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APPARATUS FOR TESTING OIL WELL CASING OR THE LIKE

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Fig. 1.

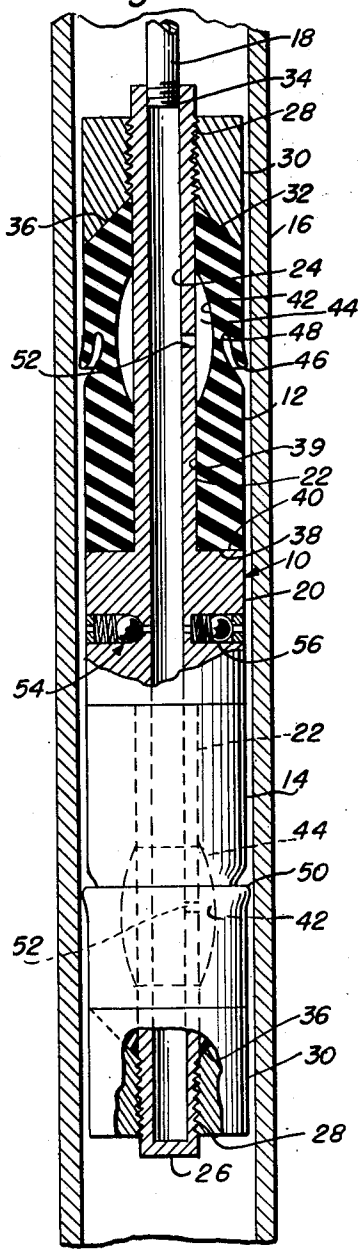


Fig. 3.

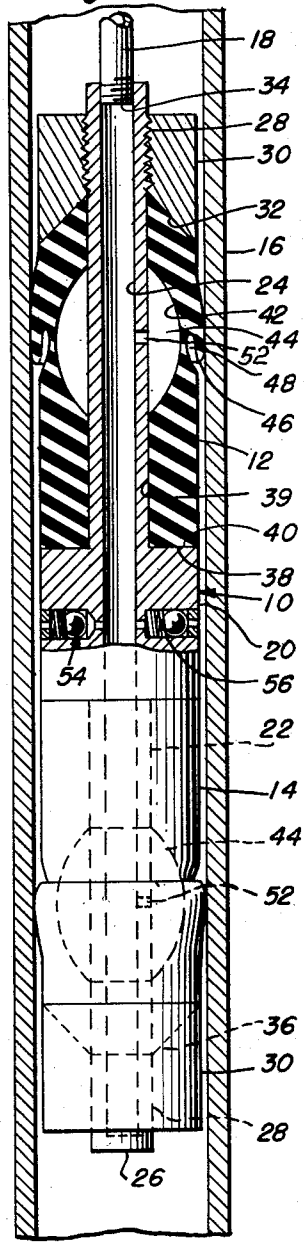
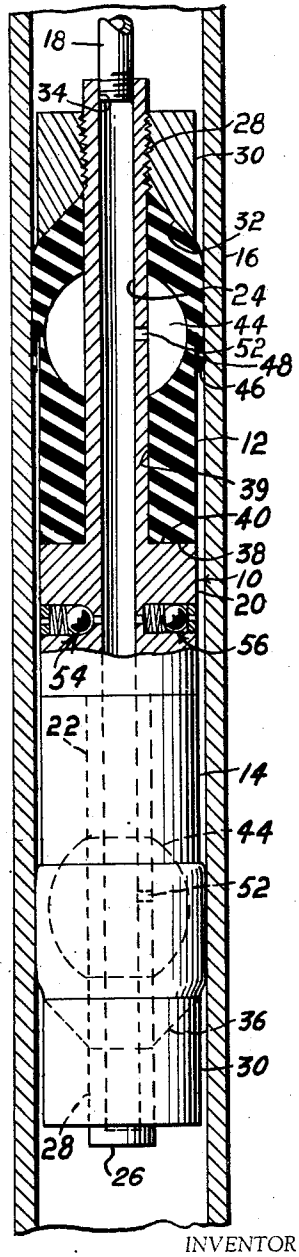


Fig. 2.



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APPARATUS FOR TESTING OIL WELL CASING OR THE LIKE

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6 Claims. (Cl. 73—40.5)

The present invention relates to a tester apparatus and, more particularly, to a tester apparatus adapted for use in testing stands of oil well pipe or casing for leaks. This application is an improvement of the collar tester apparatus disclosed in my copending United States application Serial No. 266,041, filed January 11, 1952, now United States Patent No. 2,666,041, issued January 24, 1956.

In present day drilling of wells it is desirable to test a stand of well casing or pipe and/or its joint to an adjacent section or stand as it is being run so that there will be little chance of running a defective stand of well pipe or coupling. In other words, by testing each stand at the surface of the well, as well as the collar or coupling attaching the stand to an immediately adjacent stand, the necessity of withdrawing the string or well pipe due to a leaky stand or coupling once it has been lowered into the well is reduced to a minimum. This method of testing stands of well pipe is disclosed in detail in my aforementioned copending application.

An object of the present invention is to provide an improved tester apparatus which may be inserted into a well pipe as it is being run to test a stand of the well pipe or a collar joint between adjacent stands of well pipe for leaks at pressures expected to be encountered after the well pipe has been run and the well completed.

Another object of the present invention is to provide an improved tester apparatus which may be lowered into a previously run well casing or pipe in any conventional manner for testing a section of the casing at any desired depth below the surface of the well.

Still another object of the present invention is to provide an improved tester apparatus which will seal off a section of well pipe or casing to be tested and which will eject testing fluid into the sealed-off section at extremely high pressures without having a blow by the packers. It is important to test well pipes at high pressures because in modern day drilling of wells, the well pipes must withstand high pressures deep in the earth.

A still further object of the present invention is the provision of a tester apparatus including a tester body having spaced packers exteriorly mounted thereon, the packers being initially expanded into sealing engagement with the well pipe adjacent the section to be tested by test fluid applied to the inside of the packer from the interior of the tester body, and the packers then being secondarily held in sealing engagement with the walls of the well pipe by the test fluid admitted exteriorly of the tester apparatus to the section being tested.

Still another object of the present invention is the provision of a tester apparatus having spaced packers thereon, the spaced packers being adapted to seal off a section of well pipe to be tested, the sealing action of the packers increasing with an increase of pressure of the test fluid admitted to the space between the packers.

A still further object of the present invention is the provision of a tester apparatus comprising a minimum number of parts which may be manufactured at minimum cost and which requires minimum maintenance.

Another object of the present invention is the provision of a tester apparatus having spaced packers mounted exteriorly on a tester body, the spaced packers being easily replaceable when worn or damaged.

These and other objects of the present invention will appear more clearly in the following specification, claims and drawings in which:

Figure 1 is a view partially in elevation and partially in cross section of the tester apparatus being lowered into a well casing and prior to the application of the testing fluid thereto;

Figure 2 is a view of the apparatus similar to Figure 1, the apparatus being partially in cross section and partially in elevation and showing the phase of operation of the apparatus in position in the well and after test fluid is initially applied to the tester body but prior to the injection of the test fluid to the sealed-off section between the packers; and

Figure 3 is a view of the tester apparatus similar to Figure 2 showing the apparatus in partially cross section and partially in elevation, the phase of operation of the apparatus being after the test fluid has been injected into the sealed-off space between the packers and has secondarily sealed the packers as well as providing the required test pressure to the well casing.

Referring now to the drawings wherein like character or reference numerals represent like or similar parts, the tester apparatus disclosed in Figure 1 includes an elongated tester body generally indicated by the numeral **10**, the tester body **10** having upper and lower packers **12** and **14**, respectively, mounted on its exterior for sealing engagement with the walls of a well pipe or casing **16**. Packer members **12** and **14** are made of an elastomeric material, such as rubber, synthetic rubber or the like and have in their relaxed position a maximum outside diameter slightly less than the inside diameter of the casing being tested. The tester apparatus is supported by a flexible tubing **18** which has its other end connected to a suitable source for supplying a hydraulic fluid under pressure to the tester apparatus.

As previously mentioned, my aforementioned copending application discloses in detail the method and means for lowering the test apparatus into the well casing, as well as the means for determining a leak. Further, the aforementioned copending application discloses apparatus for supplying test fluid under pressure to the tester apparatus and/or measuring the same. Therefore, it will suffice to say that the present tester apparatus may be used in well operations and with well equipment disclosed in my copending application, it being understood that my copending application forms a part of the present disclosure to that extent.

Referring specifically to Figure 1, the tester body **10** includes a cylindrical center portion **20** of a maximum outside diameter smaller than the diameter of the casing to be tested. Extending from each end of the cylindrical center portion **20** of tester body **10** are longitudinally extending stems **22**, each stem **22** being of considerably smaller diameter than the center portion **20** of tester body **10** so that they may receive packers **12** and **14**. A longitudinally extending bore **24** extends through the upper stem **22**, the center portion **20** and the lower stem **22** of tester body **10**. However, it will be noted that the bore **24** in the lower stem is closed at its lower end, as indicated at **26**.

The outer or free ends of each of the stems **22** are provided with external threads **28** which are adapted to receive internally threaded packer retaining rings or nuts **30**. Each packer retaining nut is of substantially the same shape but the upper packer retaining ring is oppositely disposed from the lower packer retaining nut. It will be noted that the end of the packer retaining rings **30** facing the center portion **20** of tester body **10** are conically tapered, as indicated at **32** so as to receive tapered ends **36** of packers **12** and **14**.

The upper end of the bore **24** in the upper stem **22** is internally threaded, as indicated at **34** and is adapted to receive the threaded end of the flexible tubing **18** which supports the tester apparatus in the casing.

Packers 12 and 14 are of substantially the same configuration but are oppositely disposed with each other as will be explained in more detail later in the specification. A description of packer 12 will be sufficient for a description of packer 14. Packer 12 is substantially cylindrical in external configuration and is provided with one end that is tapered, as indicated at 36 so as to be complemental to the conical tapered surface 32 of the packer retaining ring 30. The other end 38 of packer 12 is adapted to abut against the shoulder 40 between the stem 22 and center portion 20 of tester body 10. A longitudinal bore 39 extends through packer 12 and is of substantially the same diameter as the outside diameter of stem 22 so that the packer may be received on the stem. Intermediate the ends of packer 12, an annular internal recess or enlarged bore 42 is provided and this recess defines a pressure chamber 44 between the packer 12 and the stem 22 on which the packer is mounted. Immediately adjacent the recess 42 of packer 12 but on the exterior of packer 12 is an outwardly flaring annular lip 46 which is disposed toward the center portion 20. It will be noted that by providing the lip 46 adjacent the recess 42 a reduced portion 48 is provided in the packer body.

As mentioned above, lower packer 14 is substantially the same as the previously described upper packer 12, however, it is disposed on the lower stem 22 in such a manner that its outwardly flaring lip 50 is also disposed toward the center portion 20 of tester body 10. Adjacent each of the recesses 42 in upper and lower packer elements 12 and 14 are laterally extending passages 52 in the upper and lower stems 22. The passages 52 place the pressure chambers 44 of each of the packers 12 and 14 in continuous open communication with the longitudinal bore 24 of tester body 10.

Center portion 20 of tester body 10 is provided with a pressure responsive valve 54 which is of the ball type and spring actuated to the closed position. The valve 54 will place the bore 24 in communication with the exterior of the tester apparatus when the valve is open and, thus, will permit flow of test fluid from bore 24 to the exterior of the tester apparatus. Valve 54 can be set to operate at any predetermined desired pressure by adjustment of the spring tension or the like.

A second pressure responsive valve 56 is provided in the center portion 20 of tester body 10. This valve will permit the flow of test fluid from the exterior of the tester apparatus to the bore 24 when it is open. Valve 56 may be of the spring operated ball type, as shown in the drawing and will operate when the pressure of test fluid within bore 24 is reduced and valve 54 is closed.

The operation of the tester apparatus disclosed herein may be briefly described as follows. The tester apparatus is lowered into a section of the well casing 16 by the tube conduit 18 in a manner disclosed in my aforementioned copending application with the packers in a relaxed position, such as shown in Figure 1.

When the apparatus has been positioned adjacent the section of casing to be tested or positioned so that its packers are on either side of a collar joint between adjacent lengths of well casing, test fluid from the apparatus at the surface of the well (not shown) is then transferred through conduit 18 to bore 24. After the test fluid has filled bore 24 in the tester body, it will flow through the passages 52 into the pressure chambers 44 and its initial pressure against the walls of chambers 44 will thereby cause the upper and lower packers 12 and 14, respectively to expand. Referring specifically to Figure 2, it will be noted that the test fluid will flow into the pressure chambers 44 and will expand the packers 12 and 14 radially outwardly into tight sealing engagement with the casing 18.

Once the packers 12 and 14 have made their initial sealing engagement with the casing 16, as shown in Figure 2, the pressure of the test fluid in the bore 24 will begin to build up until it reaches a predetermined pressure higher than the pressure required to cause the initial sealing engagement of packers 12 and 14. Referring now to Figure 3, the pressure in bore 24 has built up to the pressure necessary to operate and open valve 54 and, thus, the flow of test fluid will be to the sealed-off portion between packers 12 and 14. As the pressure of the test fluid is increased to a desired test pressure, the pressure of the test fluid on the exterior of the packer will tend to equalize with the pressure in pressure chambers 44 and the bore 24 of tester body 10. By providing the lips 46 and 50 on each of the packers 12 and 14 disposed toward each other and the center portion 20 of tester body 10, the reduced portion 48 of the packers will cause each of the packers to contract slightly whereby fluid on the exterior of the packer will get underneath the lip of the packer and form a tight seal with the wall of casing 16. As the pressure of fluid is increased after the packer has assumed the position disclosed in Figure 3, it will be noted that the seal by the fluid being under the lip of the packer will continuously increase and, thus, even though the pressure between the interior of the pressure chambers 44 and the exterior of the tester body is substantially the same, the seal of the packers will not be impaired. In other words, the provision of the lips eliminates the chance of blow by the packers when the pressure on the exterior of the tester apparatus is increased.

After the desired pressure has been reached, indication of a leak may be determined by visual inspection of the casing if the tester device is being used while the casing is being run and is still at the surface of the well. On the other hand, if the tester device has been lowered into the well to test previously run casing, an indication of a leak in the casing will be determined by a drop of pressure indicated on any suitable pressure gauge such as the one disclosed in my aforementioned copending application.

When it is desired to remove the tester apparatus from the well casing, it is merely necessary to reduce the pressure of the test fluid in bore 24. A reduction of pressure in bore 24 will cause a reduction of pressure in pressure chamber 44 of each of the packers 12 and 14. However, valve 54 will immediately close when there is a reduction in pressure and, consequently, the pressure of the test fluid between the packers and exteriorly of the tester body will be trapped and must be relieved. To relieve the pressure of test fluid on the exterior of the tester apparatus which would otherwise be trapped because of the lips 46 and 50 on packers 12 and 14, valve 56 is provided and operates to permit the test fluid to flow from the exterior of the tester body and to the interior of the bore 24 and, thus, the packers 12 and 14 will return to the relaxed position disclosed in Figure 1. The tester apparatus may then be raised or lowered in the well casing as desired.

Although the tester apparatus of the present invention has been disclosed as used in testing oil well pipe, it is within the scope of the invention to use the device in testing any tubular conduit or the like where a section of the conduit must be isolated.

The terminology used in the specification is for the purpose of description and not limitation, the scope of the invention being defined in the claims.

I claim:

1. In an apparatus adapted for testing sections of well pipe or the like, an elongated tester body having a cylindrical center portion of smaller diameter than the diameter of the well pipe to be tested and elongated stem portions extending longitudinally from the ends of the cylindrical center portion, said tester body having a longitudinal bore extending therethrough and closed at its lower end, packer retaining means mounted on the free ends of the stems of said tester body, said packer retaining means having a diameter substantially equal to the diameter of the cylindrical center portion of said tester body, spaced expansible packers mounted exteriorly of and on each of said stems and between said packer retaining means and the center portion of said tester body, said packers

each having an interior annular recess defining a pressure chamber and having an external diameter substantially equal to the cylindrical center portion of said tester body and said packer retaining means, the stems of said tester body each having at least one transverse passage therein positioned adjacent the internal annular recess in each of said packers and placing the bore of said tester body in open communication with the pressure chamber in each of said packers whereby test fluid in the bore of said tester body passes into the pressure chamber of each of said packers causing said packers to expand and initially seal off a section of well pipe, pressure responsive means positioned in said tester body intermediate said spaced packers, said pressure responsive means operable at a pressure of test fluid higher than the test fluid necessary to cause said packers to initially seal off the section of well pipe to be tested to permit test fluid from said bore to enter the sealed-off section between said packers, and means on the exterior of each of said packers and responsive to the pressure of test fluid between said packers to further seal said packers as pressure of test fluid between said packers is increased.

2. In an apparatus adapted for testing sections of well pipe or the like, an elongated tester body having a cylindrical center portion of smaller diameter than the diameter of the well pipe to be tested and elongated stem portions extending longitudinally from the ends of the cylindrical center portion, said tester body having a longitudinal bore extending therethrough and closed at its lower end, packer retaining means mounted on the free ends of the stems of said tester body, said packer retaining means having a diameter substantially equal to the diameter of the cylindrical center portion of said tester body, spaced expansible packers mounted exteriorly on each of said stems and between said packer retaining means and the center portion of said tester body, said packers each having an interior annular recess defining a pressure chamber and having an external diameter substantially equal to the cylindrical center portion of said tester body and said packer retaining means, the stems of said tester body each having at least one transverse passage therein positioned adjacent the internal annular recess in each of said packers and placing the bore of said tester body in open communication with the pressure chamber in each of said packers whereby test fluid in the bore of said tester body passes into the pressure chamber of each of said packers causing said packers to expand and initially seal off a section of well pipe, pressure responsive means positioned in said tester body intermediate said spaced packers, said pressure responsive means operable at a pressure of test fluid higher than the test fluid necessary to cause said packers to initially seal off the section of well pipe to be tested to permit test fluid from said bore to enter the sealed-off section between said packers, and means positioned on the exterior of each of said packers immediately adjacent the internal annular recesses of said packers, said last-mentioned means responsive to the pressure of test fluid between said packers to further seal said packers as pressure of test fluid between said packers is increased.

3. In an apparatus adapted for testing sections of well pipe or the like, an elongated tester body having a cylindrical center portion of smaller diameter than the diameter of the well pipe to be tested and elongated stem portions extending longitudinally from the ends of the cylindrical center portion, said tester body having a longitudinal bore extending therethrough and closed at its lower end, packer retaining means mounted on the free ends of the stems of said tester body, said packer retaining means having a diameter substantially equal to the diameter of the cylindrical center portion of said tester body, spaced expansible packers mounted exteriorly on each of said stems and between said packer retaining means and the center portion of said tester body, said packers each having an interior annular recess defining pressure chambers and having an external diameter substantially equal to the cylindrical center portion of said tester body and said packer retaining means, the stems of said tester body each having at least one transverse passage therein positioned adjacent the internal annular recess in each of said packers and placing the bore of said tester body in open communication with the pressure chamber in each of said packers whereby test fluid in the bore of said tester body passes into the pressure chamber of each of said packers causing said packers to expand and initially seal off a section of well pipe, pressure responsive means positioned in said tester body intermediate said spaced packers, said pressure responsive means operable at a pressure of test fluid higher than the test fluid necessary to cause said packers to initially seal off the section of well pipe to be tested to permit test fluid from said bore to enter the sealed-off section between said packers, and means positioned on the exterior of each of said packers immediately adjacent the internal annular recesses of said packers, said last-mentioned means responsive to the pressure of test fluid between said packers to further seal said packers as the pressure of test fluid between said packers is increased, and a second pressure responsive means in said tester body positioned between said packers for permitting test fluid to flow from the sealed-off section of well pipe into the bore of said tester body when the pressure of test fluid in said bore is reduced below the predetermined pressure necessary to operate said first mentioned pressure responsive means.

4. In an apparatus adapted for testing sections of well pipe or the like, an elongated tester body having a longitudinal bore therein enclosed at its lower end, spaced cylindrical shaped packers mounted exteriorly of said tester body, means on said tester body having an external diameter substantially equal to the diameter of said spaced packers for preventing longitudinal movement of said spaced packers, each of said packers having an internal annular recess defining a pressure chamber, said tester body having a lateral passage therein adjacent the internal annular recess of each of said packers and placing the bore of said tester body in open communication with the pressure chamber in each of said packers so that test fluid in the bore of said tester body can flow through said passages into the pressure chambers of said packers to expand the same and initially seal off a section of well pipe, pressure responsive means positioned in said tester body intermediate of said spaced packers, said pressure responsive means operable at a pressure of test fluid higher than the pressure of test fluid necessary to initially expand said packers and seal off the section of well pipe to be tested, an outwardly flaring circumferential lip on each of said packers, the lip on one of said packers being oppositely disposed from the lip on the other of said packers whereby the test fluid in the section of well pipe to be tested acts on the undersurface of the lip of each packer to further seal the packers as the pressure is increased.

5. An apparatus of the character described in claim 4 wherein said circumferential lip on each of said packers is positioned adjacent the internal annular recess of each of said packers.

6. An apparatus of the character described in claim 4 wherein a second pressure responsive means is provided intermediate said packers, said second pressure responsive means permitting test fluid to flow from the sealed-off section between said packers to the bore of said tester body when the pressure of test fluid in the bore of the tester body is reduced.

References Cited in the file of this patent

UNITED STATES PATENTS

1,812,944	Granger	July 7, 1931
2,164,195	Watermire	June 27, 1939
2,241,526	Rosenkranz	May 13, 1941
2,399,125	Lehnhard	Apr. 23, 1946
2,704,090	Potts et al.	Mar. 15, 1955