Feb. 24, 1953 H. ALLEN 2,629,403

FLOW CONTROLLER

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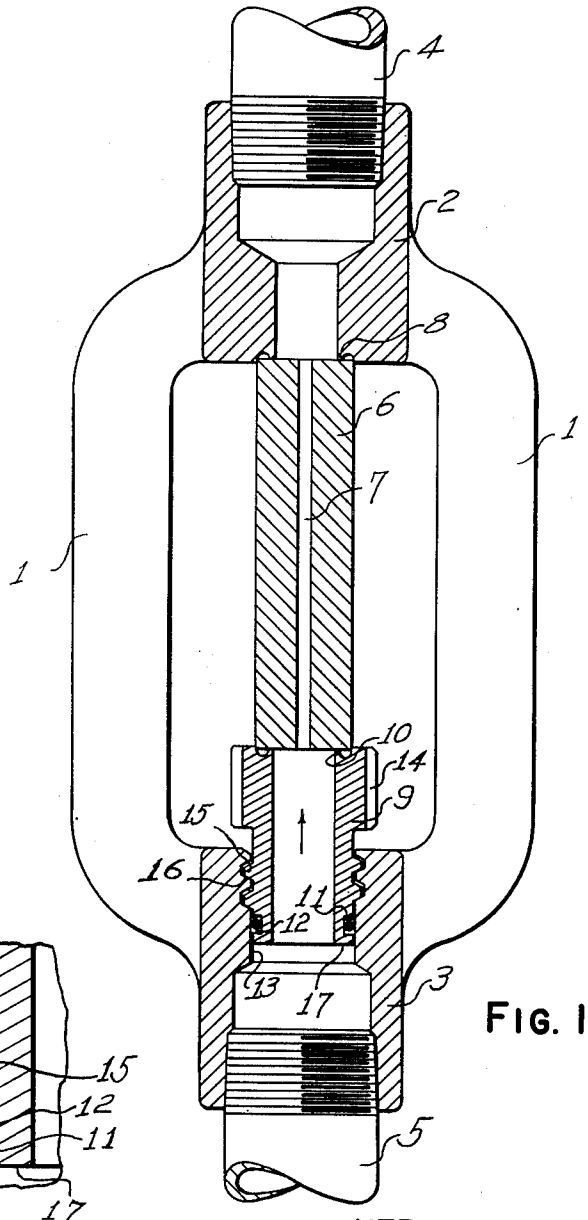


FIG. 1.

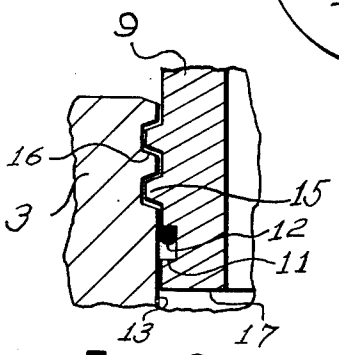


FIG. 2.

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## FLOW CONTROLLER

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14 Claims. (Cl. 138—44)

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This invention relates to improvements in flow control apparatus for wells and refers more particularly to a flow controller which may be readily assembled and wherein the actual control element may be quickly and easily changed.

In producing oil and gas wells it is the usual practice to control the rate of flow of fluid from the well. Often-times the fluid flow rate from wells is controlled in compliance with requirements of law and many times it is done solely in the interest of conservation. The rate of flow is controlled by restricting the diameter of the flow passage through which the fluid must flow. A control element known to the industry as a choke or flow bean is usually used to effect this restriction. Two types of control elements have been employed, one the positive type with a fixed restricted aperture and the other the variable type employing a fixed annular seat or flow bean and a needle valve member which may be inserted into the seat to provide a variable capacity annular flow passage. This invention is concerned with both types of flow controllers but in the interest of simplicity and not by way of limitation the invention is illustrated in conjunction with only the positive type controller.

In a well installation the control element must be readily replaceable. The necessity for replacement arises from cutting out of the control element due to the abrasive materials such as sand entrained in the well fluid. Also it is sometimes the practice to use a standard or test element meeting the specifications of law for purposes of testing the potential of the well and then inserting a different flow element designed both to resist the cutting out effect of the abrasives entrained in the fluid and to control the rate of flow so that the wells allowable may be uniformly distributed over the time period covered by such allowable.

Heretofore quick change flow bean holders have been provided but they have not been entirely satisfactory in that special tools are required for making the change and usually it is necessary to make adjustment of a plurality of parts which increases the time requirement of such change. In changing a flow controller it is desirable to make the change as quickly as possible because the flow through the particular flow line must be shut down during this period and shut downs for long periods are undesirable.

An object of this invention is to provide a flow controller wherein the flow control element may be readily and quickly changed.

Another object is to provide a flow controller

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wherein a flow control element may be changed manually without the use of tools.

Another object is to provide a flow controller wherein a flow control element is sealed in place by the pressure of the fluid controlled.

A further object is to provide a flow controller wherein a flow control element may be changed by manipulation of a single part.

Still another object is to provide a flow controller wherein a flow control element may be changed by manipulation of a single part and the pressure controlled forces the single part into sealing engagement with the flow control element.

Other and further objects of this invention will appear from the description.

In the accompanying drawings which constitute a part of the instant specification and which are to be read in conjunction therewith and wherein like reference numerals are employed to indicate like parts in the various views;

Fig. 1 is a sectional view illustrating the preferred embodiment of this invention; and

Fig. 2 is a fragmentary view, on an enlarged scale, showing the threaded engagement of the retainer in its support fitting and the seal provided therebetween in the installation of Fig. 1 and showing the relative position of the retainer and fitting when fluid is flowing therethrough.

Referring to the drawings, the flow control apparatus is illustrated as including a flow bean holder made up of a plurality of lateral support arms 1 which rigidly support flow fittings 2 and 3 in substantial axial alignment. The fittings 2 and 3 are adapted to be connected into a flow line or passage and may be threaded between adjacent pipe sections of the flow line as shown at 4 and 5, respectively. It is preferable that the flow bean holder be connected in the flow line in such manner that fitting 3 will be upstream of fitting 2 for a reason to be hereinafter more fully explained.

The support arms 1 are spaced apart to provide ready access to the flow control element 6 which is to be supported between fittings 2 and 3. In the embodiment illustrated the control element is shown as a positive type choke or flow bean 6 with a small diameter aperture 7 therethrough. The control element may be any tubular element having suitable means to restrict the cross sectional area of the flow passage therethrough. This flow bean shown is the type that is required by the laws of many States for purposes of testing. This type of bean may

of course also be used for controlling flow during normal operations.

Upon assembly of the flow bean in the holder the tubular element or bean 6 is seated in a very slight recess provided in the end surface of fitting 2 and sealingly abuts an annular portion or rib 8 adjacent the bore of the fitting. The flow bean is held in position against rib 8 by a retainer 9. It is desirable to provide ground contact surfaces between the flow bean and the retainer to insure a fluid tight seal therebetween. The retainer has a tubular portion extending into fitting 3 and has a coarse, loose threaded connection therewith. The particular character of this threaded connection is important as will be hereinafter more fully disclosed. Retainer 9 also has a recess in its outer end portion which is adapted to engage one end of the tubular element 6. An annular rib 10 adjacent the bore through the retainer sealingly engages the end of the flow bean.

Due to the loose character of the threaded mounting of retainer 9 it is necessary to provide a seal between the retainer and fitting 3. This seal should be a moving seal to permit axial adjustment of retainer 9 relative to the fitting to provide for ready assembly of the flow bean in the holder. It is preferred to use an O-ring sealing means for this purpose. A peripheral groove 11 is provided adjacent the inner end of retainer 9 in which is lodged an O-ring 12 which may be made up of suitable resilient material such as rubber, neoprene, other suitable synthetics, or the like. This O-ring upon installation is confined within a surrounding cylindrical surface 13 within fitting 3.

The importance of the particular threaded connection between retainer 9 and fitting 3 will appear from the following discussion of the assembly of a flow bean within the holder. Retainer 9 is provided at its head with grooves 14 for engagement by a suitable wrench. However, it is contemplated that the wrench may be dispensed with and that a suitable assembly of the device may be accomplished by manual manipulation of retainer 9. Before changing flow bean 6 flow through the flow line is stopped by a suitable upstream valve which has not been shown in the drawings. The flow line downstream from the valve may be vented so the pressure within the control assembly is substantially atmospheric during the change operation. Under this pressure condition the retainer may be readily turned by hand to screw it into fitting 3 to release flow bean 6 and to provide space between ribs 8 and 10 to insert a substitute flow bean. The retainer is then rotated in a direction to retract the retainer from fitting 3. This rotation is continued until rib 10 engages flow bean 6 to clamp the flow bean in place. The retainer is turned to make a finger tight connection. In this position, shown in Fig. 1, thread 15 of the retainer engages the back surface 16 of the threads in the fitting. Then when the valve controlling flow through the flow line is opened, the pressure within the fitting is materially elevated and acts upon the exposed surface or end portion 17 of the retainer to urge the retainer into tight clamping engagement with the flow bean. The pressure acting against surface 17 provides a force urging the retainer 9 against the flow bean which is much greater than the force exerted on the retainer in the opposite direction by the pressure acting on the portion of rib 10 exposed to the pressure within the retainer so the flow bean is securely clamped in place. The end surfaces of bean 6, exposed to the pressure controlled, are of substantially equal area, but the pressure upstream of the bean is usually the greatest so the bean is forced against rib 8.

By referring to Fig. 2 it is seen that the retainer has been moved by pressure acting against surface 17 to a position wherein threads 15 do not engage either wall of the fitting threads. In other words, the retainer is free to move under the influence of the pressure of the fluid controlled within the limits provided by its loose threaded connection with the fitting to perfect its seal. It is to provide for this that it is preferred to install the flow bean holder with fitting 3 upstream of fitting 2, otherwise the pressure controlled cannot be relied upon to force the retainer against the flow bean.

It will be seen that the coarse, loose threaded connection between retainer 9 and fitting 3 constitutes a means securing the retainer in telescope position relative to the fitting and adapted to advance or retract the retainer into and out of clamping position. This means includes the engaging part 15 carried by the retainer and 16 carried by the fitting which permits some movement of the retainer and its part relative to the part carried by the fitting. It is contemplated that any other suitable means may be employed to accomplish this, but the coarse, loose threaded connection is preferred because of its simplicity and ruggedness and because it lends itself readily to fabrication.

It is believed that the operation of the flow controller of this invention is apparent from the foregoing description. The device is assembled in a flow line having a valved communication with a well. The rate of flow of fluid from the well is controlled by the smallest cross-sectional area of the flow passage through the control element 6. The control element is positively held in place between fitting 2 and retainer 9 and may be rapidly and readily changed in the manner heretofore described. This change may be accomplished by manual manipulation of the retainer and involves the movement of only the one part, namely retainer 9. A sliding seal between the retainer and fitting 3 is provided by the O-ring sealing means assembly. This type of seal permits requisite movement of the retainer relative to fitting 3 as will be readily appreciated by those skilled in the art.

Rib 19, upon the outer end of retainer 9, is located adjacent the bore through the retainer and is of smaller diameter than end 17 and thus the effective area exposed to the pressure differential between the interior of fitting 3 and the exterior of the device is the annular surface 17. This provides a substantial area exposed to an elevated pressure. The force of the pressure against this area is much greater than the opposing forces due to pressure, as heretofore explained, and positively urges retainer 9 against tubular element 6 and the loose connection of the coarse threaded mounting of the retainer permits sufficient movement of the retainer toward clamping position to form positive seals at the ends of the flow bean secured between ribs 8 and 10 of fitting 2 and retainer 9, respectively.

It will be seen that the objects of this invention have been accomplished. There has been provided a well control device wherein the actual control element may be quickly and readily changed. The arrangement is such that the

change of the flow control element may be effected by manipulation of a single part. The construction is such that the single part which is manipulated to effect a change of flow beans may be turned by hand alone and the pressure controlled is utilized to tightly clamp the flow bean between ribs 8 and 10 to positively seal the communication between the flow bean and the retaining elements of the flow control device.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having described my invention, I claim:

1. Flow control apparatus comprising two spaced apart, substantially axially aligned flow fittings and means for securing a flow control element therebetween, said means including a retainer with a bore therethrough loosely connected to one of the fittings and directly movable endwise within limits into and out of clamping position relative to the other fitting whereby a flow control element may be clamped between the retainer and the other fitting, said retainer having endwise surface exposed to a pressure within the apparatus to be sealed against, the preponderance of such surface being exposed to the interior of the fitting to which it is connected whereby the pressure within the fitting urges the retainer toward clamping position.

2. Flow control apparatus comprising two spaced apart, substantially axially aligned flow fittings, a retainer with a bore therethrough having a portion in telescoping relation with one of the fittings and directly movable endwise within limits to sealingly clamp a flow control element between the retainer and the other fitting, means securing the retainer in telescoping relation with the fitting and operable to selectively advance or retract the retainer into and out of clamping position, said means including loosely engaging parts carried by the retainer and fitting respectively permitting some axial movement of the retainer toward clamping position, said retainer having endwise surface exposed to a pressure within the apparatus to be sealed against, the preponderance of such surface being exposed to the pressure within the fitting with which the retainer is secured so that the pressure of the fluid to be controlled may act against the endwise surface to urge the retainer toward clamping position.

3. Flow control apparatus comprising two spaced apart, substantially axially aligned flow fittings, one of which has a seating portion adapted to sealingly receive one end of a flow control element; a retainer with a bore therethrough loosely but sealingly connected to the other fitting in such manner as to provide for selective axial movement within limits of the retainer relative to the fitting to which it is connected, the retainer having a seating end portion adapted upon assembly to sealingly engage such flow control element to establish communication between the fittings, the retainer having endwise surface exposed to a pressure within the apparatus to be sealed against, the preponderance of such surface being exposed to the pressure within the said other fitting; whereby the force of said pressure acting against the exposed endwise surface may urge the retainer against such flow control element to sealingly secure it between the retainer and the first mentioned fitting.

4. Flow control apparatus comprising two spaced apart, substantially axially aligned flow fittings, one of which has a seating portion adapted to sealingly receive one end of a flow control element to establish communication therebetween; a retainer with a bore therethrough loosely threaded to the other fitting, means providing a sliding seal between the retainer and the said other fitting; the retainer having a seating end portion adapted upon assembly to sealingly engage a flow control element to establish communication between the fittings, the retainer having endwise surface oppositely disposed to the seating end portion presenting a greater area to a pressure interior of said other fitting than does the seating end portion; whereby the force of the pressure within said other fitting acting against the exposed endwise surface may move the retainer, within the limits provided by its loose threaded mounting, against a flow control element to sealingly secure it between the retainer and the first fitting.

5. Flow control apparatus comprising two spaced apart substantially axially aligned flow fittings, one of which has a seating portion adapted to sealingly receive one end of a flow control element to establish communication therebetween; a retainer with a bore therethrough loosely threaded to the other fitting, an O-ring sealing means provided between the retainer and said other fitting; the retainer having a seating end portion adapted upon assembly to sealingly engage a flow control element to establish communication between the fittings, the retainer having endwise surface oppositely disposed to the seating end portion presenting a greater area to a pressure interior of said other fitting than does the seating end portion; whereby the force of the pressure within said other fitting acting against the exposed endwise surface may move the retainer, within the limits provided by its loose threaded mounting, against a flow control element to sealingly secure it between the retainer and the first fitting.

6. Flow control apparatus comprising a support member having spaced apart, substantially axially aligned flow fittings; a seating portion on one of the fittings adapted to sealingly receive a flow control element urged thereagainst to establish communication between the fitting and element; a retainer with a bore therethrough loosely threaded within the other fitting, the outer end portion of the retainer providing a seating surface adapted to sealingly engage a flow control element to establish communication between the two fittings, the inner end portion of the retainer presenting a greater area to a pressure interior of said other fitting than does the outer end portion; whereby the force of the pressure within said other fitting acting against the inner end portion may move the retainer, within the limits provided by its loose threaded

mounting, against a flow control element to sealingly secure it between the retainer and the first fitting.

7. Flow control apparatus comprising a support member having spaced apart, substantially axially aligned flow fittings; a seating portion on one of the fittings adapted to sealingly receive a flow control element urged thereagainst to establish communication between the fitting and element; a retainer with a bore therethrough loosely threaded within the other fitting, means providing a sliding seal between the retainer and the said other fitting, the retainer having an outer end portion providing a seating surface adapted to sealingly engage a flow control element to establish communication between the two fittings, the inner end portion of the retainer presenting a greater area to a pressure interior of said other fitting than does the outer end portion; whereby the force of the pressure within said other fitting acting against the inner end portion may move the retainer, within the limits provided by its loose threaded mounting, against a flow control element to sealingly secure it between the retainer and the first fitting.

8. Flow control apparatus comprising a support member having spaced apart substantially axially aligned flow fittings; a seating portion on one of the fittings adapted to sealingly receive a flow control element urged thereagainst to establish communication between the fitting and element; a retainer with a bore therethrough loosely threaded within the other fitting, an O-ring sealing means provided between the retainer and the said other fitting, the retainer having an outer end portion providing a seating surface adapted to sealingly engage a flow control element to establish communication between the two fittings, the inner end portion of the retainer presenting a greater area to a pressure interior of said other fitting than does the outer end portion; whereby the force of said interior pressure acting against the inner end portion may move the retainer, within the limits provided by its loose threaded mounting, against a flow control element to sealingly secure it in place.

9. As a sub-combination, a connection adaptable for use in conjunction with flow control apparatus comprising a fitting and a retainer with a bore therethrough loosely threaded to the fitting, said retainer having an annular seating portion at its outer end and adjacent the bore adapted to sealingly engage a flow control element and an annular endwise surface of substantial area exposed to the pressure within the fitting, said endwise surface exposed to the pressure within the fitting being greater than all oppositely facing endwise surface exposed to the same pressure.

10. As a sub-combination, a connection adaptable for use in conjunction with a flow bean holder comprising a fitting; a retainer with a bore therethrough loosely threaded within the fitting, said retainer having an annular seating portion at its outer end and adjacent the bore adapted to sealingly engage a flow control element and an inner endwise surface of substantial area exposed to the pressure within the fitting; said endwise surface exposed to the pressure within the fitting being greater than all oppositely facing endwise surface exposed to the same pressure and a sealing means between the retainer and fitting providing a moving seal therebetween.

11. As a sub-combination, a connection adaptable for use in conjunction with a flow bean holder comprising a fitting; a retainer with a bore therethrough loosely threaded within the fitting, said retainer having an annular seating portion at its outer end and adjacent the bore adapted to sealingly engage a flow control element and an inner endwise surface of substantial area exposed to the pressure within the fitting; said endwise surface exposed to the pressure within the fitting being greater than all oppositely facing endwise surface exposed to the same pressure and external peripheral groove in the retainer; a cylindrical surface within the fitting surrounding the groove; and an O-ring in the groove operable with the groove walls and cylindrical surface to provide a moving seal between the retainer and fitting.

12. In combination two spaced apart flow fittings with a lateral support arm therebetween rigidly holding the fittings in substantial axial alignment, a flow control element having one end sealingly engaging a portion of one of the fittings, and means releasably holding the flow control element against said fitting including a retainer with a bore therethrough loosely threaded into the other fitting, one end of the retainer having an annular seating portion adjacent the bore sealingly engaging the end of the flow control element remote from the other fitting, the retainer having an endwise surface of substantial area exposed to a pressure within said other fitting, said endwise surface exposed to the pressure within the fitting being greater than all oppositely facing endwise surface exposed to the same pressure whereby upon assembly and in operation an increase in pressure within the fitting urges the retainer into tight engagement with the flow control element within the limits of movement provided by the loose threaded mounting of the retainer.

13. Flow control apparatus comprising two spaced apart, substantially axially aligned flow fittings, one of which has a seating portion adapted to sealingly abut one end of a flow control element; a retainer with a bore therethrough having a part extending within the other fitting, means providing a seal between the retainer and the latter fitting, loose fitting coacting parts carried by the retainer and the latter fitting arranged to effect axial movement upon rotation of the retainer and the latter fitting; the retainer having a seating end portion adapted upon assembly to sealingly engage such flow control element to establish communication between the control element and the latter fitting, the retainer having an endwise surface spaced from said seating end portion and exposed to the pressure within the fitting; said endwise surface exposed to the pressure within the fitting being greater than all oppositely facing endwise surface exposed to the same pressure whereby the force of said pressure acting against the exposed surface may urge the retainer against such flow control element to sealingly secure it between the retainer and the first mentioned fitting.

14. Flow control apparatus comprising two fixedly spaced axially aligned flow fittings, one of said fittings having an annular seating surface facing toward the other, and a tubular retainer with a bore therethrough in a telescoping axially movable sealed engagement with the other of said fittings and extending from said other fitting toward the first fitting and having an annular seating surface opposed to said first mentioned annular seating surface on the first fitting, said retainer having a preponderance of

endwise surface exposed to a pressure sealed against on that end remote from its seating surface.

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