

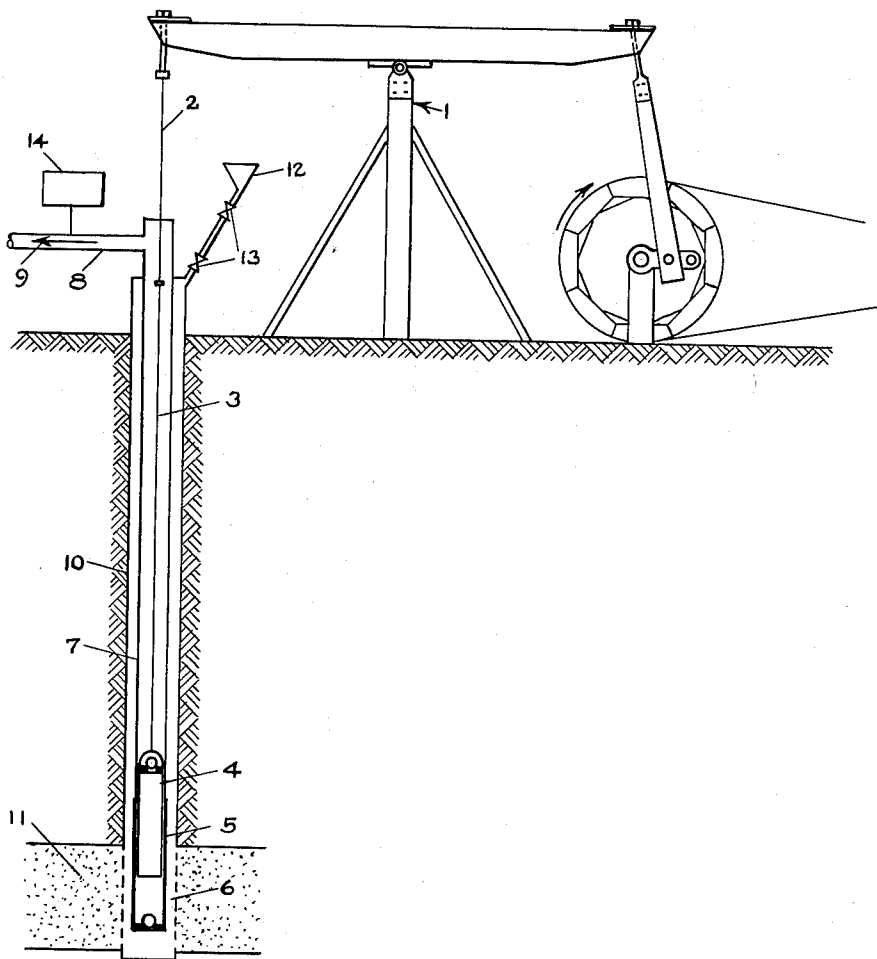
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METHOD RELATING TO THE PRODUCTION OF OIL

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METHOD RELATING TO THE PRODUCTION OF OIL

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This invention relates to a new method for determining whether an oil well pump is removing fluid from a well bore at substantially the same rate as the fluid is flowing from the formation into the well bore. More particularly, the determination is carried out by the application of radioactive materials.

It is desirable to operate an oil well pump at the maximum rate at which the reservoir rock is capable of yielding its fluid. If the pump is not removing the fluid as fast as it is entering the well bore, the fluid level will rise in the oil well casing and develop a back pressure on the reservoir which retards the rate of flow of fluid from the reservoir into the well bore, and it follows therefore that under these conditions one is operating at a production rate below the capacity of the well.

Heretofore it has been difficult in oil production to determine whether or not an oil well pump is removing fluid from the well at substantially the same rate as the fluid is entering the well bore. The conventional methods employed to accomplish this are the "feel" of the polish rod method or the sound reflection method to determine the operating fluid level in the well bore. Neither of these methods is satisfactory, particularly in the deeper wells now being produced. In the "feel" method the operator literally tries to feel the vibration or pound that results when the pump plunger strikes the fluid in a partially filled pump barrel. This vibration or pound is not present when there is sufficient fluid present in the well bore to fully load the pump barrel. Since the "feel" method depends considerably upon the human element, it is unsatisfactory from the standpoint of accuracy, particularly in wells deeper than about 2500 feet. The sound reflection or "echo method" depends upon measuring the time required for a sound wave to travel from the earth's surface down the annular space between the tubing and casing of a well to the surface of the fluid in the casing and back to the earth's surface. While the "echo method" has been used successfully in shallow wells it has not been satisfactory enough for wells deeper than about 3500 feet. Furthermore, the "echo method" is very costly.

It is an object of this invention to provide a new and improved method for determining whether an oil well pump is removing the fluid from the well bore at substantially the same rate as it is entering the well bore from the formation. A further object is to provide a rapid and inexpensive means of making this determination. A still further object is to provide a means for making this determination by the application of radioactive materials.

The above and other objects of this invention are accomplished broadly by adding a small quantity of radioactive material to the upper surface of the fluid in the well bore and then testing the fluid for radioactivity as the fluid is pumped from the well, as will be disclosed in greater detail hereinafter.

An embodiment of this invention is illustrated together with standard oil well equipment in the accompanying drawing. A standard oil well power unit 1 is used to actuate the polish rod 2 directly connected to the pump rods 3. The pump rods 3 raise and lower a plunger 4 operating in a working barrel 5 to lift fluid from the well bore 6 to the surface through tubing 7 and then through the flow line 8 to a storage tank (not shown), arrow 9 indicating the direction of flow. Numerals 10 and 11

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refer to an oil well casing and oil formation, respectively. The above describes conventional oil well equipment which is shown merely to explain the application of this invention.

According to a preferred embodiment of this invention a mixture of a relatively short half life radioactive material, e.g. sodium-24, and a liquid carrier therefor, e.g. a very light oil, the specific gravity of said mixture being less than the specific gravity of the fluid in the well bore, is introduced through container 12 and valves 13. The radioactive oil mixture passes down through casing 10 and collects on top of the fluid in the well bore 6. When the fluid level is at substantially the same level as the bottom of the working barrel 5 (i.e. below the pump suction) the radioactive material is pumped to the surface through tubing 7 and flow line 8 where a radiation survey instrument 14, e.g. a Geiger counter, attached to flow line 8 indicates the presence of radioactive material. The instrument may be a continuous recording type which makes a permanent record, or it may be of the instantaneous type, e.g. one which indicates the presence of radioactive material by actuating a signalling device such as a light or an alarm. The indication that radioactive material is passing through flow line 8 shows that the pump is lifting fluid from the well bore at substantially the same rate as the fluid is flowing from the formation 11 into the well bore 6.

When the fluid level is substantially above the bottom of working barrel 5, the radioactive material collects on top of the fluid in the well bore 6 and is not pumped to the surface. Under this condition the recording Geiger counter 14 indicates the absence of radioactive material in flow line 8 which shows that the pump is removing fluid from the well bore at a rate somewhat less than the fluid is flowing into the well bore from the formation 11.

Thus, according to the method of this invention, when the recorder 14 indicates the presence of radioactive material in flow line 8 the fluid is being removed from the well bore at substantially the same rate as the fluid is flowing from the formation into the well bore, and when the recorder 14 shows the absence of radioactive material in flow line 8 the fluid is being removed from the well bore at a rate substantially less than the rate it is capable of flowing from the formation into the well bore.

Some examples of radioactive materials suitable for use in this invention are sodium-24, iodine-131 and phosphorous-32. Light oils which may be used include kerosene, gasoline, naphtha, light crude, and the like. Extremely small amounts of radioactive materials are sufficient. From about five to ten gallons of the mixture of radioactive material and light oil, depending primarily upon the depth of the well, gives good results.

This invention makes a substantial contribution to the art of determining whether an oil well pump is removing fluid from the well bore at substantially the same rate the fluid is flowing from the formation into the well bore. The method provided by the present invention is rapid, accurate, inexpensive and simple.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

What is claimed is:

1. Method of determining the rate at which an oil well pump is removing fluid from the well bore with respect to the rate at which the fluid is capable of entering the well bore from the formation in the absence of back pressure, which comprises depositing on top of the fluid in the well a mixture of a radioactive material and a carrier therefor, the specific gravity of said mix-

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ture being less than the specific gravity of said fluid, whereby the fluid pumped from the well will have a greater radioactivity when the fluid is pumped from the well at a rate in excess of the rate at which the fluid is entering the well from the formation than when the fluid is pumped from the well at a rate that is less than the rate at which the fluid is entering the well from the formation, and then measuring the radioactivity of the fluid as it is pumped from the well.

2. Method of determining the rate at which an oil well pump is removing fluid from the well bore with respect to the rate at which the fluid is capable of entering the well bore from the formation in the absence of back pressure, which comprises depositing on top of the fluid in the well a mixture of a radioactive material and a light oil, the specific gravity of said mixture being less than the specific gravity of said fluid, whereby the fluid pumped from the well will have a greater radioactivity when the fluid is pumped from the well at a rate in excess of the rate at which the fluid is entering the well from the formation than when the fluid is pumped from the well at a rate that is less than the rate at which the fluid is entering the well from the formation, and then measuring the radioactivity of the fluid as it is pumped from the well.

3. Method of determining the rate at which an oil well pump is removing fluid from the well bore with respect to the rate at which the fluid is capable of entering the well bore from the formation in the absence of back pressure, which comprises depositing on top of the fluid in the well a mixture of a relatively short half life radioactive material and a carrier therefor, the specific gravity of said mixture being less than the specific gravity of said fluid, whereby the fluid pumped from the well will have a greater radioactivity when the fluid is pumped from the well at a rate in excess of the rate at which the fluid is entering the well from the formation than when the fluid is pumped from the well at a rate that is less than the rate at which the fluid is entering the well from the formation, and then measuring the radioactivity of the fluid as it is pumped from the well.

4. Method of determining the rate at which an oil well pump is removing fluid from the well bore with respect to the rate at which the fluid is capable of entering the well bore from the formation in the absence of back pressure, which comprises depositing on top of the fluid in the well a mixture of sodium-24 and a carrier therefor, the specific gravity of said mixture being less than the specific gravity of said fluid, whereby the fluid pumped from the well will have a greater radioactivity when the fluid is pumped from the well at a rate in excess of the rate at which the fluid is entering the well from the formation than when the fluid is pumped from the well at a rate that is less than the rate at which the fluid is entering the well from the formation, and then measuring

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the radioactivity of the fluid as it is pumped from the well.

5. Method of determining the rate at which an oil well pump is removing the fluid from the well bore with respect to the rate at which the fluid is capable of entering the well bore from the formation in the absence of back pressure, which comprises depositing on top of the fluid in the well a mixture of iodine-131 and a carrier therefor, the specific gravity of said mixture being less than the specific gravity of said fluid, whereby the fluid pumped from the well will have a greater radioactivity when the fluid is pumped from the well at a rate in excess of the rate at which the fluid is entering the well from the formation than when the fluid is pumped from the well at a rate that is less than the rate at which the fluid is entering the well from the formation, and then measuring the radioactivity of the fluid as it is pumped from the well.

6. Method of determining the rate at which an oil well pump is removing the fluid from the well bore with respect to the rate at which the fluid is capable of entering the well bore from a formation in the absence of back pressure, which comprises depositing on top of the fluid in the well a mixture of phosphorous-32 and a carrier therefor, the specific gravity of said mixture being less than the specific gravity of said fluid, whereby the fluid pumped from the well will have a greater radioactivity when the fluid is pumped from the well at a rate in excess of the rate at which the fluid is entering the well from the formation than when the fluid is pumped from the well at a rate that is less than the rate at which the fluid is entering the well from the formation, and when measuring the radioactivity of the fluid as it is pumped from the well.

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