Nov. 21, 1967 M. M. KINLEY 3,353,607

FLOW VALVES AND CHOKES, AND MEANS FOR INSTALLING SAME

Filed June 7, 1965 2 Sheets-Sheet 1

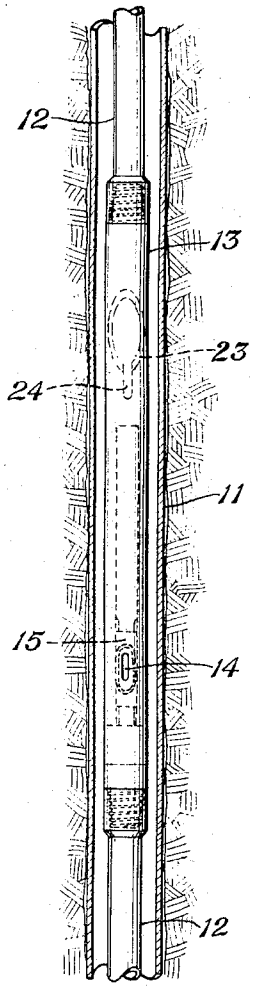


Fig. 1

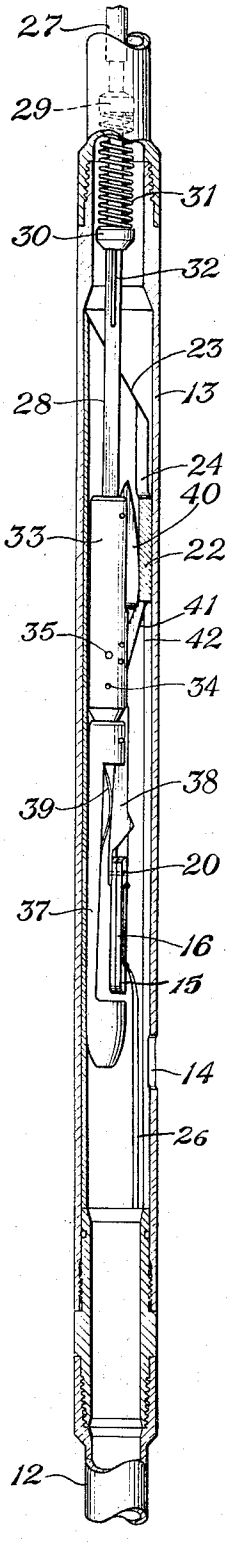


Fig. 2

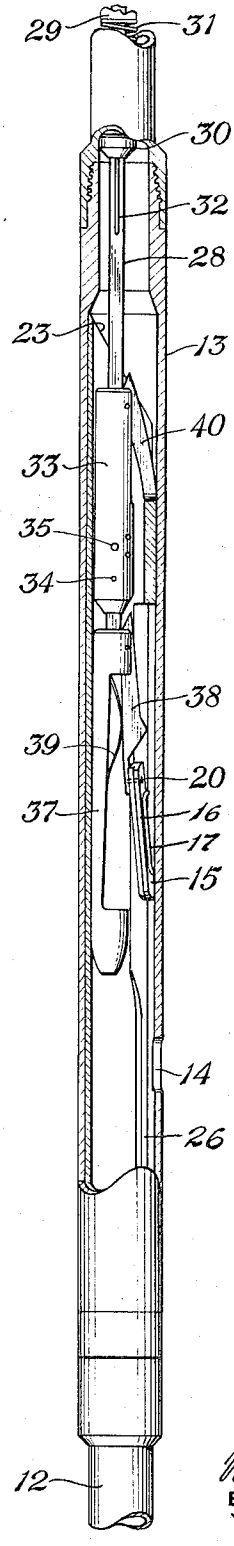


Fig. 3

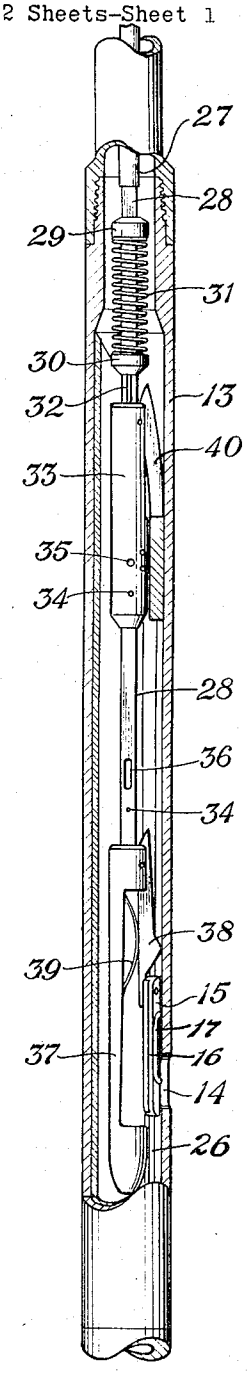


Fig. 4

INVENTOR
Myron M. Kinley
BY
Earl Babcock
ATTORNEY

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FLOW VALVES AND CHOKES, AND MEANS FOR INSTALLING SAME

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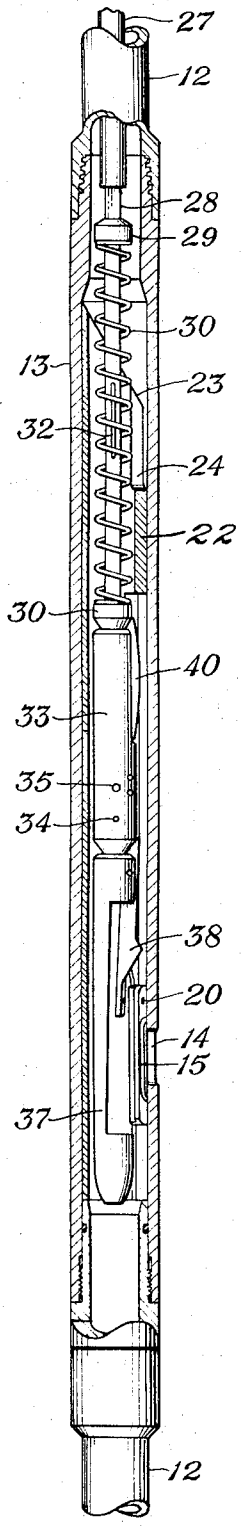


Fig. 5

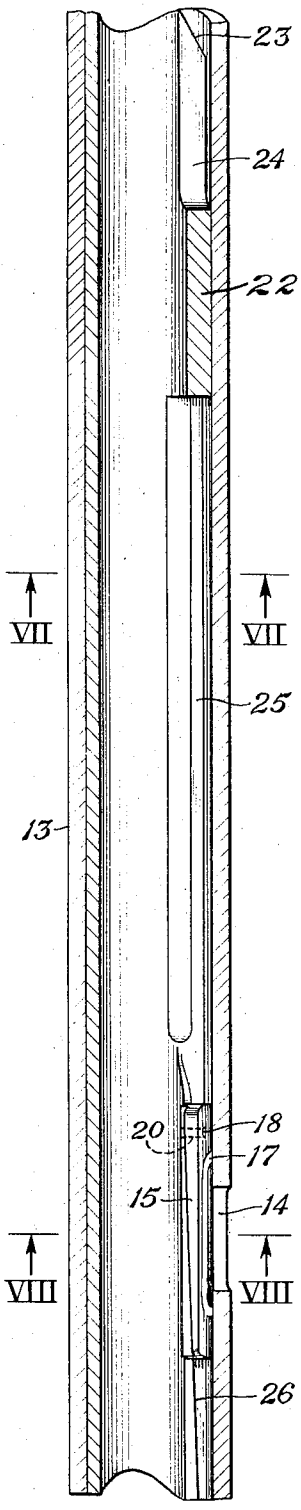


Fig. 6

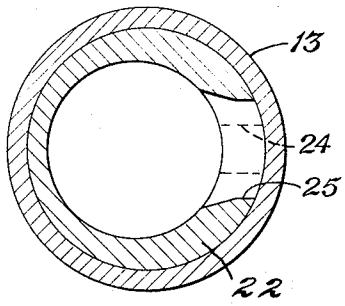


Fig. 7

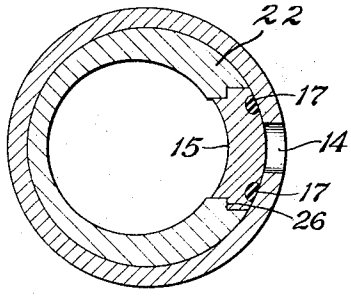


Fig. 8

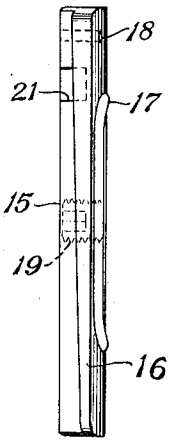


Fig. 9

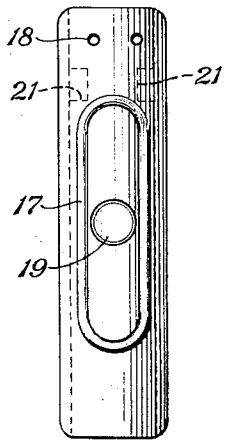


Fig. 10

INVENTOR
Myron M. Kinley
BY
Earl Babcock
ATTORNEY

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FLOW VALVES AND CHOKES, AND MEANS FOR INSTALLING SAME

Myron M. Kinley, 103 Maple Lane, Chickasha, Okla. 73018

Filed June 7, 1965, Ser. No. 461,953
12 Claims. (Cl. 166—117.5)

ABSTRACT OF THE DISCLOSURE

Apparatus for controlling flow of fluid through an opening in the side wall of a string of tubing or other pipe in a well, wherein the means for so controlling the fluid flow is adapted to be lowered on, and inserted adjacent said opening by manipulation of, a wireline tool.

This invention relates to flow valves for use in oil well tubing and to means for installing the same after the tubing is in place in a well.

As shown and described in the U.S. patent to Howard, et al., No. 2,664,162 granted Dec. 29, 1953, it is common practice to connect a special section or "sub" in a string of tubing, the section being so constructed as to permit a valve or choke to be lowered down through the tubing and installed therein after the tubing is in the well.

The present invention relates to the same art as the above-cited Howard patent. The primary object is to provide a more simplified construction, both in the valve itself and in the tools for installing the same, while insuring a positive seal when the valve is closed. Certain features of the invention are applicable to the installation of side wall chokes in tubing, as well as positively closed valves, as will be apparent from the following description.

Other objects and advantages will be apparent from the following description of the preferred form of the invention, when taken in connection with the accompanying drawings, in which:

FIGURE 1 is a view of a cased oil well, in cross-section, with a special section of tubing constructed in accordance with the present invention located therein;

FIGURES 2 to 5 inclusive are vertical cross-sectional views of the tubing section of FIGURE 1, with the tools for installing the valve shown therein to illustrate the sequence of operation of the tools; FIGURE 2 showing the position of the initial step in the operation; FIGURE 3 showing the position after the second step; FIGURE 4 showing the valve being driven into place; and FIGURE 5 showing the valve in place and the tools ready for removal from the well.

FIGURE 6 is a somewhat enlarged, vertical cross-sectional view of the special section of the tubing similar, but slightly different than that shown in FIGURES 2 to 5;

FIGURE 7 is a transverse cross-sectional view of the device of FIGURE 6, the view being taken on the line VII—VII of FIGURE 6.

FIGURE 8 is a transverse cross-sectional view of the device of FIGURE 6, the view being taken on the line VIII—VIII of FIGURE 6.

FIGURE 9 is a side view of the sleeve segment which constitutes the valve element of the device of FIGURES 6 and 7; and

FIGURE 10 is a front view of the sleeve segment of FIGURE 9.

Referring to the drawing in detail, and first to the arrangement of FIGURE 1, it will be seen that an oil well is there shown as having a casing **11**, in which tubing **12** may be run.

The tubing includes a special section **13** which has a larger diameter than the rest of the tubing, so that it may include special features, but still have the same clearance inside as the rest of the tubing so that any regular tools may be passed down through it.

The section **13** has a side wall opening **14**. By covering or uncovering this opening **14**, the flow of fluid into the tubing from the side wall thereof can be controlled.

The valve element **15** which covers or uncovers the opening **14** is a segment of a sleeve, and the assembled arrangement may be regarded as a sleeve valve. The segment **15** has its outer surface curved to conform to the cylindrical inner surface of the section **13**. Its outer edges **16** may be tapered, as shown in FIGURE 9, so it can be wedged tightly in place in section **13**, or the outer edges **16** may be parallel, as shown in FIGURES 2 to 5. The segment **15** should be so constructed as to snugly fit into the section **13** so as to be held by friction, or be otherwise held in place when seated Also, the segment **15** may have an elongated groove in its curved surface, in which an O-ring **17** (see FIG. 10) may be mounted to insure making a perfect seal with the section **13**.

The upper end of the segment **15** has holes **18** through which shear pins **20** may pass, as shown in FIG. 2, to secure it to the tools when lowering it into the well.

The segment **15** may have a threaded hole therein in which a plug **19** may be secured, as illustrated in FIGURES 9 and 10. If desired the plug may have an orifice or choke hole through it, and the orifice may be of any desired size. By having plugs with different size orifices therein, the amount of fluid flowing into the tubing through the opening **14** may be regulated. Of course, an orifice may be drilled in the segment **15** instead of using the plug **19**.

The segment **15** may also have a fishing neck **21** so that a suitable grappling tool may be used to remove it from its position covering the opening **14**, but the grappling tool forms no part of the present invention, and is neither shown nor described herein.

Because the valve element **15** is a segment of a sleeve, and because there is only one opening **14** in the section **13**, it is essential that the segment **15** be exactly oriented with respect to the opening **14** when it is in place to seal the opening.

Therefore, there must be an arrangement in the section **13** for guiding the segment **15** and for sealing it against the wall of the section **13** when it is in place.

To this end, the section **13** has liner **22** therein which may be welded or otherwise rigidly secured in the section **13**.

As best shown in FIGURES 6, 7 and 8, the liner **22** has a bore which is eccentric with respect to its outer cylindrical surface. The purpose of this design is to give added strength and dimension to the wall of the liner along the side which functions to guide the segment **15**.

The top of the liner **22** is tapered, so shown at **23**, and the lower part of the taper is provided with a keyway or slot **24** extending a short distance downwardly along the thick portion of the wall.

Beneath the keyway **24** there is a long slot **25** in the thick wall of the liner, and the lower portion of this slot is provided with holding surfaces **26** which coact with the edges **16** of the segment **15** to engage segment **15** as it is driven downwardly in the liner.

The purpose of the tools shown in FIGURES 2 to 5 inclusive is to locate and drive the segment **15** into its proper position in the liner **22** and hence in the section **13** to cover and seal the opening **14**.

The tools may be run into the tubing on a wire line, and may include a jar **27**, such as an ordinary link jar or any other known type, and which, per se, forms no part of the present invention. The jar should be capable of delivering a downward blow, however.

Beneath the jar **27**, there is a mandrel **28** upon which devices are mounted to slide up and down. The mandrel **28** may be of square cross-section, as shown, or it may be circular with the parts which slide up and down thereon splined to it.

At the top of the mandrel **28**, there is a collar **29** fixed to it, and there is a sliding collar **30** thereon. Between these collars there is a coiled compression spring **31**, which is compressed before the tools are run into the well.

The spring **31** is held compressed by a spring latch **32** on the mandrel **28** beneath the lower collar **30**. The spring latch **31** may be like that normally used on an umbrella.

Slidably mounted on the mandrel **28** a suitable distance below the spring latch **32** is a control sleeve **33**. This sleeve **33** is secured against vertical movement on the mandrel when the tools are being run into the well by two shear pins **34** and **35**. Shear pin **34** is small and weak. Shear pin **35** is larger and stronger but passes into a short slot **36** in the mandrel and hence does not hold the sleeve **33** against movement on the mandrel until after pin **34** shears.

Fixed to the mandrel **28** at its bottom end is a carrier **37** for the segment **15**. The carrier has a lever **38** pivoted near its upper end and is urged outwardly by a leaf spring **39**.

The lever **38** has the segment **15** secured to it by the shear pins **20**, and when being run into the well is in the retracted position shown in FIGURE 2, being so held by the sleeve **33** and pin **34**, the bottom of the sleeve **33** being tapered and engaging the tapered top extension of the lever **38**.

When the pin **34** shears, the mandrel **28** and carrier **37** then move downwardly the length of slot **36** and the parts take the position shown in FIGURE 3, the lever **38** no longer being held retracted, so that the leaf spring **38** swings it and the segment **15** outwardly into the slot **25** in the liner **22**.

The sleeve **33** is provided with means for controlling the shearing of the pins **34** and **35** when desired. At its upper end there is provided a strong detent **40**, which may be urged outwardly by a spring not shown. The outer surface of this detent **40** may be curved, as shown, to avoid getting it hung up in a collar of the tubing while the tools are being lowered into or removed from the well.

The detent **40** is held retracted in a slot in the sleeve **33** while the tools are being lowered, by a catch **41** pivoted on the sleeve **33** near the lower end thereof.

The catch **41** has a slot (not shown) at its pivot point so that it can drop slightly from the position shown in FIGURE 2, but it is held up temporarily by a very small shear pin **42**. There may be a small tension spring (not shown) for drawing the catch **41** downwardly after the pin **42** shears, so as to be sure the catch **41** no longer interferes with outward movement of the detent **40**.

With their parts in the position shown in FIGURE 2, the tools are operated by lowering them down through the tubing on a wire line. When they reach the depth shown in FIGURE 2, with the catch **41** in the upper part of the slot **25** in the liner **22**, an upward pull on the wire line will shear the pin **42** and the catch **41** will drop down.

The tools are then raised to some distance above that shown in FIGURE 3 and again lowered.

The detent **40** now being released and extanded outwardly, it will engage the tapered upper surface **23** of the liner **22** and be oriented or moved by cam section into the keyway **24**.

It should be mentioned that the shear pin **42** may be broken by pulling the tools upwardly into any collar of the tubing instead of breaking it by pulling the catch **41** against the top of the slot **25**, as just described, and as illustrated in the drawing.

Once the tools are lowered into the tubing, they cannot be raised without shearing the pin **42**.

In some cases the catch **41** may not be necessary, but some provision for holding the detent **40** retracted while lowering the tools into the tubing is preferred.

Because the sleeve **33** cannot rotate on the mandrel, and because the carrier **37** is fixed to the mandrel, the lever **38** will now be in the correct position to place the segment **15** in the slot **25** of the liner when the sleeve **33** separates from the carrier a slight distance.

With the parts in the position just described, and as shown in FIGURE 3, the jar **27** is caused to deliver a downward blow on the mandrel **28**, by manipulation of the wire line. Because the detent **40** is holding the sleeve **33** against downward movement, the pin **34** will shear, and then subsequently with additional jar blows, if necessary, the pin **35** will shear.

When the pins **34** and **35** have both sheared, the parts will take the position shown in FIGURE 4.

It will be observed that in FIGURE 4, the segment **15** is well down in the slot **25**, so that it is no longer necessary to hold it oriented. The sleeve **33** and detent **40** have served their function of orienting the lever **38** carrying the segment **15**. Therefore, the detent **40** may now be retracted from its position in the keyway **24**.

Upon the further downward movement of the mandrel **28** through the sleeve **33** from the position shown in FIGURE 4, the sleeve **33** will press the latch **32** inwardly and release the collar **30**, whereupon the collar **30** will be urged downwardly by the spring **31**. Upon the collar **30** striking the top of detent **40**, retraction of the detent into its recess in the sleeve **33** will be accomplished.

Further jar blows will then drive the segment **15** in to position covering the opening **14**, and the pins **20** will shear, so that the parts take the position shown in FIGURE 5.

With the parts in the position shown in FIGURE 5, the tools can be lowered on down past below the section **13**. Hence the operator will know that the segment **15** has been properly placed.

It is within the purview of the invention to provide a number of sections **13** in the tubing **12**, located at different producing zones, for example, so as to control flow of fluid into the tubing at different levels. Segments **15** can be set in the various sections **13**. Some sections **13** may be provided with chokes of selected sizes and others may be sealed off entirely, the operation being quite flexible in this regard.

Of course, the provision of the catch **41** is necessary, where multiple section operation is desired, to avoid setting the segments in sections already closed by a previous setting.

In FIGURES 6, 9 and 10, the edges **16** of the segment **15** and the holding surfaces **26** in the slot **25** of the liner **22** are shown as tapered, or converging downwardly, instead of being parallel as shown in FIGURES 2 to 5. These tapered surfaces of FIGURES 6, 9 and 10 serve as wedging means to provide additional friction, and thus assist in holding the segment **15** in place when it is seated.

While only a few embodiments of the invention have been shown and described, it is obvious that various changes may be made in the arrangement and construction of parts without departing from the spirit of the invention or the scope of the annexed claims.

What is claimed is:

1. Apparatus for controlling the flow of fluid through the side wall of a string of tubing in a well comprising a section of tubing adapted to be made up with the string and having an opening in its side wall, a segment of a cylinder adapted to cover the opening, a longitudinally extending slot with an open upper end formed on the inside of said section for receiving said segment as it is lowered, means cooperating with said section and said segment for sealing said segment with the wall of said section around the opening in said section when said segment is in said slot, and means for inserting said segment into said slot after said tubing is in place in the well.

2. The combination of claim 1 in which an O-ring is mounted on the outer surface of said segment so that, when the segment is in place, the O-ring will provide a seal around the opening in said section.

3. The combination of claim 1 in which the segment is provided with an orifice capable of serving as a choke governing the flow of fluid through the opening in said section.

4. The combination of claim 1 in which said section has an internal diameter as large as that of the string of tubing.

5. In a system for controlling the flow of fluid through the side wall of a string of tubing in a well having a section of tubing made up with the string and having an opening in its side wall, the combination with said section of a segment of a cylinder adapted to cover the opening, holding means cooperating with said section and said segment for holding said segment in sealed engagement with the wall of said section around the opening in said section, and positioning tools capable of being operated on a wire line for lowering said segment into the well after the tubing is in place therein and for causing the segment to engage said holding means.

6. The combination of claim 5 in which said positioning tools include a lever upon which said segment is mounted and means for holding said lever and segment retracted while the same are being lowered into the tubing.

7. The combination of claim 5 in which the positioning tools includes orienting guide means to insure that said segment will engage said holding means.

8. The combination of claim 5 in which said positioning tools include orienting guide means to insure that said segment will engage said holding means and mechanism for rendering said orienting guide means inoperative after said segment is in place around the opening in said section, whereby said positioning tools can be lowered on down into the tubing below said section.

9. The combination of claim 5 in which a jar is associated with said positioning tools whereby said segment may be driven by jar blows into said holding means.

10. The combination of claim 7 in which said orienting guide means includes a detent which is spring pressed outwardly and a catch for holding said detent retracted until it is desired to release the same in the tubing.

11. The combination of claim 10 in which said catch is capable of being operated by raising said tools in the tubing to release said detent.

12. The combination of claim 5 in which said holding means consists of wedge surfaces of the segment and section which cooperate with each other.

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CHARLES E. O'CONNELL, *Primary Examiner.*

JAMES A. LEPPINK, *Examiner.*