

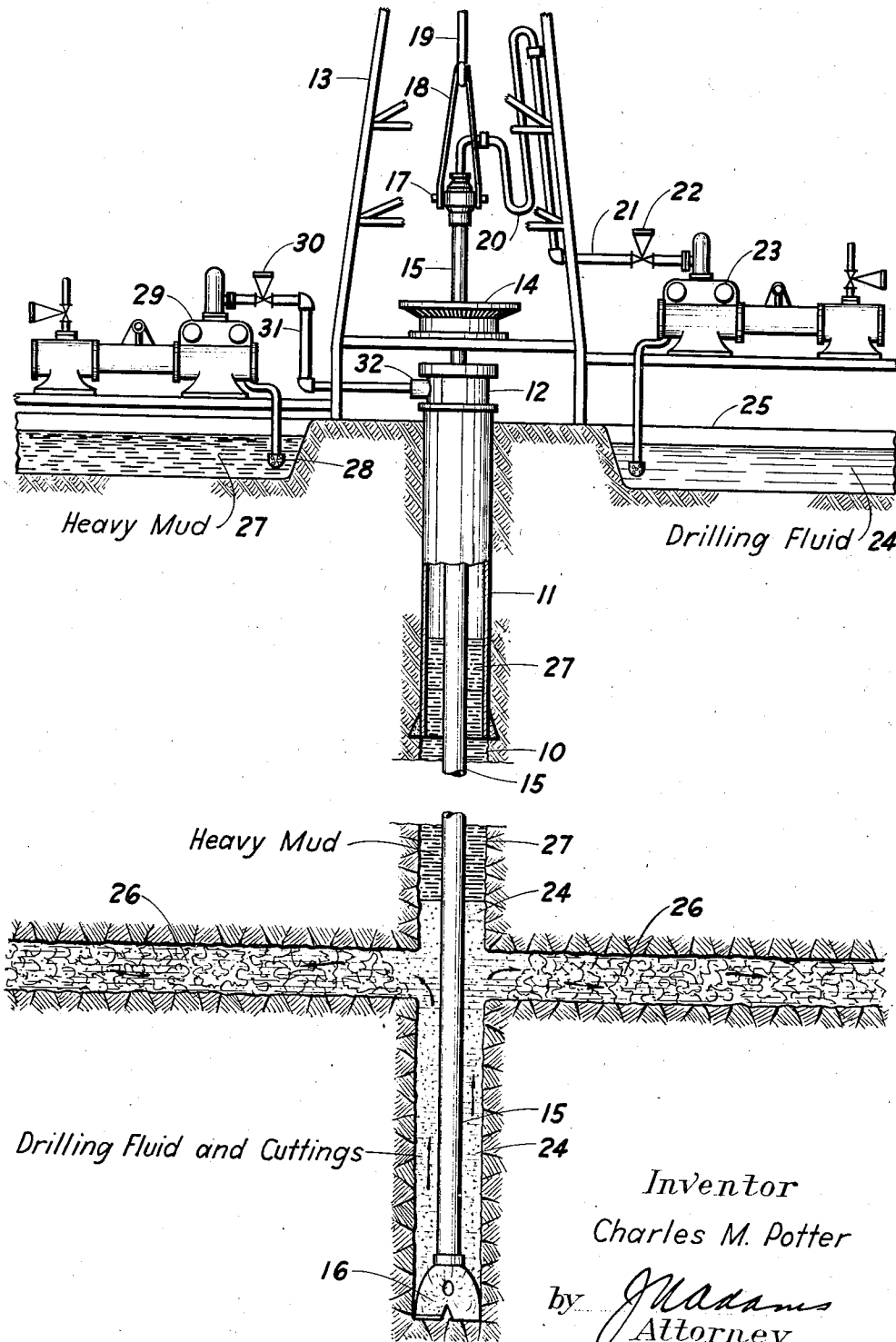
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METHOD OF DRILLING WELLS

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METHOD OF DRILLING WELLS

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4 Claims. (Cl. 255—1.8)

This invention relates to an improved method of drilling wells with rotary equipment through cavernous or porous formations, and particularly refers to a method of introducing two different mud-laden fluids into the well during the drilling operations.

In the drilling of well bores, particularly those for the production of oil and gas, porous or broken formations and sometimes actual caverns are penetrated, some of which may carry large quantities of water that interferes greatly with the maintenance of an adequate hydrostatic head on the formation being penetrated, on the characteristics of the drilling fluid, and also the disposal of the cuttings from the drill bit. If the conventional method of circulating mud fluid is used, the fluid either becomes lost in the formation or is so diluted and contaminated by the fluids entering the well that it becomes useless for carrying the drill cuttings to the surface. Under some circumstances such formations may be sealed off from the rest of the well by the introduction of cement or various materials which will coagulate or precipitate in the porous formation. Such treatments are effective where pressures are low and the extent of the porous or cavernous formations is limited, but occasionally these are of such a nature that no practical method of sealing can be found.

This invention comprehends broadly the utilization of the exposed cavernous formation to receive the actual drilling fluid together with the drill cuttings from the bottom of the well bore. Under most circumstances it is necessary to use a second fluid as a substantially stationary "cap" above the fluid which is being passed outwardly into the porous or cavernous formation, the cap serving to overcome the hydrostatic head of the water that normally flows out of that formation into the well bore. This cap may thus be considered to "float" on the flowing drilling fluid, which may be water or a very thin mud. The cap material is usually a heavy and very viscous mud, in some cases almost a gel and, in the majority of cases, may be made from water, a colloidal material, such as bentonite, and a weighting material, such as finely ground barytes. The height of this column in the well bore obviously depends on the location of the cavernous formation, the hydrostatic pressure of the liquid in that formation, and the pressure necessary to "put away" the drilling fluid and cuttings into the cavernous or porous formation.

It is an object of this invention to provide a method of drilling wells through porous or

cavernous formations in which a floating mud cap is used above that formation and drilling fluid introduced through the drill pipe passes upwardly around the latter and thence outwardly through the porous formation instead of to the surface.

Another object is to provide a method of drilling wells in which a cap of heavy mud is used in the upper part of the well bore to overcome high hydrostatic heads of fluid in the lower part of said bore, this cap being substantially stationary and left in place during the introduction and withdrawal of the drill pipe and bit.

Another object is to provide a method of drilling wells in which a relatively thin mud or water is used for the actual drilling operations, thereby preventing the formation of mud rings in the lower part of the well bore, and at the same time putting away the cuttings into a porous formation between the bottom of the bore and the surface of the earth.

Another object is to provide a method of drilling wells in which the so-called "circulation" takes place below a stationary body of heavy mud in the upper part of the well, thus reducing the distance through which the cuttings must be lifted by the circulating fluid. In this regard the word "circulation" may be a misnomer as the actual drilling mud is never returned to the surface of the ground or to the pump but is put away into a subsurface porous or cavernous formation.

These and other objects and advantages of the invention will be further apparent from the following description and from the accompanying drawing which illustrates a preferred mode of application of the invention.

The drawing is a vertical and part sectional view of a drilling well which has traversed a porous or cavernous formation into which the cuttings from the bore below that formation are to be placed.

In the drawing, reference numeral 10 illustrates generally the well bore, the upper portion of which is cased by a suitable conduit 11 at the upper end of which is a casinghead 12. A conventional derrick structure 13 supports a rotary table 14 driven by suitable means not shown and adapted to rotate a drill pipe 15, the latter extending downwardly to the bottom of the well and terminating in a drill bit 16.

At the upper end of drill pipe 15 is a conventional swivel 17 provided with balls 18 supported by the hook of a traveling block 19. A flexible hose 20 is connected between swivel 17 and the

discharge piping system 21 through valve 22 to pump 23. A suitable source of drilling fluid 24 is provided in sump 25 so that the drilling fluid 24, which may be water, oil or a very inexpensive light mud material, may be continuously supplied to drill pipe 15 and drill bit 16 to carry away the cuttings from the latter.

Among those formations which are penetrated by bore 10 is one designated 26, which is porous or cavernous, these terms being considered to be substantially equivalent in this specification. Formation 26 may or may not contain salt water or other fluid under high pressure but it is of such a nature that substantial quantities of drilling fluid 24, together with the cuttings from drill bit 16, may be forced into it under suitable hydrostatic pressure. In this example the hydrostatic pressure necessary to force the drilling fluid 24 and the cuttings into formation 26 is supplied by means of a "floating mud cap" 27 in bore 10 between formation 26 and the surface of the earth. The depth of this cap obviously depends upon the location of formation 26, the hydrostatic head required, and those other factors which will be apparent to one skilled in this art. The heavy mud 27 which comprises the mud cap is desirably supplied from a separate sump 28 and is introduced at intervals as it is required by means of a pump 29 through valve 30 and line 31 into the side outlet 32 of casinghead 12.

It has been found that a floating mud cap of this kind is not destroyed by the introduction and removal of drill pipe 15 and drill bit 16 during the normal operations attendant to drilling. Also, the use of such a cap removes the necessity for drilling under pressure or for snubbing in the drill pipe where high hydrostatic pressures are encountered in the formations.

Another advantage that has been noted is the separate control of the viscosity and weight of

the fluid 24 actually used for drilling which may be entirely independent of the viscosity and weight of the mud cap material 27.

Although a single arrangement of apparatus 5 for carrying out this method and only one mode of procedure have been described and illustrated, it is obvious that many changes could be made without departing from the invention and all such changes which come within the scope of the appended claims are embraced thereby.

I claim:

1. A method of drilling a well bore with a drill pipe and drill bit below cavernous or porous subsurface formations comprising the steps of continuously feeding a drilling fluid downwardly through said drill pipe and bit, passing said fluid together with cuttings from said bit upwardly around said pipe within said well bore, maintaining a substantially stationary cap of heavy mud on the fluid in said bore to impose a predetermined hydrostatic head thereon and passing said drilling fluid and cuttings outwardly from said bore under said hydrostatic pressure into a cavernous or porous formation below said cap.
2. A method of disposing of drill cuttings from a well bore below a porous or cavernous formation comprising the steps of pumping a first fluid into said bore below said formation, and maintaining a substantially stationary cap of a second fluid in said bore above said formation to impose sufficient hydrostatic head on said first fluid to cause it to carry said cuttings into said formation.
3. A method according to claim 2 in which said second fluid has a higher density than said first fluid.
4. A method according to claim 2 in which said first fluid is water and said second fluid is a weighted mud.

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