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ART OF DRILLING OIL OR GAS WELLS

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This invention relates to method of drilling oil or gas wells and particularly relates to those drilling operations where mud-laden fluids are employed.

At the present time it is customary to employ mud-laden fluids in the drilling of oil or gas wells for the purpose of controlling oil or gas pressures, to remove the debris from the bottom of the hole, to lubricate the drill and to prevent sticking in the hole.

It is also customary to introduce the mud-laden fluid through the center of the drill string whereby the fluid flows into the hole at the bottom of the drill through passages therein and then rises to the top of the well through the annular space surrounding the drill, thereafter, usually flowing into a mud pit or sump. The mud may then be treated to remove sand, debris and gas and is picked up by a pump and re-introduced into the drill string for recirculation.

The use of such minerals as barytes, iron oxide and lead oxide has been proposed and are employed to a considerable extent at present.

I have now found that an efficient high density mud-laden fluid, suitable for use in drilling of oil or gas wells, can be prepared by suspending in water or in the mud normally produced by the drill bit, a proportion of finely ground ferro-alloy. Suitable ferro-alloys for this purpose are ferrophosphorus, ferrosilicon, ferromanganese, ferrotitanium or ferrotungsten. These alloys are ordinarily produced in the massive form and for my purpose I grind the pieces of alloy into a finely divided form, preferably into a powder of less than 200 mesh. For certain purposes I may grind the ferro-alloy to a fineness such that it will substantially all pass through a screen of 300 to 325 meshes to the square inch. By providing a variety of different sized particles a filter bed medium may be built up to prevent loss of mud in porous formations. In addition a certain amount of colloidal sized particles may be added to aid the wall building effect of the ferro-alloy.

The ferro-alloys which I propose to employ for this purpose are characterized by, (1) a high density, i. e., namely in the neighborhood of 5.5 to 6.5 or 7.5 and higher, (2) by a relatively small surface area per unit weight, and (3) by a chemical stability when employed in the usual drilling muds. In this connection, it is customary to control the hydrogen ion concentration of the aqueous drilling mud by the addition of various chemicals so that a minimum viscosity is obtained. Such control necessitates the addition to the aqueous mud of chemicals such as caustic soda,

sodium silicate and various phosphates, particularly the molecularly dehydrated phosphates such as sodium hexa metaphosphate, sodium acid pyrophosphate, tetra sodium pyrophosphate, and sodium tetrphosphate. In some cases acid reacting chemicals may be employed. My improved weighting substances may be employed with such an assemblage of chemicals without deleterious reactions therewith.

For the present purpose I prefer to employ a finely ground ferrophosphorus that is one which has been ground to pass at least a 200 mesh screen and preferably which will pass a 325 mesh screen. Suitable iron-phosphorus alloys are at present articles of commerce and may be obtained carrying from 17% to 18% up to 22% to 25% or more of phosphorus. Special alloys having a lower phosphorus content may likewise be utilized, provided the phosphorus content is sufficient to produce a non-rusting inert alloy. The ferrophosphorus as commercially produced may contain from .1% to as much as 2% or 3% of silicon and also 2% to 3% of manganese, as well as up to 2% of titanium. The specific gravity of such alloys will be dependent upon the phosphorus content, in general the lower phosphorus content alloys being the heavier. The phosphorus content of the alloy here employed may accordingly be somewhat varied. In general however, I prefer to employ sufficient alloying elements so that chemical action in the drilling mud is entirely inhibited. For most purposes, I prefer to employ ferro-alloys having a specific gravity of more than 6 and generally find that an alloy with the specific gravity of from 6.2 through 6.5 or 7 or 7.5 or more, is to be preferred.

When employing a ferrophosphorus having a specific gravity of say 6.5, in the production of drilling muds, I find that it is possible to obtain high gravity muds, weighing as much as 11 or 12 up to 15 and even 20 or more pounds per gallon by the addition of the finely ground ferro-alloy to the aqueous mud. In comparison with an ordinary clay having a specific gravity of 2.4 the addition of the same weight of my ferro-alloy involves the addition of only 35% to 40% of weighting material on a volume basis. I am therefore enabled to produce a satisfactory drilling mud with a very low volume of solids and as a consequence of low surface content, which is found to be desirable in order to minimize gas-cutting. This is due to the combination of extreme inertness of the ferro-alloy herein employed as well as to the restricted surface presented for adsorption of gases.

In producing well drilling muds incorporating ferrophosphorous or other ferro-alloy, the finely divided ferro-alloy may be added directly to the mud stream or to the mud in the sump which is then later introduced by pumping into the well. In many cases, it may be desirable to add gel-forming bodies or minerals to the mud and particularly to add bentonite or bentonitic clay for the purpose of developing gel strength in the mud should the natural formation be deficient in this regard. I may also add various suspending agents of a chemical nature, colloidal bodies and viscosity reducing agents, such as are at present employed. While the ferro-alloys herein disclosed are so chemically inert as to exhibit little increase in viscosity as compared with chemical salts and minerals, it may be desirable in certain cases to add the above mentioned viscosity reducing agents for the purpose of overcoming the viscosity effect caused by the addition of the gel-forming minerals. Satisfactory viscosity reducing agents are the alkali metal phosphates, particularly the sodium phosphates and in this connection it is preferred to employ substances such as sodium hexa metaphosphate, sodium acid pyrophosphate, sodium tetra pyrophosphate, sodium tripolyphosphate and sodium tetrphosphate. Such phosphates are water soluble and may be added from time to time in order to control the viscosity of the circulating mud.

What I claim is:

1. A high gravity mud-laden fluid comprising finely divided ferrophosphorus suspended in an aqueous medium.
2. A mud-laden fluid for oil and gas wells comprising gel-forming minerals and a quantity of finely divided ferrophosphorus.
3. The fluid defined in claim 2 in which the ferrophosphorus contains between 17% and 25% phosphorus.
4. A mud-laden fluid for oil and gas well drilling comprising finely divided ferrophosphorus in suspension and a suspending agent therefor.
5. A mud-laden fluid for oil and gas well drilling comprising in aqueous suspension gel-forming minerals, finely divided ferrophosphorus and a proportion of soluble phosphates effective to decrease the viscosity of said fluid.
6. In the art of drilling oil or gas wells, the process comprising introducing into the well an aqueous suspension of ferrophosphorus together with a gel-forming body.
7. In the art of drilling oil or gas wells, the process comprising introducing into the well an aqueous suspension of ferrophosphorus, and a gel-forming body, said suspension also carrying in the dissolved state a molecularly dehydrated phosphate.
8. In the art of drilling oil or gas wells, in which a mud-laden fluid is employed, the process comprising introducing into said mud-laden fluid, finely divided ferrophosphorus.
9. In the art of drilling oil or gas wells, in which a mud-laden fluid is employed, the process comprising introducing into said mud-laden fluid finely divided ferrophosphorus having a screen size of less than 200 mesh.
10. In the art of drilling oil or gas wells in which a mud-laden fluid is employed, the process comprising introducing into said mud-laden fluid finely divided ferrophosphorus and a bentonitic clay.
11. In the art of drilling oil or gas wells, the process which comprises introducing into the well an aqueous suspension of a gel-forming body together with a finely divided ferro-alloy selected from the class consisting of ferro-phosphorus, ferro-silicon, ferro-manganese, ferro-titanium and ferro-tungsten, said ferro-alloy possessing a fineness of at least 200 mesh.
12. In the art of drilling oil or gas wells, the process which comprises introducing into the well an aqueous suspension of ferro-phosphorus.

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