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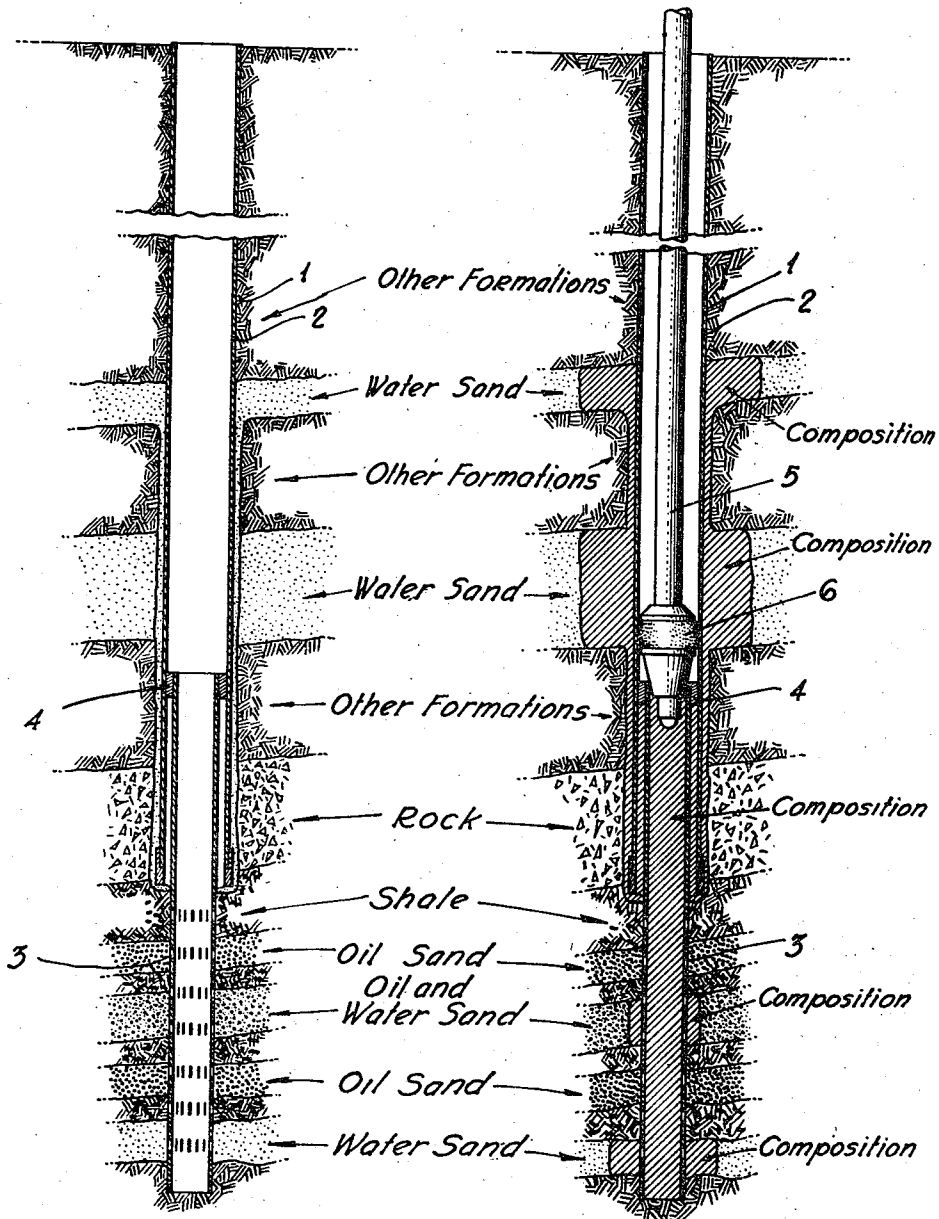
2,213,038

FORMATION SEALING COMPOSITION

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Fig. 1

Fig. 2



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FORMATION SEALING COMPOSITION

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The present invention relates to a water shut-off sealing composition. This sealing composition, while adaptable for many purposes, nevertheless has been particularly compounded with the idea of using the same as a substitute for cement in the shutting off of water from water sands, such as are sometimes encountered in an oil well.

Most States have a law to the effect that any water tending to seep within a well hole must be shut off in some manner. The general practice is to utilize cement which is pumped through a tubing, and which cement travels outside the casing for the purpose of sealing off the water-bearing sands, as well as sealing off sands which contain both water and oil.

The inventor is aware of the fact that certain operators have attempted to seal off water bearing sands by the use of rotary mud. However, it is common knowledge that said mud is not satisfactory in that it only in some cases provides a temporary seal and does not in any case result in a permanent seal.

An object of the present invention is to utilize a composition having qualities which render it impervious to water, and which composition may be readily run through a pump tubing under pressure, to in turn penetrate the water bearing sands and to permanently seal said sands so that water will not seep within the well hole.

Other objects are the provision of a composition which is inexpensive in cost of manufacture, not subject to deterioration, the ingredients of which may be mixed on the job, and does not require the use of skilled labor for said mixing or pumping within the well hole.

In the practice of my invention, I may utilize a mud which, in the present instance, constitutes a clay, such as the well known Mojave or Frazier types. Such a mud, when brought to a given consistency, as hereinafter detailed, is adapted to have added thereto what I term chemicals. These chemicals, together with the clay or mud, so alter the general character of the clay or mud as to cause the same to form what I term a water shut-off composition, the characteristic of which is a water impermeable mass both prior to its introduction within the well hole through the medium of tubing, and likewise after it is within the well hole and allowed to set. After the composition has set, it becomes a hard shale.

For the purpose of the invention, I have detailed specifically the viscosity of the clay of the Frazier or Mojave type, which are best adapted for the purpose of the invention, in combination

with the chemicals which are to be added thereto. I have also indicated the pressures which are to be utilized in pumping the composition into the well hole.

It is a well known fact that as oil is depleted from oil sands, the more readily will the sand take water due to the fact that the water has a greater surface tension than the oil. Sometimes the water, once admitted to the depleted oil sands, will hang tenaciously in the pores of the sand, thus retarding flow of oil to the well. Furthermore, the chilling effect of the water on oils of the paraffin base type may cause a formation of wax in the sand adjacent the well and further retard production.

Another object of the invention is the provision of a suitable composition which may be utilized when circulation is lost during rotary drilling operation and for the purpose of re-establishing circulation.

With respect to the foregoing object, it is well known that during a drilling operation utilizing a rotary mud, that oftentimes the mud will strike a strata of water bearing sands, or other strata, to the end that the mud penetrates such sands or strata and the usual circulation, which is through the drill tubing and back between the casing or well hole and said tubing, is lost. When this occurs, it becomes necessary to in some manner reestablish circulation. Various means may be resorted to, such as cementing, but this requires a great deal of work and is not at all times positive. With the present invention, the composition may be used and allowed to remain in the well hole so that it may harden, all as hereinafter detailed. Thus, by sealing up, as it were, the sands or strata that cause the loss in the circulation, circulation is re-established.

In the drawing:

Figure 1 illustrates a well hole having a liner passed through both oil and water sands, the water sand of which is to be shut off or sealed, and,

Figure 2 is a longitudinal sectional view illustrating means whereby the composition may be pumped through the liner and around the casing to effect water shut-off in water sands without in any manner impairing passage of oil through the liner.

For the purpose of illustrating the use of the present composition, I have illustrated on the drawing two figures; Figure 1, briefly described, is intended to represent a well hole surrounded by water bearing sands, and which sands must

be sealed. Figure 2 illustrates the same well hole as Figure 1, with the composition being pumped therein for the purpose of sealing the sands. In both figures, 1 is the well hole, 2 the well casing, and 3 a liner. As is usual practice, the liner is held to the casing by an adapter 4. A tubing 5 carries at one end a packer 6, the packer of which is received in part within the adapter 4. At the surface of the well hole, a suitable cement pump may be provided so that the composition of the present invention may be forced through the tubing and packer under high pressure, to-wit, 750 to 1,000 pounds per square inch, and in turn passed outwardly through the liner so that the composition will flow between the well hole and the casing and gradually fill the water sands and those sands which contain both water and oil. For instance, in both of the figures of the drawing, I have shown water sands, oil sands and oil and water sands, and it will be noted upon viewing Figure 2 of the drawing that as to the oil sand, the composition will not set at all; in the oil and water sand, the composition will in part set, and in the water sands, the sands are completely sealed.

In carrying out my invention, I utilize a clay of some type, preferably a clay having the characteristics of Frazier Mountain or Mojave. Mojave and Frazier Mountain clays are clays that are obtained from regions bearing these names in the State of California. These clays are characterized in that they have rapid dispersion in a liquid and are free of abrasive material. These clays also remain in a colloidal state in a liquid without settling out to any appreciable extent. The clay must be thoroughly mixed with water by means of proper instrumentalities, to the end that it has a uniform consistency and a funnel viscosity in the range of 1,000 to 10,000 seconds for 500 cc. in and 500 cc. out. The clay consistency when so mixed is that of a jelly, and the Stormer viscosity is in excess of 75 centipoises.

To this clay having the aforesaid viscosity, I add what I term my chemicals and thoroughly admix the same, such as by circulating the mix in a tank. The chemicals added have the following composition:

Ingredient:	Per cent
SiO ₂ -----	18.2
Fe ₂ O ₃ -----	1.5
Al ₂ O ₃ -----	6.5
CaO-----	49.9
MgO-----	1.3
PbO-----	1.3
Na ₂ O-----	0.3
Cl-----	18.6
SO ₃ -----	0.6
Loss on ignition-----	1.8

The chemical mix should have a specific gravity between 2.1 and 2.45 and the variation in pounds per cubic foot in a dry loose state ranges between 131 and 153. When the chemicals are admixed with dry Frazier Mountain clay, the specific gravity of the mix varies between 2.16 and 2.48 and the pounds per cubic foot in a dry loose state varies between 134.9 and 154.9.

When the complete formula is made up fresh utilizing Frazier Mountain clay plus the chemicals hereinbefore set forth, the specific gravity of the composition varies between 1.635 and 1.955, and the weight in pounds per cubic foot lies between 102 and 122.

When the complete formula or composition has been dehydrated, the specific gravity is between

1.99 and 2.31, and the weight in pounds per cubic foot varies between 125.8 and 145.8. The permeability of the complete formula after dehydration is 3 milli-darcys, and the porosity 2.5%; in other words, the dehydrated sample is practically impermeable. In fact, when a fresh mix is made constituting the Frazier Mountain clay, plus the chemicals which are added thereto, and this fresh mix is tested in the conventional filter-cake apparatus, under a pressure of 100 pounds per square inch, only a few drops of water are exhausted from the material in over an hour's time, thus indicating that the composition is practically impermeable to commence with.

Assuming that the chemicals, plus the clay, have been properly admixed in a tank to a uniform consistency, the new composition so formed will have a funnel viscosity range of 100 to 1,000 seconds for 500 cc. in and 500 cc. out. The composition is then pumped through the tubing 5 into the well, at pressures varying between 750 and 1,000 pounds per square inch.

Considering the invention in a commercial aspect, I may combine the following ingredients with the clay, calculated on a dry basis:

	Parts by weight
Clay-----	100
24-hour cement-----	10.5
Calcium chloride-----	11
Unslaked lime-----	8
Prepared bentonite (para-gel)-----	8
Litharge-----	.5
Flake caustic-----	.05

Having made up the material in a fresh state at the well, this composition is forced through the tubing under the pressures named. In accordance with well known physical laws, the extent to which the composition will deposit on the rock walls will depend upon its colloidal state, its rate of flow, the pressure used, and condition of the walls of the well hole. Furthermore, as the hydrostatic head at any depth increases directly with the specific gravity of the fluid, I pump the composition through the tubing under the high pressures named, for the reason, as previously stated, that the extent of penetration of the composition into the water sands varies with the porosity of the rock or sand and the excess of pressure applied.

The ingredients of my particular composition have certain physical characteristics which render my composition a superior one for the purpose of sealing water sands.

The clay, either Frazier Mountain or Mojave, or such clays as may be found, dependent upon the district, should be highly colloidal. Of course, the Frazier Mountain and Mojave clays are colloidal and have a swelling action of two (2) to three (3) times their volume, when wet. Bentonite is highly colloidal, having a swelling action of six (6) to eight (8) times its volume when wetted. Bentonite also slows up the reaction of the other ingredients in the formula, but its most important function is to make the finished mass impermeable.

The caustic lowers the surface tension of the solution, thus increasing the penetrating power of the mix into the formation, and aiding dispersion of the clay.

The lead oxide (litharge) acts as a negative catalyst, aiding in slowing the reaction of the chemicals to give a gradual set.

The calcium chloride causes further swelling

of the material and thus more effective sealing power. It also heats the solution, thus lowering the viscosity and gives the solution more penetrating power. Most important, however, it takes the moisture out of the mud and retains it to be utilized in the setting of the cement in the mixture, thus allowing the material to not dry out too rapidly and thereby cause large cracks ordinarily experienced in the dehydration of muds.

The calcium oxide (unslaked lime) gives off considerable heat and thus lowers the viscosity of the mixture, forming a calcium hydrate, thus making the finished mass further impermeable.

After a given amount of the composition, say seven (7) tons, has been forced through the tubing, under the pressure mentioned, to-wit, 750 to 1,000 pounds per square inch, I clean the tubing by forcing water therethrough. The composition is then allowed to set for a period of 96 to 120 hours, whereupon the tubing may be removed and a suction bailer used for removing the composition within the casing.

In the use of the composition of my invention for the purpose of regaining or re-establishing circulation, where circulation is lost during a rotary drilling operation of the usual type, to-wit, where a fish tail bit is being rotated through the medium of the usual drill pipe and rotary mud forced downwardly through the drill pipe, out the fish tail, and back between the well hole and the periphery of the drill pipe, the mud may deviate or be lost in the formation, particularly in water sands. In fact, it is difficult to regain circulation when it is once lost by ordinary methods now known. However, with my invention, I have found that the composition, properly used as herein described, will permit circulation to be regained. To do this, I pump my composition downwardly through the drill pipe and into the cavity or sands where circulation is lost. The composition is allowed to stand twenty-four hours, more or less, which will build up a wall preventing the rotary mud from penetrating the cavity or sands. Thereafter, drilling may be continued as usual.

I claim:

1. A composition for use in oil wells comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with cement, calcium chloride, unslaked lime, bentonite, litharge and caustic, which upon the addition of free water undergoes a chemical change and hardens into a water impermeable mass.

2. A water shut-off composition comprising the following approximate parts by weight: 100 parts of clay of the Frazier Mountain and Mojave types in the form of a colloidal jelly, 10.5 parts of cement, 11 parts of calcium chloride, 8 parts of unslaked lime, 8 parts of bentonite, 0.5 part of litharge, and 0.05 part of caustic.

3. A water shut-off sealing composition for wells comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with cement which upon the addition of free water will undergo a chemical change and set into a water impermeable hardened mass.

4. A water shut-off sealing composition for wells comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with bentonite and cement which upon the addition of free water will undergo a chemical change and set into a water impermeable hardened mass.

5. A water shut-off sealing composition for wells comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with bentonite, cement, and a caustic to lower the surface tension when the composition undergoes a chemical change and sets into a water impermeable hardened mass by the action of free water.

6. A water shut-off sealing composition for wells comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with bentonite, cement, a caustic to lower the surface tension when the composition is admixed with free water, which composition undergoes a chemical change and sets into an impermeable hardened mass by the action of free water, and litharge for slowing up the chemical reactions between the various ingredients of the composition and the free water to give delayed permanent water impermeable set in said final composition.

7. A water shut-off sealing composition for wells comprising a clay of the Frazier Mountain and Mojave types and addition agents homogeneously admixed therewith to form with water a highly colloidal plastic jelly having a specific gravity lying between 1.635 and 1.955, and a weight in pounds per cubic foot lying between 102 and 122; said addition agents comprising cement, bentonite, a caustic to lower the surface tension of the fluid composition and increase the penetrating power thereof, litharge for slowing the reaction of the chemicals to give a gradual set, and calcium chloride to lower the viscosity of the composition.

8. A water shut-off sealing composition for water bearing strata comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with bentonite, litharge and a cement which with the addition of free water undergoes a chemical change and sets into a water impermeable hardened mass.

9. A water shut-off sealing composition for water bearing strata comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with cement, calcium chloride, unslaked lime, bentonite, litharge and caustic which on the addition of free water undergoes a delayed chemical change and sets into a water impermeable hardened mass.

10. A water shut-off sealing composition for water bearing strata comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with cement and calcium chloride which upon the addition of free water undergoes a chemical change and sets into a water impermeable hardened mass.

11. A water shut-off sealing composition for water bearing strata comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with cement and unslaked lime which upon the addition of free water undergoes a chemical change and sets into a water impermeable hardened mass.

12. A water shut-off sealing composition for water bearing strata comprising a colloidal jelly of clay of the Frazier Mountain and Mojave types combined with cement and caustic which upon the addition of free water undergoes a chemical change and sets into a water impermeable hardened mass.

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