April 17, 1956 A. VAUGHN 2,742,093

TUBING TEST TOOLS

Filed June 30, 1952

2 Sheets-Sheet 1

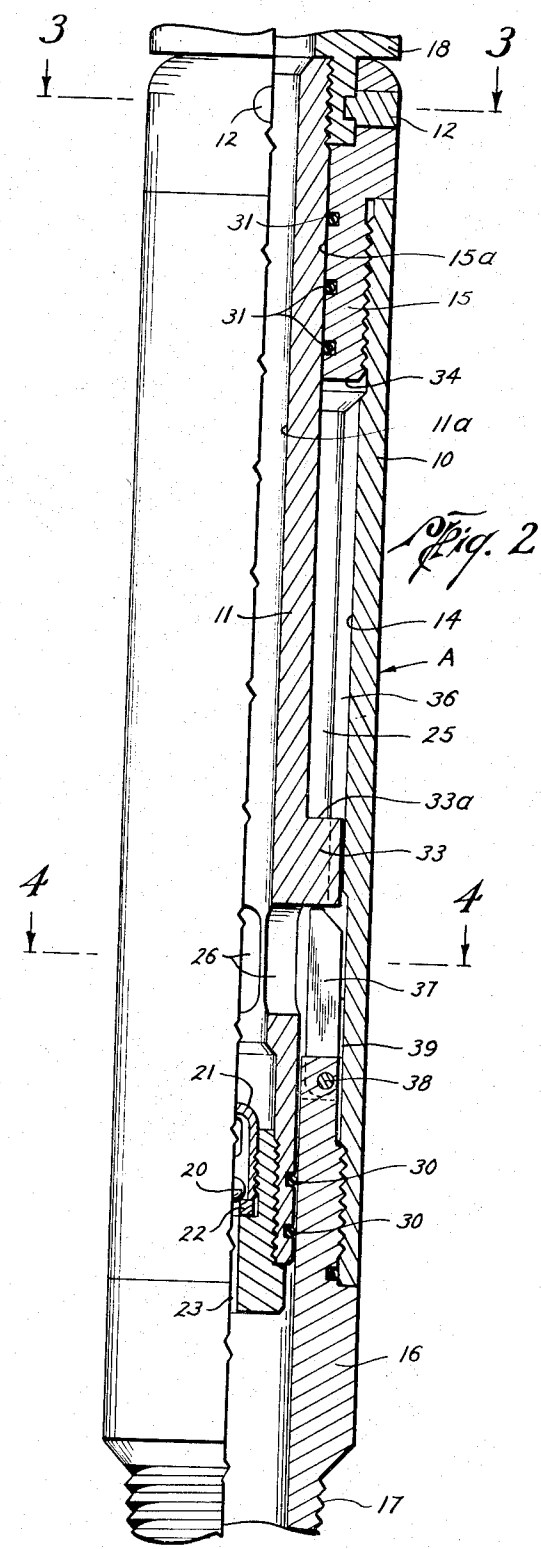


Fig. 2

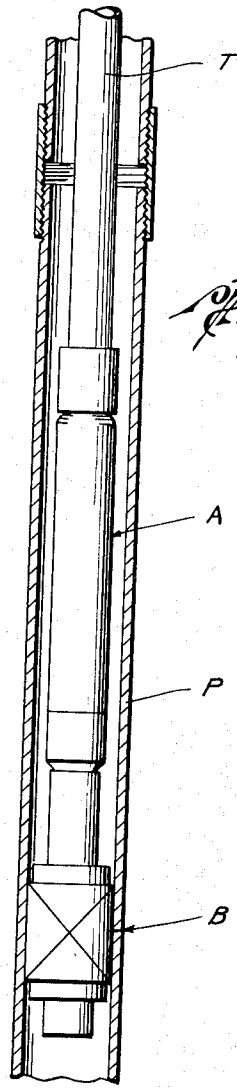


Fig. 1

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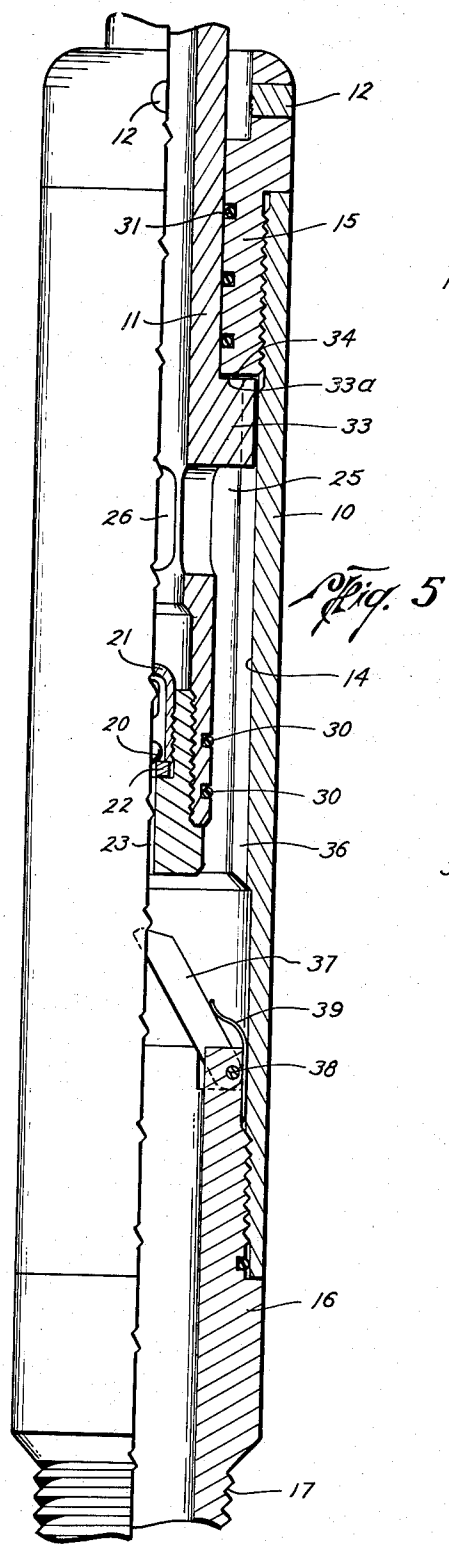


Fig. 5

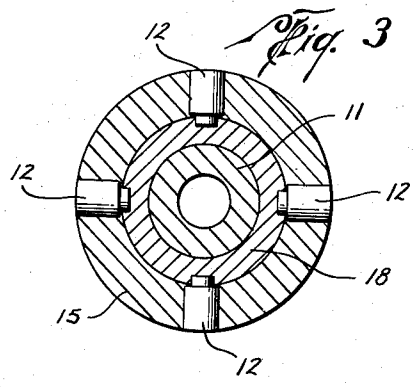


Fig. 3

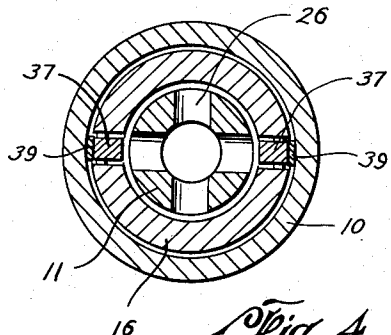


Fig. 4

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TUBING TEST TOOLS

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14 Claims. (Cl. 166—224)

This invention relates to new and useful improvements in tubing test tools.

When running squeeze packers, retainers, and the like into wells, long lengths of tubing are required to lower such tools from the well surface to the desired depth in the well bore. After the tool has been positioned in the well, fluid under pressure is conveyed through the tubing to the tool to perform the cement or plastic squeezing, acidizing, sand or hydrafracing, or other similar pressure operations and thereafter the tubing functions as the production string to conduct the well fluids to the surface. If one or more of the stands or lengths of tubing is defective, there is a danger of rupturing same under the pressure operations, with the result that fluid under pressure is lost at the point of rupture and it becomes necessary to remove the tubing until the defective length of tubing is located for replacement. Such procedure obviously results in loss of materials and time, and presents a constant hazard to the well operator.

It is therefore an object of this invention to provide a tubing wherein each stand or length of tubing, or a plurality of such stands or lengths, may be tested as added to the tubing string during the lowering of a well pressure tool such as a squeeze packer into a well.

An important object of this invention is to provide a tubing test tool which is adapted to be connected between a well packer or the like and the tubing thereabove, whereby the tubing may be pressure tested for defects whenever desired prior to actuating said packers and thereafter the tubing test tool may be manipulated to allow flow through the tubing in either direction.

Another object of this invention is to provide a tubing test tool for use in conjunction with a well packer or the like, supported on a tubing string, wherein the test tool has an inner mandrel within an outer body with a sealing means therebetween to prevent the flow of fluid under pressure to the well packer during the testing of the tubing, and including a means to render the sealing means non-sealing to thereby allow the flow of fluid through the well tubing in either direction.

The construction designed to carry out the invention will be hereinafter described together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

Figure 1 is a diagrammatic view illustrating the use of the tubing test tool of this invention in conjunction with a well packer.

Figure 2 is a vertical view, partly in section and partly in elevation, and illustrating the tubing test tool of this invention in the testing position.

Figure 3 is a horizontal sectional view taken on line 3—3 of Figure 2, and illustrates the connection of the inner mandrel with the outer body.

Figure 4 is a horizontal sectional view taken on line 4—4 of Figure 2, and illustrates the relative positions of the latch means and the openings in the inner mandrel during the testing operation.

Figure 5 is a view similar to Figure 2, but illustrates the tubing test tool in its released position wherein the latch means is activated and fluid may pass through the outer body.

In the drawings, the letter P designates the well pipe or well casing within the well bore of an oil, gas, or water well. The tubing test tool A is connected at its lower end to a well pressure device such as the well packer B, and at its upper end to the tubing T which is composed of numerous stands or lengths of tubing which extend to the surface of the well. As each stand or length of the tubing T is added to the string during the lowering of the test tool A and the packer B into the well pipe P, the tubing may be tested by supplying fluid under pressure through a conventional construction located at the surface, whereby each section of the tubing which is added may be tested if desired. After the packer B has been lowered to the desired point in the well pipe P, all of the tubing T will have been tested and the test tool is actuated to permit fluid to pass therethrough and thence through the packer B to perform the usual cementing, acidizing or other similar pressure operations. Also after actuation a flow of fluid through the tubing in either direction may occur.

Referring now to Figure 2 therein can be seen the tubing test tool A of this invention in its testing position. This tubing test tool A has an outer elongate body **10** and an inner mandrel **11** which is movable in telescoping relationship with respect to said body; when in its fully telescoped position, the mandrel is releasably connected to the body **10** by means of a plurality of shear pins **12**. As shown in the drawings, the outer body **10** has a central section in which the inner bore **14** is of enlarged diameter as compared to the inner bore diameters of two end sections **15** and **16** of the outer body **10**. As can be seen the end sections **15** and **16** are threaded to the center sleeve of the outer body **10**, but these sections **15** and **16** could be integral therewith if so desired.

The lower section **16** has tool joint threads **17** thereon which are adapted to thread into a connecting collar on a well packer B. On the upper end of the inner mandrel **11** there is threaded a box **18** which is adapted to be connected to the pin end of the tubing T. Thus, in the usual tubing test operation, the well packer will be positioned below the tubing test tool A and the tubing P will be positioned thereabove as particularly shown in Figure 1.

At the lower end of the bore **11**–*a* of the inner mandrel **11**, there is located a one-way valve **20** which is downwardly closing when vertically positioned as shown in Figure 2. This valve **20** takes the form of a ball and is enclosed in a cage **21** thereabove. The ball **20** rests upon an annular valve seat **22** located above a fluid inlet opening **23** therebelow. As will be apparent from the drawings, the valve **20** will permit fluids to pass upwardly through the opening **23** and into bore **11**–*a* of the inner mandrel, but will not permit fluids to pass from the bore **11**–A below the valve **20**.

Due to the enlarged bore **14** of the outer body **10** at the central section thereof, a longitudinal and annular space **25** is formed between the wall of the enlarged bore **14** and the outer surface of the inner mandrel **11**. The inner bore **11**–*a* of the mandrel **11** communicates with the space **25** through openings or slots **26**, which are formed in the mandrel above the downwardly closing check valve **20**. When the tubing test tool is in the testing position as shown in Figure 2 with the shear pins **12** holding the inner mandrel **11** and the outer body **10** together, the fluid on the inside of the mandrel **11** cannot pass outwardly through the body to the lower end

of the body 10 due to the presence of seal rings 30 which are mounted in the lower end of the mandrel 11 at the outer surface thereof to provide a seal between the inner mandrel 11 and the outer body 10. Similar seal rings 31 are provided at the upper end of the body 10 on the inside surface 15–*a* of the upper section 15. On the external surface of the inner mandrel 11 there is formed a radially extending flange or flange segments 33 which serve as a stop member when the mandrel 11 is unmoved to its extended position with respect to the outer body 10 as shown in Figure 5. The upper surfaces 33–*a* of the stop member 33 will abut the shoulder 34 on the outer body 10 by reason of the enlarged bore 14 of the outer body 10. The flange segments 33 are adapted to engage with longitudinal keyways 36 which are formed in the wall of the bore of the outer body 10 whereby rotation of the mandrel 11 with respect to said outer body is prevented. Mounted within the lower portion of the bore of the body 10, and within slots formed in the upper end of the reduced diameter section 16 of the outer body 10 are the latch members 37. These latch members 37 are pivoted on pivot pins 38 which extend across the slots and in the test position, prior to the time that the pins 12 are sheared, the latch arms 37 are retained in a vertical non-latching position by reason of their engagement with the outer surface of the mandrel 11. However, when the mandrel 11 is moved to its extended position with respect to the body 10 (Figure 5) and the lower end of the mandrel 11 reaches a position above the latch arm 37, each spring 39 urges each latch arm into or toward the center of the inside of the outer body 10. This position is best seen in Figure 5 and in that position the latch arms 37 prevent the mandrel 11 from moving downwardly into the original fully telescoped position shown in Figure 2.

In the operation of the test tool A, it is preferably connected as shown in Figure 1, with the well packer B therebelow. However, it will be appreciated that the test tool A could be used in conjunction with the tubing T thereabove in instances wherein the device such as the well packer B would be unnecessary. In positioning the tubing within the well pipe P, with the tubing test tool A on the lower end thereof, the tool A is initially in the position shown in Figure 2, that is, the outer body 10 and the inner mandrel 11 are fully telescoped and are so held in their telescoped position by the shear pins 12. This telescoped position of the body 10 and the mandrel 11 may be referred to as the testing position since the fluid under pressure which is admitted into the top section of tubing at the surface in the conventional manner and with the conventional connections used in applying pressure through tubing, is prevented from passing downwardly through the testing tool by reason of the downwardly closing check valve 20 and the sealing means 30. Thus, in order to test tubing located above the test tool A, fluid under pressure is supplied into the tubing and passes into the bore 11–*a* of the mandrel 11, whereby a pressure may be built up in tubing.

As will be appreciated, the testing of the tubing will be carried out prior to the time that the well packer B is set, and may be conducted as many times and whenever desired during the adding of stands or sections of tubing to the string. After the packer B has reached the desired depth within the well casing P, the packer B may be set by lifting it out of its J-shaped slots or by lifting up on the tubing T, depending upon the type of packer B employed.

Thereafter, the shear pins 12 may be severed by lifting up on tubing T to extend the mandrel 11 with respect to the outer body 10. Such extension of the mandrel relative to the body moves the sealing means 30 upwardly from the position shown in Figure 2 until the mandrel 11 is stopped by the abutment of the stop member or flange 33 with the shoulder 34. As can be seen in Figure 5, the sealing means 30 which had previously been located between the mandrel 11 and the body 10, are then released from their sealing position and are disposed within the enlarged bore 14 of the outer body 10, whereby fluid on the inside of the mandrel 11 may pass outwardly through the ports 26 into the space 25 between the mandrel 11 and the body 10 for the discharge through the lower end of the body 10. When the well packer B is connected to the lower end of the body 10, such fluid would, of course, pass through the packer B and the usual squeezing operation would be performed. The ports 26 and annular space 25 form a by-pass passage around the downwardly closing valve 20 and thus after the inner mandrel has been extended the valve 20 is, in effect, rendered inoperative to shut off downward flow and a free flow of fluid may thereafter occur through the tubing in either direction.

When the mandrel 11 is extended with respect to the body 10 a sufficient distance so that the lower end of the mandrel 11 is above the upper end of the latch arms 37, the spring 39 can then take effect and urge the arms 37 toward the center of the bore of the outer body 10, as shown in Figure 5. When the latching arms 37 are thus located in their latching position the mandrel 11 is prevented from returning to fully telescoped position within the body 10 so that the communication between the inside of the mandrel 11 with the lower end of the outer body 10 is maintained at all times to assure that fluid can pass below the testing tool A and through the tubing in either direction.

It is believed evident that a tool has been devised which is capable of testing tubing by applying fluid pressure thereto at any point during these lowering operations of the tubing into the well pipe P. Additionally, this tool is of simple construction and operation and eliminates the necessity for removing the mechanism of the test tool prior to carrying out the squeezing operation with the well packer or in order to permit the tubing to function in its usual manner as a flow conductor.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape, and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed is:

1. A tubing test tool adapted to be connected in a well tubing and lowered therewith into a well bore, said tool including, a pair of tubular members which are telescopically connected and which are movable to a telescoped position or to an extended position with respect to each other, a downwardly closing valve means mounted in the bore of the inner one of said tubular members, said members having a by-pass passage having one end communicating with the area above the valve means and its opposite end communicating with the area below the valve means whereby said passage conducts fluid around the downwardly closing valve means when the members are in an extended position with relation to each other, and means on one of the members and adapted to engage the other member to close the by-pass passage when the members are in telescoped position relative to each other.

2. A tubing test tool adapted to be connected in a well tubing and lowered therewith into a well bore, said tool including, an outer tubular body, an inner tubular mandrel telescopically connected with the body and movable to either a telescoped position or to an extended position with respect to the body, a downwardly closing valve means within the bore of the inner mandrel for shutting off downward flow through the mandrel, said mandrel and body having means for establishing communication between the area within the bore of the mandrel above the downwardly closing valve means and the area below said valve means when the mandrel is in an extended position with respect to the body, whereby fluid flow may by-pass around the valve means, and means operable by the movement of

the mandrel to its telescoped position relative to the body for closing the communication establishing means.

3. A tubing test tool as set forth in claim 2, together with means operable when the mandrel is extended with respect to the body for latching the mandrel in such position to prevent closing of the communication establishing means.

4. A tubing test tool adapted to be connected in a well tubing and lowered therewith into a well bore, said tool including, an outer tubular body, an inner tubular mandrel telescopically connected with the body and movable either to a telescoped position or to an extended position with respect to the body, detachable means normally connecting the mandrel to the body in telescoping position, a downwardly closing valve within the inner tubular mandrel to shut off downward flow therethrough, the mandrel and body having a by-pass passage formed therein which passage has one end communicating with the area above the valve and its other end communicating with the area below the valve for conducting fluid around the valve, said by-pass passage being closed when the mandrel and body are telescoped and being opened when the detachable means is detached and the mandrel is extended with respect to the body.

5. A tubing test tool as set forth in claim 4, together with a latch means operable when the mandrel is extended for latching the mandrel against subsequent movement to its telescoping position.

6. A tubing test tool as set forth in claim 4, wherein the detachable means comprises a frangible shear pin which initially connects the mandrel to the body.

7. A tubing test tool as set forth in claim 4, together with interengaging means on the mandrel and body for non-rotatively connecting these parts.

8. A tubing test tool as set forth in claim 4, together with releasable connecting means connecting the inner and outer members in telescoped position whereby said members may be lowered into the well bore in such position to permit pressure testing of the tubing to be accomplished, said connecting means being releasable by manipulation of the tubing to allow the members to be moved to extended position, and a latch means operable when the members are extended for latching said members against subsequent movement to a telescoped position.

9. A tubing test tool adapted to be connected in a well tubing and lowered therewith into a well bore, said tool including, an outer body having an axial bore which is reduced in diameter at its upper and lower portion, an inner tubular mandrel telescopically connected with the body and having sliding engagement within the reduced portions of the body, said mandrel being disposed within the lower reduced portion of the bore of the body when said mandrel is telescoped and being movable in to the bore of the body above said lower reduced portion when extended, said mandrel having a radial opening in its wall in communication with the bore of the body intermediate the upper and lower reduced portions of said bore, whereby when the mandrel is extended with respect to the body communication is established between the bore of the mandrel, through the bore of the body, and the area below the body, such communication being shut off when the mandrel is within the lower reduced portion of the bore of the body, and a downwardly

closing check valve mounted in the bore of the inner mandrel below the radial opening in said mandrel.

10. A tubing test tool as set forth in claim 9, together with sealing means between the exterior of the inner mandrel and the walls of the upper and lower reduced portions of the bore of the body.

11. A tubing test tool as set forth in claim 9, together with frangible means normally connecting the inner mandrel with the body when said mandrel is in a telescoped position with respect to the body.

12. A tubing test tool as set forth in claim 9, together with a latch means mounted within the bore of the body and operable by movement of the mandrel to extended position for preventing subsequent movement of the mandrel to telescoped position.

13. A tubing test tool as set forth in claim 9, together with frangible means normally connecting the inner mandrel with the body when said mandrel is in a telescoped position with respect to the body, and latch means operable upon fracturing of the frangible means and movement of the mandrel to an extended position for preventing subsequent movement of the mandrel to telescoped position.

14. A tubing test tool adapted to be connected in a well tubing and lowered therewith into a well bore, said tool including, an inner tubular member and an outer tubular member which are telescopically connected and which are movable to a telescoped position or to an extended position with respect to each other, both members having their lower ends in communication with the lower end of the bore of the tubing below the tool and the inner member having communication with the bore of the tubing above the tool, a downwardly closing valve in the bore of the inner tubular member, the outer member having the lower portion of its bore reduced and adapted to slidably receive the inner member, that portion of the bore of the outer member above the reduced portion being spaced from the exterior of the inner member to form a by-pass area which communicates with the tubing below the tool when the inner and outer members are in extended position and the inner member is above the reduced portion of the bore of the outer member, said inner member having an opening in its wall which communicates with the by-pass area, whereby when the members are in extended position flow is established, through the opening and by-pass area, between the bore of the tubing above the valve and the bore of the tubing below the valve, and a sealing means on the inner member positioned to seal with the reduced portion of the bore of the outer member when the members are in telescoped position to thereby close off direct communication between the by-pass area and the bore of the tubing below the tool.

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