

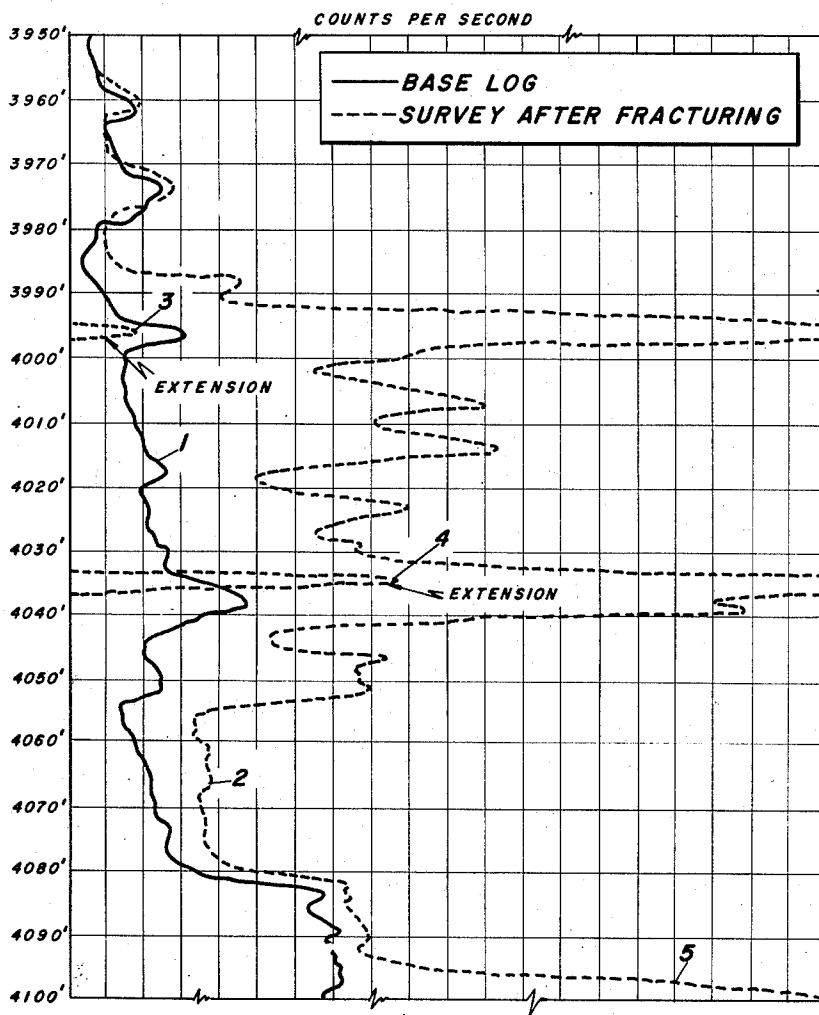
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2,951,535

METHOD OF FRACTURING

Filed Oct. 5, 1955



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2,951,535

## METHOD OF FRACTURING

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1 Claim. (Cl. 166—42)

This invention relates to a method of fracturing earth formations and employing radioactive sand or similar inert materials to determine the location of fractures in oil wells and any "fall out" of the sand from the fracturing fluid.

Earth formations in oil wells are now commonly fractured in accordance with the process of the Farris patent, Reissue No. 32,733. After a well is fractured with this process, it is desirable to determine the location of the fractures to be certain that they are in the producing zone and to determine whether the sand has gone into the formation or has "fallen out" of the fracturing fluid.

It is known to the art, as in the United States patent to Buckley, No. 2,220,205, to trace fluid pumped into an oil well, by adding radioactive materials to the fluid and then logging the well to determine the location of the radioactive material.

In attempting to trace fluids in fracturing earth by means similar to the Buckley process, i.e. by mixing carnotite or the like, the results have not been entirely satisfactory. Such methods depend upon the introduction of a substance foreign to the normal fluid and propping agents used fracturing. Besides the additional expense, these foreign substances may affect the chemical and physical properties of the fracturing fluid. Such substances are of no aid in fracturing, unless they have the characteristics of fracturing sand and fracturing fluid. Otherwise, they will have a tendency to clog the apertures between the grains of sand, thereby retarding the flow from the fracture. Also these substances will "fall out" of the fluid or "plate on" the walls of the bore hole and will give incorrect and unreliable information when the well is logged.

Sand, on the other hand, is commonly used as a propping agent in a fracturing process. See the Farris patent cited above, and if some of the propping agent itself is rendered radioactive a successful fracturing process can be performed, and at the same time information about the process can be obtained.

By means of this invention radioactive fracturing sand is blended with untreated sand. The said sand is rendered radioactive by the process of coating or glazing it with a composition containing radioactive isotopes. This sand is more fully described and claimed in the copending application, Serial No. 538,763, filed October 5, 1955, now abandoned. Sufficient radioactive sand to give successful detection by a gamma ray detection device is used. The sand is mixed with the fracturing fluid and the well is fractured. The well is logged before and after fracturing. A comparison of the two curves gives the desired information.

It is to be understood that there may be variations of this method. It is not necessary that radioactive sand be employed all during the fracturing process. Near the end of the fracturing process, radioactive sand or a radioactive blend can be introduced into the fracturing fluid, and pumped into the fracture.

The accompanying drawing is a reproduction of a

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typical radioactive log obtained by the method provided by the present invention. As shown, the recording paper has spaced horizontal lines designating well depths and spaced vertical lines designating counts per second of radioactivity. The solid curve, designated by the numeral 1, is the log of the well before fracturing or the base log. It is noted that the curve is rather uniform and shows the detection of the normal gamma rays of the different strata in the bore hole. The dashed curve, designated by the numeral 2, is the log of the well after fracturing. Along this curve 2, at points designated by numerals 3 and 4, definite and clearly defined points of fracture are shown. The location and sand concentration of these points of fracture can be readily determined from the chart. The bottom of the hole and any "fall out" of the radioactive sand is shown at 5. Points of fracture shown at 3 and 4 are recorded on the chart in the manner shown, because the radioactive sand in the fracture emits gamma rays of sufficient strength to be detected by the counter. It is to be pointed out that there should and usually will be little or no "fall out" of the sand particles.

In accordance with the invention, a preferred method of locating the fracture in wells is as follows: The well is logged, in accordance with known practices, by measuring the natural gamma radiation of the earth formations, to obtain a base survey. In the accompanying drawing the record of this survey is shown by curve 1. It shows a low and even level of radioactivity. Two hundred pounds of radioactive Ottawa sand are blended with eighteen hundred pounds of untreated sand. This gives 2 millicuries ratio of iron 59 and 55 per ton of sand. The sand is then mixed with the fracturing fluid. This mixture is then pumped into the well to make the fracture in accordance with the teachings of the Farris patent cited above. The well is then flushed. Then a second log is made with the same method and apparatus employed in making the base survey. The representation of this log is shown in the accompanying drawing by the dashed curve 2. At points 3 and 4, a sharp increase in the radioactive level is found which is an excellent indication of fractures at these points.

The above described method is only one method, it being described merely to make the disclosure complete and to illustrate how the invention may be best carried out. It is not the intent that the invention to limited to the above method, as various changes may be made without departing from the spirit of the invention or the scope of the annexed claim.

## We claim:

The method of fracturing an earth formation in a well bore and then locating said fracture which includes the steps of treating some particles of fracturing sand by coating them with a gamma ray emitting composition, said gamma ray emitting composition having a suitable half-life for logging, blending such particles of treated sand with particles of untreated sand, mixing such blended sand with a fracturing fluid, then pumping the fracturing fluid into the earth formation at a high pressure to fracture the same and leave deposits of the blended sand in the formation as propping agents, the method being such that the location of the fractures can be determined by making radioactive logs of the well before and after fracturing indicative of the location of the particles of sand coated with the gamma ray emitting composition.

## References Cited in the file of this patent

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 2,951,535

September 6, 1960

Russell G. Mihram et al.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 22, for "32,733" read -- 23,733 --;  
column 2, line 45, for "to", first occurrence, read -- be --.

Signed and sealed this 4th day of April 1961.

(SEAL)

Attest: ERNEST W. SWIDER

~~XXXXXXXXXX~~  
~~KARL H. AXELINE~~

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