

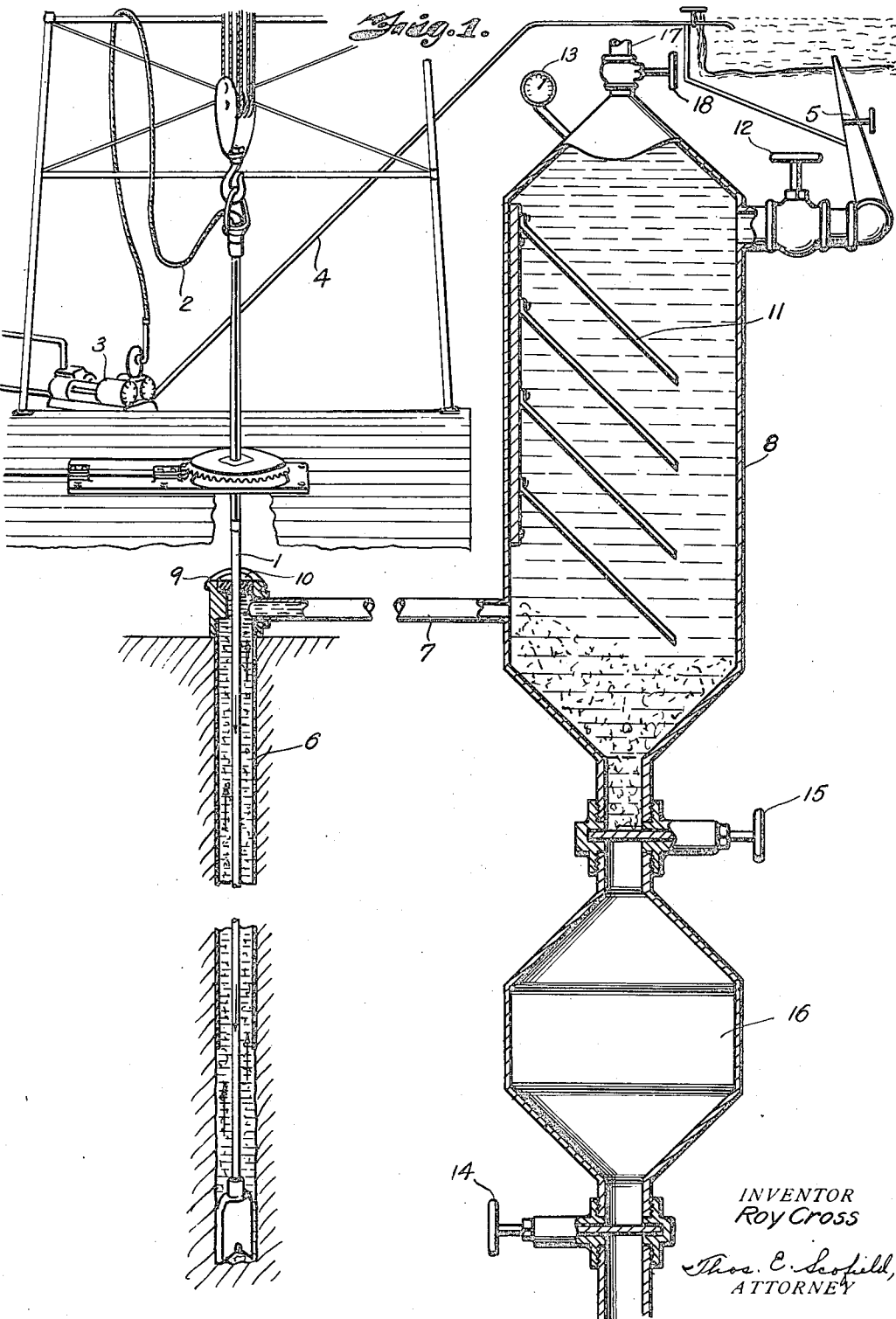
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OIL WELL DRILLING

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OIL WELL DRILLING

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This invention relates to improvements in oil well drilling fluids and methods of using same, and refers more particularly to the use of a gelatinizing material in connection with water to be used as a circulating fluid in connection with rotary drilling rigs particularly as adapted to the drilling of oil wells.

Briefly, the novelty of the invention includes the use of a viscous fluid of low specific gravity, which prevents the loss of the liquid into porous formations through which the well is drilled; provides a fluid which has lubricating properties both to the circulating pump and drill bit; provides a corrosion inhibiting fluid; a fluid which is not easily gas cut and one which has a relatively greater specific heat than the ordinary mud laden fluids used; a fluid which has a relatively smaller percentage of solids than mud laden fluids heretofore employed and one which serves to maintain, without loss of circulation, a head of liquid above the gas in the well thereby reducing to a minimum the probability of gas pressure blowing out the liquid head; also the use of this drilling fluid of high viscosity and low percentage of solid matter in connection with a device for maintaining pressure on the circulating fluid as it comes from the well and for removing the bit cuttings while the fluid is under this pressure.

In the usual rotary system of drilling oil wells, a hollow rotary drill pipe is attached to a bit by means of a revolving table at the top of the well. A continuous stream of mud laden fluid is forced by means of a slush pump or mud hog through the drill pipe to the bottom of the hole and returned to the surface between the drill pipe and the casing, carrying with it the cuttings from the face of the bit. This mud laden fluid usually contains 30 pounds or more of solid matter or dry material from which the mud is made, for each 100 pounds of the mud laden fluid. It is necessary to have this large amount of solid matter in order to suspend and carry away the cuttings and to give the proper viscosity so that there will be no excessive sedimentation of the mud.

In the drawing, Fig. 1 is a diagrammatic showing of the upper end or head of an oil well casing connected to a cuttings separator and slush pump to create circulation of the mud laden fluid.

Referring to the drawing, 1 represents a drill pipe into which the fluid is introduced through a pipe 2, by means of a slush pump or mud hog 3. The suction side 4 of the slush pump 3 may draw its charge from a pond or pool of material or may take the return fluid as discharged from the separator through the pipe 5. In any event, provision must be made for adding additional liquid or solid matter to the circulating stream. Such liquid and solids are added preferably after the circulating drilling fluid is discharged from the separator itself and prior to the re-introduction of the drilling fluid to the drill pipe by means of the pump 3.

At 6 is shown a well casing in which the fluid rises after being discharged from the bottom of the drill pipe at the face of the bit. The annular space between the casing 6 and the drill pipe 1 is filled with drilling fluid which is returned due to the pressure of the circulating pump 3. This fluid is discharged through the pipe 7 into the separator 8, the casing being capped by a suitable casing head 9. The turning drill pipe is preferably packed with a packing gland 10, through which if desired, some of the fluid may be passed. In the container 6 there may be arranged, inclined at an angle as shown and spaced relatively close together to act as a screen or diverting mechanism for the cuttings, a plurality of thin rods 11.

The fluid accumulating in the separator rises and is discharged through the pipe 5, controlled by a valve 12. This valve is used to maintain whatever back pressure may be desired upon the circulating system. A pressure gauge 13 is provided for indicating the pressure, or an automatic pressure arrangement may be used to manipulate the valve 12 in order to maintain any predetermined desired pressure upon the separator and circulating system.

As suggested, the fluid discharged through the pipe 5 is diverted to a slush pond or

direct to the suction side of the circulating pump 3.

The cuttings separated out by means of the system of rods arranged in the separator as well as by reason of the slowing down of the stream of fluid in the relatively large chamber or separator 6, gravitate downwardly and accumulate in the bottom of the separator. These cuttings may be withdrawn when there is considerable pressure on the system by keeping the valve 14 closed and the valve 15 open. Thus, when the cuttings have accumulated in the lower chamber 16, the valve 15 is closed and the lower valve 14 opened so that the cuttings are taken off without affecting the pressure on the system. In the top of the separator is provided a drawoff pipe 17 controlled by valve 18, by means of which any accumulated gas may be taken off from time to time, or excessive pressures relieved.

One of the purposes of the present invention is to replace the usual oil well mud with a material that will give an equal viscosity with a very small fraction of the amount of solid matter. In other words, it will have the same or better effect in carrying away cuttings than the ordinary mud laden fluid. In fact, it has a superior value over ordinary mud laden fluid in every respect, and one of the purposes of this invention is to supply in conjunction with this superior drilling fluid a means of dispensing with the requirement for a high specific gravity or a heavy weight per gallon. It is not the purpose of this invention to supply a drilling fluid substantially heavier than a plain water drilling fluid. This fluid does not have the excessive weights of the mud described in the Stroud Patents 1,575,944 and 1,575,945.

In this invention bentonite is used as a generic term for such substances as well as for the natural material.

Drilling fluids have a great many advantages over the ordinary mud laden fluids and over mud laden fluids containing weighting materials. The following will suffice to explain some of the advantages.

(1) In a typical case, for example at Santa Fe Springs in California, when a mud laden fluid is made the dry material costs about \$4.50 per ton. It is necessary to haul this material to the well. To make a mud laden fluid of the ordinary consistency required, 30 pounds of the dry material is used for 100 pounds of the fluid. This is probably the best mud laden fluid made in California, the dry material being known as "slough mud". In the case of bentonite referred to above the same viscosity may be obtained by the use of only three pounds per 100 pounds of drilling fluid. It is, therefore, ten times as effective and, if the one material is worth \$4.50 per ton, the treated bentonite is worth at least \$45 per ton without considering the other superior qualities of the treated ben-

tonite nor the labor costs in handling the material.

(2) In many instances it is necessary to haul the mud considerable distances, often 100 miles or more. The transportation costs, therefore, on the treated bentonite are approximately one-tenth of the transportation costs of the ordinary mud. In most places, as a matter of fact, the mud costs very much more than \$4.50 per ton.

(3) An ordinary "twelve pound" mud laden fluid weighs about 50 per cent more than the drilling fluid set out in this invention and, for this reason, a correspondingly greater amount of work is done in circulating and the cost of pumping is very much greater. The saving in power over mud laden fluid has been observed in many cases to be considerably more than ten per cent.

(4) The saving in power is not entirely due to the lower weight of fluid to be handled in the case of the present drilling fluid, since treated bentonite has a peculiar action in lubricating the slush pump, drill bit and the drill pipe, making it very much easier to turn because of this lubrication. This saving alone is usually sufficient to pay the entire cost of the treated bentonite drilling fluid.

(5) Bentonite is neither acid nor caustic, but it has sufficient alkalinity without an excessive amount of electrolytes to effectively prevent corrosion of metal parts. It even makes possible the use of weighting materials, if weighting materials are ever justified, of the nature of hematite, which normally is very corrosive or conducive to active corrosion of metal parts. The treated bentonite almost completely overcomes any corrosive action when mixed with iron oxide or hematite.

(6) Bentonite drilling fluid as herein set out, based on experience, has been the most effective agent yet encountered in restoring lost circulation in drilling oil wells. Therefore it has been most effective at holding back gas and water, because it more effectively and continually maintains the head of liquid against the gas. In practically all cases, the loss of head or loss of circulation in an oil or gas well is the cause of a gas blowout, so that bentonite acts as an insurance against loss of circulation and maintains a sufficient head of drilling fluid above the gas and between the drill pipe and the casing. There is no gas pressure district that has a pressure greater than 50 pounds for each 100 feet of depth. Very few, if any, gas wells have a pressure more than 40 pounds for each 100 feet of hole. It is perfectly apparent, then, that ordinary weighting material is not so much required to prevent gas blowouts as for the constant maintenance of a liquid head. A water head alone is ordinarily sufficient insofar as the weighting element is concerned, so long as the hole is full of water,

but the water head does not give the other necessary features. It is rather apparent that the weight of a water head will be sufficient to hold in gas. Otherwise most of the gas entrapped in the earth would have escaped, since it is held there by reason of hydrostatic heads. Bentonite in all probability prevents loss of circulation because when treated properly with limited quantities of lime, magnesia, calcium silicate or related substances, producing approximately the same hydrogen ion concentration, it forms a gel of very fine texture from which the water does not separate as it does with the ordinary mud laden fluid. For example, this gel tends to hold water from passing through a filter paper, or will pass through the filter paper with the water. This avidity for the water therefore prevents the loss of water out into porous formations, as is the case with the ordinary heavy mud laden fluid which is not of the nature of a finely textured gel.

(7) The same behavior of bentonite drilling fluid is of great advantage when the producing formation has been reached in rotary drilling. In the ordinary rotary mud laden fluid there is a sucking action due to capillarity on the water, which draws the water into the sand and leaves the caked mud on the outside. This penetration of the water into the interstices of the sand forces the oil back, often to very great distances, so that when the well is ready for production there is considerable interference with the proper flow of the oil into the hole. In the case of this drilling fluid, however, the gel condition of the drilling fluid prevents penetration of the water to any great distance and, therefore, the oil is not forced back; as a thin gel seal is produced in the exposed sand surface. When drilling is stopped and it is desired to bring in the well, with the ordinary mud laden fluid it is found that there has been an excessive occlusion by water. It has been found by actual experience in California that wells in which present drilling fluids have been used have always come in with as large, and in most cases a very much larger, production of oil than in those instances in which the ordinary mud laden fluid has been used. While the driller has sometimes found it advisable to clean out his ordinary mud laden fluid and prepare the present fluid when the producing horizon has been reached, this is eventually found unnecessary, since the cost of drilling with the bentonite drilling fluid is less from the very start, this drilling fluid being superior at all stages of the drilling.

(8) On account of the peculiar gel-like texture of the treated bentonite drilling fluids there is less tendency for the drilling fluid to be subject to what is spoken of as "gas cut." If the gas begins to pass out into the fluid it destroys in time the head of the fluid. With bentonite the small amount of mineral matter

is less conducive to the holding of the gas. In the case of ordinary mud laden fluids the gas tends to build up on each particle of mud, possibly by adsorption, and as the mud approaches the surface the gas is released and the head is thus gradually destroyed, since the action is cumulative.

(9) As set out, the drilling fluid set forth by the present invention is superior to ordinary mud laden fluids in all respects except in weight per gallon, which gives added pressure with the same head of fluid. It has been pointed out that it is practically never necessary with proper care to carry more pressure than that which would be given by water and, also, that there is very little danger of loss of head when the present drilling fluid is used. However, as an extra insurance against loss of head and gas blowouts, an apparatus such as is shown in Fig. 1 may be used in connection with the present fluid. By means of this apparatus and the slush pump it is perfectly apparent that any desired pressure may be carried against the pressure of any gas or water formation that will be encountered. This apparatus may be used without carrying any pressure, if desired, and the moment that there is any tendency for the drilling fluid to become gas cut, or the moment any gas shows as at the tip of the casing, it is only necessary to turn the valve or pinch in the valve opening to develop whatever pressure may be required to prevent a blowout. At the same time any gas collected in the receiver may be removed and the cuttings may also be removed under any pressure desired. It is obvious that this equipment eliminates any necessity for a heavy weighting material during the drilling of the well.

(10) It may be also pointed out that in the use of bentonite drilling fluids it is possible to have a fluid of a higher viscosity, and yet capable of being pumped, than is possible with any ordinary mud or weighted mud. This makes it possible to have a much superior effect in the present drilling fluid in preventing caving of the hole. It also is not so subject to dilution by water coming into the open hole. It is also very much superior in carrying out the cuttings; and from drilling fluid of this type low in solids the cuttings, particularly with the device set out in Fig. 1, are removed with greater ease.

While the general term bentonite has been used, it is to be understood that bentonite refers to any substantially neutral or slightly alkaline material that forms a viscous mixture with water and having a relatively small amount of solid material, for example, less than 20 per cent. As a general thing, it is desirable that the solid matter in the drilling fluid be less than 10 per cent, through the most desirable fluid has solid matter even less than four per cent.

(11) The oil well drilling fluid of a viscosity

such as disclosed in this application has the important feature of a considerably greater specific heat than the ordinary mud laden fluid and, for that reason, it is possible to keep the bit at a lower temperature and to drill at a faster rate. Another reason for the ability to keep lower temperatures is the fact that in the heavy mud laden fluid the contact with the metal is not as close as in the case of the present drilling fluid. Regardless of the explanation it has been observed that in deep wells the bit may be kept cooler with the present method than with the former mud laden fluid.

I claim as my invention:

1. A step in the circulation of oil well fluids using rotary drilling equipment which comprises discharging the drilling fluid from the well into a receptacle on which pressure is maintained while the cuttings are being separated.

2. The process of preventing gas blowouts during the drilling of oil wells which comprises carrying pressure on a receptacle into which the drilling fluid is discharged and separating the cuttings in such receptacle.

3. The process of circulating mud laden fluid in oil wells being drilled with rotary equipment comprising the steps of pumping to the drill bit face and back while maintaining a predetermined pressure on the circulating fluid including that portion of the system in which the cuttings are separated from the fluid.

4. A process of circulating drilling fluid in rotary driven oil wells comprising the steps of creating a pump circulation to the drilling face and back to the pump, separating the cuttings from the fluid under pressure, reducing the pressure subsequent to removing the cuttings.

In testimony whereof I affix my signature.
ROY CROSS.