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METHOD OF FRACTURING IN WELLS

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FRACTURING FLUID

FIG. 1.

FIG. 2.

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METHOD OF FRACTURING IN WELLS

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5 5 Claims. (Cl. 164—42)

This invention is directed to a method of fracturing wells to restrict production of sand from hydrocarbon bearing strata. Production of sand, which often accompanies production of oil or gas from subsurface formations, is detrimental in hydrocarbon fluid producing operation because it causes for example, rapid erosion and plugging of subsurface pumping equipment; erosion of surface flow lines; and reduction or prevention of fluid flow through accumulation of sand in the well bore.

An object of this invention is to provide an improved method for reducing or eliminating sand production from hydrocarbon producing formations.

Briefly, the invention concerns a method for restricting the production of sand from hydrocarbon bearing strata comprising fracturing impervious nonhydrocarbon bearing strata adjacent hydrocarbon bearing strata, extending the fracture system into the hydrocarbon bearing strata, and then producing hydrocarbon fluid through these fractures.

In drilling oil wells, the procedures of drilling through subsurface formations, setting pipe, and perforating operations cause the produced fluids to travel at high velocity through the regions in which the confining forces have been greatly altered. Alteration of confining forces on the sand grains of hydrocarbon producing formations, together with the high velocity of the produced fluids through the perforations formed in the hydrocarbon producing formations, cause sand to flow into the well bore.

Completing a well in the manner of the present invention, briefly noted above, eliminates the causes of sand production inherent in conventional completion practice. The completion, according to the invention, will not include a gross alteration of the confining forces and, furthermore, regions of high produced fluid velocity within the hydrocarbon bearing strata will not exist.

The above and other objects of the invention will be apparent from a description of the invention taken in conjunction with the drawing wherein:

FIG. 1 is a cross-sectional view of a well bore illustrating the fracturing operation according to the invention; and

FIG. 2 is a cross-sectional view of the well bore illustrating the producing operation according to the invention.

For a more complete understanding of the invention, reference to FIGS. 1 and 2 in greater detail will now be made.

FIGS. 1 and 2 show a well bore 10 penetrating a plurality of subsurface strata including an impervious stratum 11 and a hydrocarbon producing sand stratum 12. A casing 13 is arranged in well bore 10 and cemented therein according to conventional practice by means of cement 14.

When it is desired to produce hydrocarbons, a gun perforator (not shown) is lowered through casing 13 to adjacent the impervious stratum 11, and casing 13, cement 14, and impervious stratum 11 are perforated as indicated by the perforations 15. Then, a fracturing fluid is introduced into the well bore and impervious stratum 11 is fractured. The fractures 18 formed by this operation extend into hydrocarbon sand stratum 12.

Preferably, as illustrated in FIG. 1, the fracturing equipment includes a pipe 17, the lower open end of which extends to adjacent impervious stratum 11, provided with a packer 16 adapted to seal off the annulus between casing 13 and pipe 17 above impervious stratum 11. To form fractures 18 in strata 11 and 12, fracturing fluid is pumped down pipe 17, and through perforations 15 in casing 13, cement 14, and stratum 11 according to conventional hydraulic fracturing practice.

Other fracturing techniques may be used. For example, a pipe provided with straddle packers adapted to seal off the annulus between the pipe and the casing above and below the impervious stratum may be employed in which event the flow of fracturing fluid is down the pipe and through perforations provided in the portion of the pipe located between the straddle packers. Or the use of a pipe and a packer or packers may be omitted altogether in which event the flow of fracturing fluid is down the casing.

When the fracturing operation has been completed the fracturing fluid, pipe 17, and packer 16 are removed from the borehole and the well is produced. The flow of produced hydrocarbons is through fractures 18 and perforations 15 and up casing 13 as shown by the arrows in FIG. 2.

A propping agent such as sand is preferably included in the fracturing fluid in order to help prop open fractures 18 in order to make it easier for the oil to flow into casing 13. As for the fracturing fluid itself, any conventional fracturing fluid may be used. For example, a hydrocarbon such as crude oil alone or with a bodying agent may be employed. Bodying agents are materials such as colloidal materials, a metallic salt of an organic acid, a high molecular weight olefin polymer, a molecular linear polymer such as polypropylene or a plastering agent such as blown asphalt, pitch, or the like. Other fluids which may be used as the fracturing fluid are water, dilute hydrochloric acid, gels (such as a mixture of heavy metal soaps), fuel oils, crude oils, and lighter fractions of crude petroleum. Additionally, organic compounds of the plastic group which have the property of reverting to a nonviscous condition with the passage of time or through the action of certain chemicals or through appropriate changes in temperature or pressure may be used.

The impervious strata may consist of shale, limestone, low permeability sandstone, or any impervious material present.

The drawing illustrates perforating and fracturing of an upper stratum only. However, it is within the scope of the invention to perforate and fracture a stratum below impervious stratum 11. Thus, strata located above or below, or above and below the hydrocarbon sand 12 may be fractured and the fractures extended into stratum 12.

Having fully described the nature, objects, and operation of the invention, we claim:

1. A method for restricting the production of sand along with hydrocarbons produced from a hydrocarbon bearing stratum located adjacent an impervious nonhydrocarbon bearing stratum, both said hydrocarbon bearing stratum and said impervious stratum being penetrated by a borehole comprising the steps of sealing off the face of said hydrocarbon-bearing stratum exposed to said borehole to prevent direct fluid flow from said hydrocarbon-bearing stratum into said borehole; gun perforating only said impervious stratum; locating fracturing fluid adjacent the gun perforations in said impervious stratum; initiating fractures only in said impervious stratum; and then, a fracturing fluid is introduced close to said hydrocarbon-bearing stratum by applying pressure to said fracturing fluid so that fractures form which extend through said impervious stratum into said hydrocarbon-bearing stratum, and then producing said
3. A method as recited in claim 1 including sealing off said hydrocarbon-bearing stratum by cementing the borehole wall following setting of casing.

3. A method as recited in claim 2 including employing a propping agent in said fracturing fluid.

4. A method for restricting the production of sand along with hydrocarbons produced from a hydrocarbon bearing stratum located adjacent and below an impermeable non-hydrocarbon bearing stratum penetrated by a borehole comprising the steps of locating fracturing fluid adjacent said impermeable stratum; initiating fractures only in said impermeable stratum sufficiently close to said hydrocarbon bearing stratum by applying pressure to said fracturing fluid so that fractures from it extend through said impermeable stratum into said hydrocarbon bearing stratum; and then producing said hydrocarbon bearing stratum only through the perforations and fractures in said impermeable stratum.

5. A method as recited in claim 4 including employing a propping agent in said fracturing fluid.

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