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(54) **METHOD AND APPARATUS FOR EVALUATING THE POTENTIAL EFFECTIVENESS OF REFRACING A WELL**

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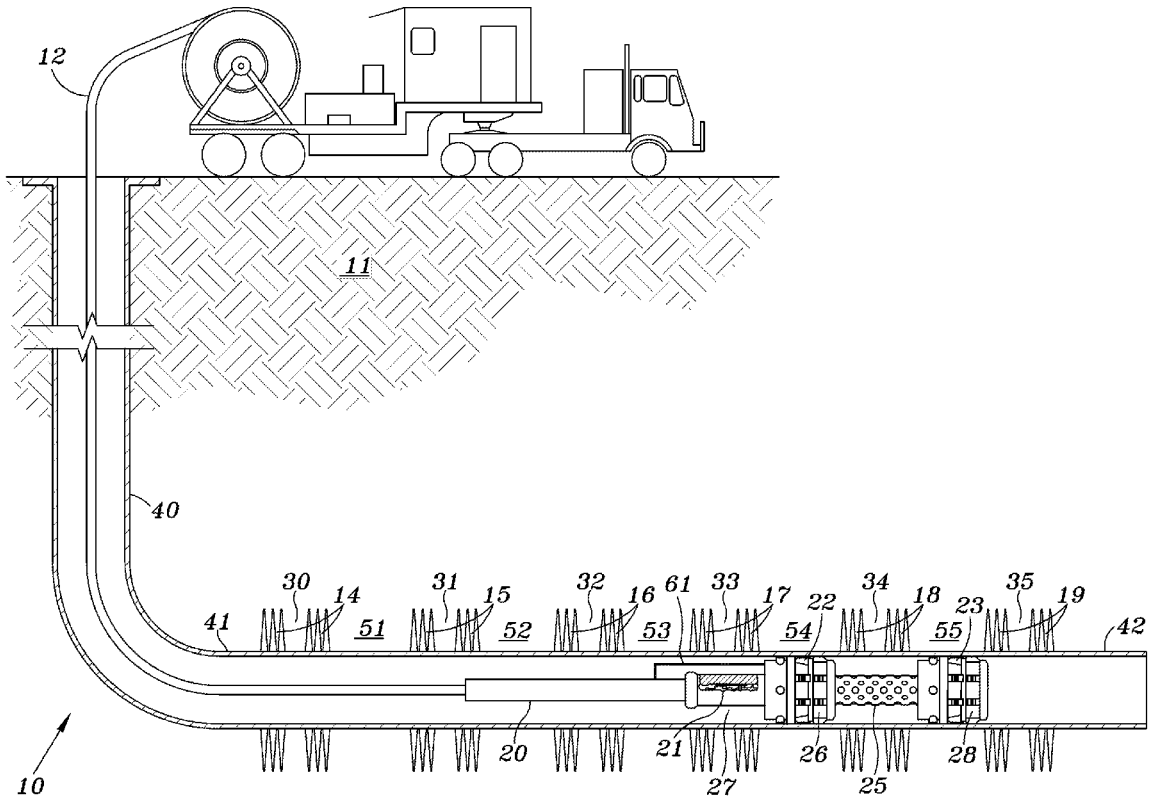
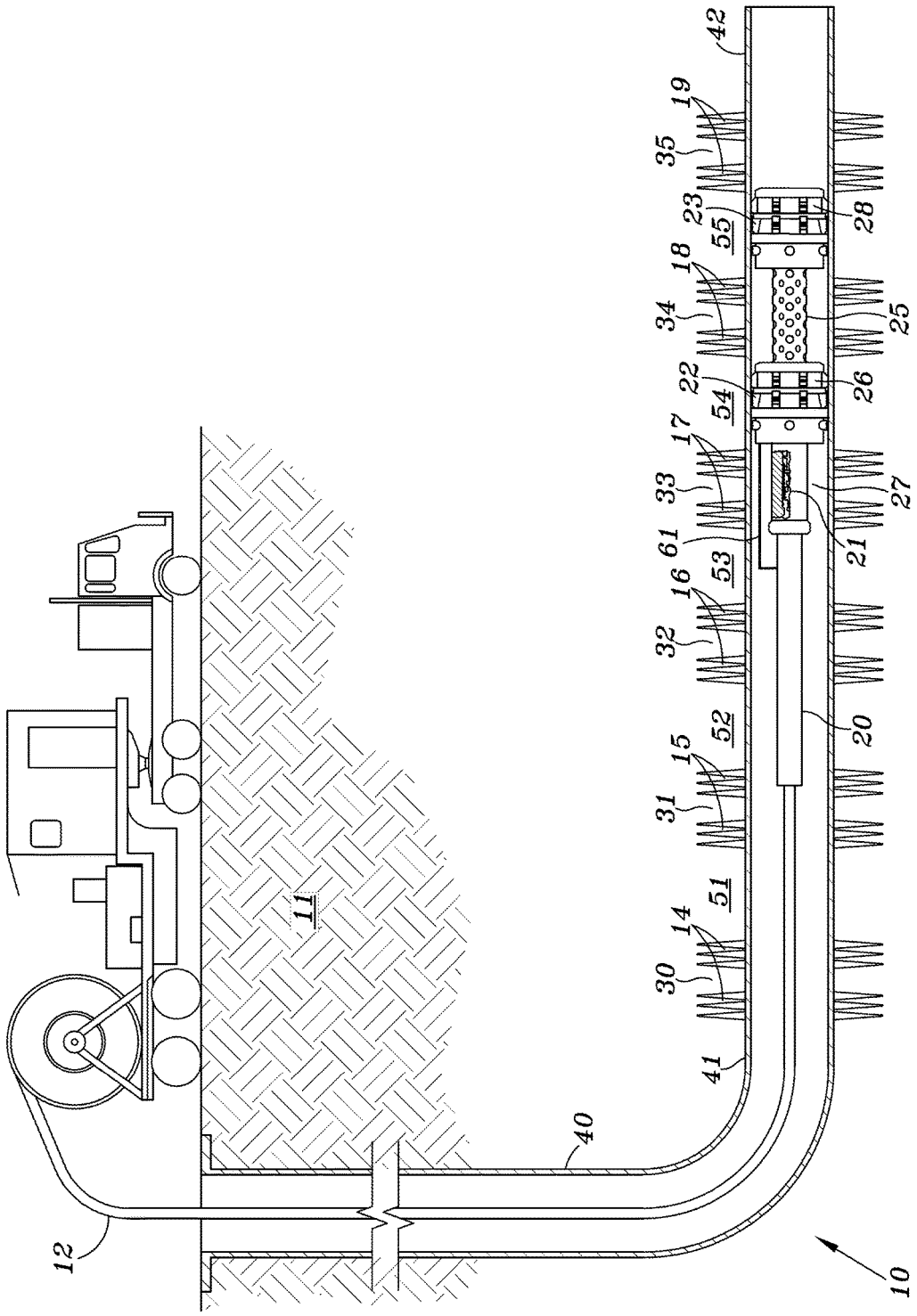
(57) **ABSTRACT**

A method for evaluating the potential effectiveness of refracing a previously fracked oil/gas well is accomplished by isolating a plurality of previously fracked zones of an oil/gas well in a formation and measuring the fluid flow rates from the isolated zones using a three phase flow meter positioned within the well at or near the previously fracked zones. The zones may be isolated by an isolation assembly which includes two packers connected by a perforated pipe and attached to a tubular positioned within the well.

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METHOD AND APPARATUS FOR EVALUATING THE POTENTIAL EFFECTIVENESS OF REFRACING A WELL

[0001] This application is a continuation of U.S. application Ser. No. 14/829,602 filed Aug. 18, 2015 the entire contents of which is hereby incorporated herein by reference thereto.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] This invention relates to a method and apparatus for evaluating the potential effectiveness of refracing an oil/gas well. Individual production zones are tested for flow rates of gas, water and oil to determine which previously fracked production zones are the most productive and consequently the best candidates for refracing.

Description of Related Arts Invention

[0003] Currently when refracing a well the overall productivity of the well is considered before a decision to refrac is made. Little is known about which of the many perforated zones are productive in a well. Therefore, a method of determining which of the zones could benefit from refracturing is very important.

[0004] Furthermore, while some efforts have been made to measure the total production of fluids within a well, very little effort has been made to monitor the individual production rates for gas, water, and oil as well as pressure and temperature at various stages of frac zones for the purpose of evaluating the effectiveness of refracing an individual zone using the proposed method and tool configuration in this application.

[0005] Consequently there is a need to for a more precise method of measuring the oil output of individual frac zones in order to evaluate the potential effectiveness of refracing a given production zone.

BRIEF SUMMARY OF SOME OF THE PREFERRED EMBODIMENTS

[0006] These and other needs in the art are addressed in one embodiment by isolating individual frac zones of a previously fraced formation and measuring the Static Bottom Hole Pressure and Flowing Bottom Hole Pressure, so a productivity index can be calculated and the ratio of Oil, Gas and Water can be measured through the use of a three phase flow meter, such as a Doppler flow meter. The production index is a measure of well's potential or ability to produce fluids as a function of reduction in pressure. The production index (PI) is calculated by subtracting the flowing bottom hole pressure (PF) from the static bottom hole pressure (PS) to get a drawdown pressure. The production rate in barrels per day (bpd) is divided by the drawdown to arrive at the PI. Thus if the drawdown pressure is 500 psi and the producing rate is 500 bpd, then the PI is 1.

[0007] The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter that form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and the specific embodiments disclosed may be readily utilized as a basis for modifying or designing other embodiments for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent embodiments do not depart from the spirit and scope of the invention as set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] For a detailed description of the preferred embodiments of the invention, reference will now be made to the accompanying drawing in which:

[0009] The FIGURE illustrates a schematic showing of a horizontal well having a plurality of frac zones with an embodiment of equipment for carrying out the invention placed within the well.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] The FIGURE shows a well **10** within formation **11** including a casing having a horizontal portion **41** and a vertical portion **40** and a tubular string **12** which may be coiled tubing or jointed pipe tubing.

[0011] As shown the well includes a vertical section and a horizontal portion which terminates at **42**. However it is understood that the well may consist of a vertical section only surrounded by a plurality of vertically spaced frac zones.

[0012] In a typical horizontally fraced well, there are a plurality of fracked zones **30**, **31**, **32**, **33**, **34**, **35** wherein the casing **41** has been perforated at **14**, **15**, **16**, **17**, **18**, and **19**. As is known in the art, fracing fluids are introduced sequentially into the formation through the perforations in the casing to fracture the formation adjacent the casing to facilitate the flow of oil and other fluids from the formation to the interior of the well.

[0013] According to an embodiment of the invention, coiled or jointed pipe tubing **12** is lowered into the well and includes a jet pump section **20** and, a pup joint **27** having a three phase flow meter **21** located within the pup joint.

[0014] An isolation assembly which includes a first packer **26**, a perforated sub **25**, and a second packer **28** is attached to the tubing **12** at an end thereof via meter **27** and jet pump **21**. When positioned within the well as shown in the FIGURE the isolation assembly will permit only fluid from previously fracked zone **34** to enter the interior of flow meter **21** via the openings in perforated sub **25**. When inflatable packers are used, power fluid from the jet pump may be diverted to the packers via a conduit **61** for inflating the packers.

[0015] To measure the flow rate of fluids from zone **34**, power fluid is delivered to jet pump **20** which will draw fluid from zone **34** through perforated sub **25**, packer **26** and pup joint **27**. Consequently the three phase flow meter **21** in pup joint **27** will record the oil, gas and water flow rates from the previously fraced zone **34**. Flow meter **21** also includes temperature and pressure gauges.

[0016] According to an embodiment of the invention, once the flow rate of a fluid in a given frac zone has been measured, the flow rates of fluid in an different normally adjacent zone can be measured by moving the isolation unit to isolate a different frac zone such as frac zone **33** shown in the FIGURE.

[0017] The Initial Bottom Hole Pressure will be measured before each zone is tested and the straddle packers isolate that zone. The Flowing Bottom Hole Pressure will be measured when the jet pump is engaged and drawdown is achieved. Consequently the production index for each frac zone in a producing well can be calculated. Based upon the calculation a determination can be made as to the original frac zones that are most likely to exhibit increased productivity due to a refracing procedure.

[0018] Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations may be made herein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A method of evaluating the potential effectiveness of refracing a producing oil/gas well that has already been fracked at a plurality of zones along the length of the well comprising:

a) isolating a first producing, previously fracked zone in the well,

b) measuring the oil, water, or gas flow rate, from the producing zone while the zone is being produced,

c) calculating a production index for the isolated previously fracked zone, and

d) determining the previously fracked zones that are most likely to exhibit increased productivity due to a refracing procedure based upon the production index.

2. The method of claim **1** further including the step of isolating two or more previously fracked zones and measuring the oil flow rate flow from each previously fracked zone.

3. The method of claim **1** wherein the previously fracked zone is isolated by placing a packer within the well at the beginning and end of the zone.

4. The method of claim **3** wherein the oil, water, or gas flow rate is obtained by placing a three phase flow meter in tubing located within the well, the tubing including a perforated pipe positioned between the packers.

5. The method of claim **4** wherein the oil, water, or gas is produced using a jet pump positioned within the production tubing.

6. The method of claim **5** wherein the packers are either of the inflatable type or mechanical type and a portion of power fluid for the jet pump is diverted to set the packers.

7. The method of claim **1** wherein the well is a horizontal well.

8. The method of claim **1** further including measuring the temperature and pressure of fluid within the previously fraced zone.

9. The method of claim **1** further including measuring an initial static bottom hole pressure and a flowing bottom hole pressure of the previously fraced zone, measuring a production rate of the previously fraced zone, wherein the production index is calculated by subtracting the flowing bottom hole pressure from the static bottom hoe pressure and dividing the production rate by the result of subtracting the flowing bottom hole pressure from the static bottom hole pressure.

10. The method of claim **1** further including the step of refracing the previously fraced zones that are determined to be most likely to exhibit increased productivity.

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