valve sleeve surrounding the body and rotatable relative thereto, an operating spring acting between the body and sleeve to rotate the sleeve on the body, and a spring latch releasably holding the sleeve against operation.

6. A device for controlling flow in a well and applicable to a structure in a well including, two relatively rotatable sections having cooperating ports, one section being a tubular body and the other a valve sleeve surrounding the body and rotatable relative thereto, an operating spring acting between the body and sleeve to rotate the sleeve, and a latch releasably holding the sleeve against operation, the operating spring being a helical spring surrounding the body and having one end anchored to the body and the other end anchored to the sleeve.

7. A device for controlling flow in a well and applicable to a structure in a well including, two relatively rotatable sections having cooperating ports, one section being a tubular body and the other a valve sleeve surrounding the body and rotatable relative thereto, an operating spring at the exterior of the body acting between the body and sleeve, means housing the spring and holding the sleeve against axial movement on the body, and a latch releasably holding the sleeve against operation.

8. A structure of the character described including, a tubular body, a sleeve on the body, the body and sleeve having cooperating ports, helical springs around the body at the ends of the sleeve, each spring having one end anchored to the body and the other end anchored to the sleeve, and means releasably holding the sleeve against operation relative to the body.

9. A structure of the character described including, a tubular body having an access opening, a sleeve on the body, the body and sleeve having cooperating ports, helical springs around the body at the ends of the sleeve, each spring having one end anchored to the body and the other end anchored to the sleeve, and means releasably holding the sleeve against operation relative to the body including a latch engageable through the access opening.

10. A structure of the character described including, a tubular body having an annular series of access openings, a valve sleeve rotatable on the body, the body and sleeve having cooperating fluid handling ports spaced from the said openings, spring means normally tending to rotate the sleeve on the body, and means releasably holding the sleeve against rotation including, a latch carried by the body cooperating with shoulders at the interior of the body adjacent the access openings.

11. In combination, a control carried by structure in a well and including, a ported tubular body, a valve operable relative to the body and controlling flow through the port of the body, means normally tending to operate the valve, and a releasable latch holding the valve against operation, and an actuator including a string to be lowered into the well, and a latch actuating element on the string engageable with the latch to operate it.

12. In combination, a control carried by structure in a well and including, a ported tubular body, a valve operable relative to the body and controlling flow through the port of the body, a spring normally tending to operate the valve, and a releasable latch holding the valve against op-

eration, and an actuator including a string to be lowered into the well, and a latch actuating element on the string engageable with the latch to operate it.

13. In combination, a control carried by structure in a well and including, a ported tubular body, a valve operable relative to the body and controlling flow through the port of the body, means normally tending to operate the valve, and a releasable latch holding the valve against operation, and an actuator including a tubular string to be lowered into the well, and a latch actuating member on the string engageable with the latch to operate it, the string being in communication with the exterior of the control through said valve.

14. In combination, a control carried by structure in a well and including, a ported tubular body, a valve operable relative to the body and controlling flow through the port of the body, means normally tending to operate the valve, and a releasable latch holding the valve against operation, and an actuator including a tubular string to be inserted in the well, a latch actuating member carried by the string engageable with the latch, and spaced packers on the string engageable in the body, the string having an opening between the packers establishing communication between the interior of the string and the exterior of the control through the said valve.

15. In combination, a control carried by structure in a well and including, a ported tubular body, a valve operable relative to the body and

controlling flow through the port of the body, means normally tending to operate the valve, and a releasable latch holding the valve against operation, and an actuator including a string to be lowered into the well, and a spring actuated latch engaging member on the string engageable with the latch to operate it.

16. In combination, a control carried by structure in a well and including, a ported tubular body, a valve operable relative to the body and controlling flow through the port of the body, means normally tending to operate the valve, and a releasable latch holding the valve against operation, and an actuator including a string to be lowered into the well, and a spring actuated plunger carried by the string engageable with the latch to operate it.

ARTHUR L. ARMENTROUT.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,069,744	Ulmer	Aug. 12, 1913
1,979,857	Benson	Nov. 6, 1934
2,143,055	Crickmer et al.	Jan. 10, 1939
2,153,268	Neighbors	Apr. 4, 1939
2,168,735	Gilstrap	Aug. 8, 1939
2,178,540	McNeese et al.	Nov. 7, 1939
2,248,169	Granger	July 8, 1941
2,380,022	Burt	July 10, 1945