Feb. 25, 1941. H. J. HAWTHORNE 2,233,260

MEANS AND METHOD OF DRILLING WELLS

Filed April 12, 1938 2 Sheets-Sheet 1

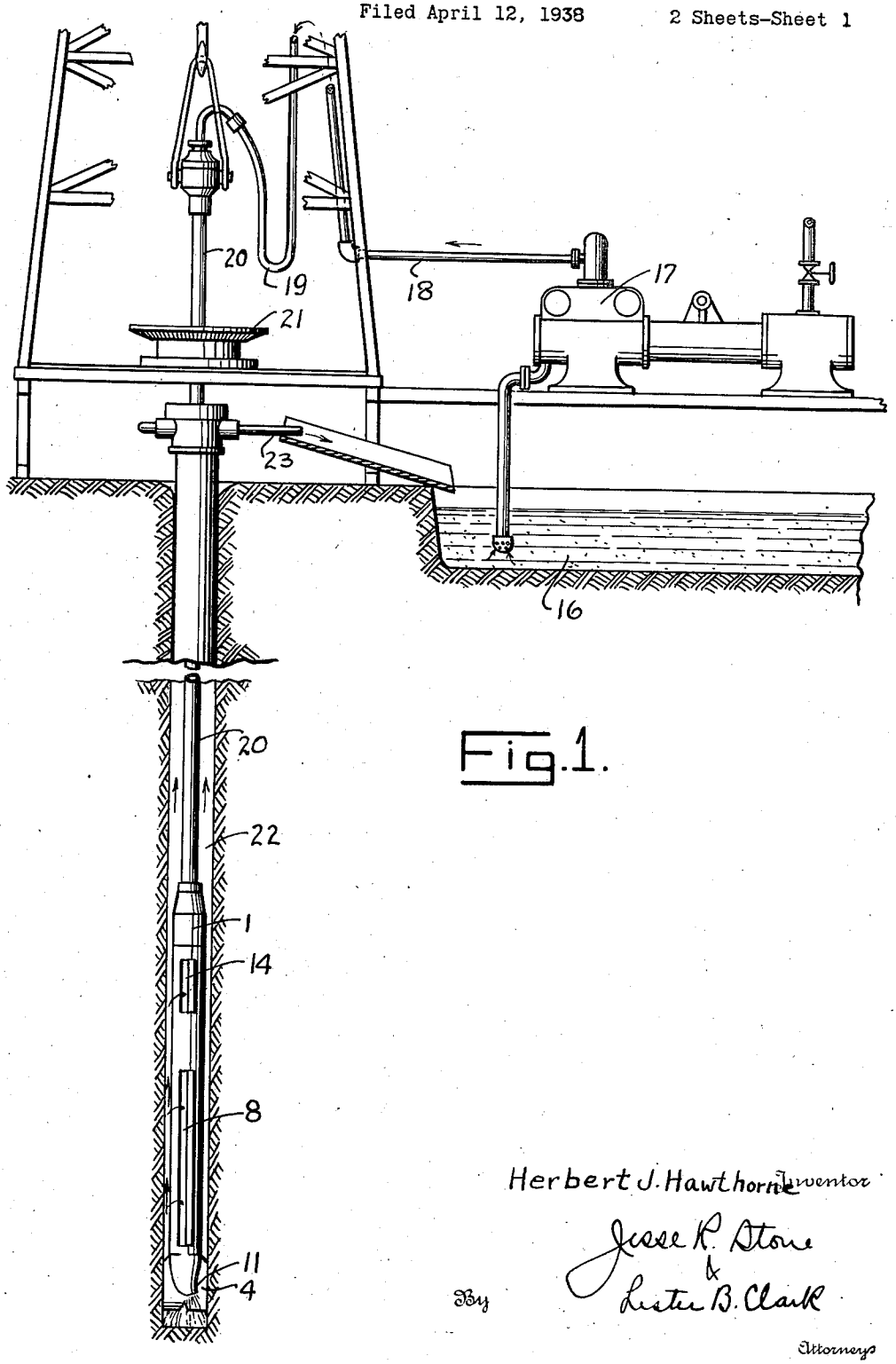

Fig. 1.

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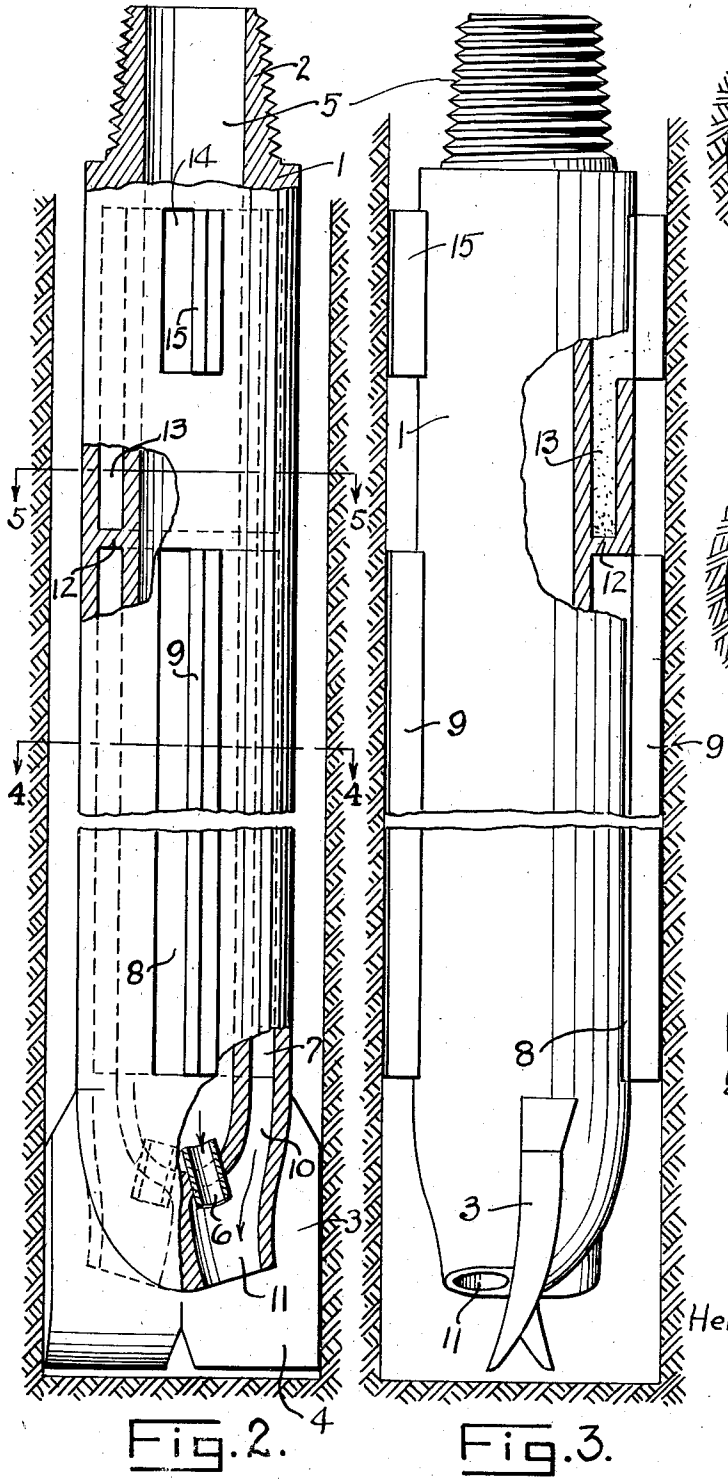

Fig. 2. Fig. 3.

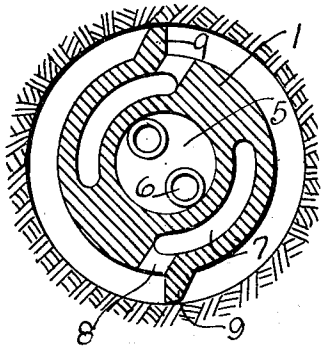

Fig. 4.

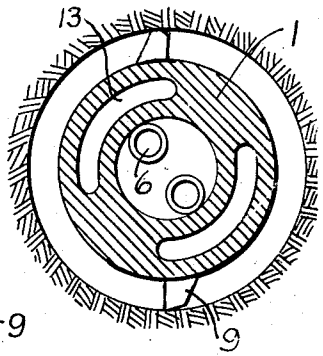

Fig. 5.

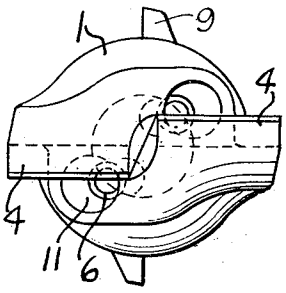

Fig. 6.

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UNITED STATES PATENT OFFICE

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MEANS AND METHOD OF DRILLING WELLS

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Application April 12, 1938, Serial No. 201,584

5 Claims. (Cl. 255—24)

My invention relates to apparatus for and method of drilling deep wells for oil, gas, and the like.

In the modern system of rotary drilling the well is normally drilled by a drill bit having cutters thereon which cut into and disintegrate the formation at the lower end of the bore hole and the cuttings from the bit are carried upwardly to the surface by means of a stream of heavy flushing fluid which is pumped downwardly through the drill stem and the drill against the bottom of the hole. This stream of flushing fluid flows upwardly in the bore or outside the drill stem and is discharged into the settling pit at the surface. Heavy pumps are employed for circulating the flushing fluid on its route downwardly through the drill stem and upwardly in the bore hole to the settling pit, said pumps working at high pressures. In modern drilling the mud pumps are equipped to pump the mud into the hole under pressure of from five hundred to one thousand pounds per square inch. It is hence discharged through the drill bit against the bottom of the hole with great force. In drilling soft formations the action of the flushing fluid on the bottom of the hole to assist in disintegrating the material being drilled is of material assistance in the drilling operation.

It is also to be noted that in drilling deep wells heavy and powerful machinery must be provided to rotate the drill at great depths. Wells in the neighborhood of two miles deep are not unusual. When the drill becomes dull or it becomes necessary for any reason to withdraw the drill stem from the hole a material amount of valuable time is consumed in coming out and going back into the hole.

It is an object of the invention to provide a drill and a method of operating the same which will enable the driller to maintain his bit in operating condition for long periods of time without the necessity of withdrawing the drill.

It is another object of the invention to provide a drill bit which will operate without excessive torque upon the drill stem, thus making it possible to operate the lighter equipment and with a much less expenditure of power in the operation of the drill.

It is another object of the invention to enable the driller to act upon the formation at the bottom of the well by an erosive action of abrasive material which will cut away the bottom of the hole with little cutting action of the bit itself.

I desire to provide a drill bit having cutters thereon which act normally to preserve the gauge of the hole and to stir up the cuttings, dependance being placed largely upon the erosive action of the flushing fluid for wearing away the material at the bottom of the hole.

I also desire to provide a drill bit having provision for delivering into the stream of flushing fluid of particles of abrasive material which act to wear away the material being drilled. The details and advantages of my invention will be more clearly understood by reference to the drawings herewith wherein:

Fig. 1 is a diagrammatic representation of an installation whereby my drilling process may be accomplished.

Fig. 2 is a side view of a drill bit constructed in accordance with my invention, certain parts being broken away for greater clearness.

Fig. 3 is a view similar to that shown in Fig. 2 taken at right angles to the Fig. 2 showing.

Figs. 4 and 5 are transverse sections taken on the planes 4—4 and 5—5 respectively of Fig. 2.

Fig. 6 is a bottom plan view of the drill bit which I employ.

In carrying out my invention I use a drill bit having a head 1 with upper threaded shank 2 for attachment to a drill collar or drill stem in the usual manner. The head is somewhat elongated and has at its lower end a plurality of cutters. I have shown a soft formation type of bit having laterally extending blades 3 thereon, the forward cutting edges 4 of which engage with the bottom of the hole. The side edges of these blades engage the side wall of the hole and maintain the hole in proper gauge. While I have shown one type of drill bit it is to be understood that any desired form of cutter may be employed.

There is a central longitudinal chamber 5 through the drill bit for the passage of flushing fluid. This passage is closed at the lower end except for discharge nozzles 6. Said nozzles are shown as two in number, each nozzle positioned to discharge the flushing fluid along the forward face of the cutting blade 3 but not into contact therewith.

In the side walls of the head outside the fluid conducting channel I provide a plurality of compartments 7, which are intended to contain particles of abrasive material. As will be seen from Fig. 4 there are two compartments 7 placed opposite each other and above the cutting blade. Each compartment has a slotted opening 8 leading from the outside thereto and at the rearward edge of the slotted opening 8 is a reaming blade 9. As will be seen from Figs. 2 and 3 the slotted

opening with its reaming blade adjacent thereto extends upwardly from the bit a material distance. The lower end of each of the compartments 7 has a discharge opening 10 which leads downwardly past the fluid nozzle 6 and so that the particles of abrasive material passing downwardly from the compartments will be discharged with the flushing fluid at 11, downwardly against the bottom of the hole.

Above the lower compartments 7 in the bit and separated therefrom by a partition wall 12 are compartments 13 extending from said partition to the upper end of the bit. These compartments are closed except for an inlet opening 14 slotted in the side of the chamber and having adjacent thereto on the rearward side a reaming blade 15. It will be seen that a cross section adjacent the upper compartments 13 will appear the same as a cross section taken through the compartment 8 lower down the head.

The abrasive material which I contemplate using is broken up into granulated form so that it may be carried downwardly with the stream of flushing fluid and delivered against the bottom of the hole with great force.

The impact of these abrasive particles against the material will cut the said material away. I contemplate using diamond substitutes, such as particles of tungsten carbide, in this operation, but particles of carborundum, high speed steel, and the like, will also serve the purpose, the object being to deliver particles of material which are harder than the formation being drilled, thus acting to disintegrate the material of the formation.

The operation of drilling with my method will now be noted. With reference to Fig. 1 particularly, the drilling mud is taken from the slush pit 16 at the surface of the ground. A heavy mud pump 17 draws the mud up from the pit and discharges it through the pipe 18 and holes 19 into the upper end of the drill stem 20. The said drill stem is rotated by means of the rotary shown diagrammatically at 21, thereby communicating rotative movement to the drill bit 1 at the lower end of the well.

The flushing fluid which is pumped downwardly through the drill stem 20 and the drill 1 will be discharged, as previously described, through the nozzles 6 in front of the cutters of the drill and against the formation at the bottom of the hole. The cuttings will be washed back upwardly in the space 22 outside of the drill stem and will pass outwardly through the outlet 23 to the mud pit 16.

Particles of abrasive material such as has been noted will be delivered downwardly with the stream of flushing fluid and will be discharged against the bottom of the hole. Some abrasives such as tungsten carbide have a high specific gravity and will tend to settle out of the rising stream of flushing fluid outside the pit and will be carried by the reaming blade 9 around into the slot 8 and into the chamber 7 where it will again pass downwardly to the discharge nozzle. Where the hard material is light, however, it may rise with the mud and may be again introduced with the flushing fluid into the drill stem, thus continually making the circuit to the bottom of the hole and back. Particles of the heavier abrasive material which have become worn and broken up in use will be carried somewhat higher in the stream of flushing fluid before they will settle out in the upper chambers 13. These lighter particles of tungsten carbide will accumulate in the upper chamber 13 and will be removed therefrom when the drill bit is withdrawn from the hole. The heavy particles will, however, be used over and over again in the process of drilling.

When the drill is rotated the cutting blades 4 will be called upon to do very little of the drilling operation. They tend to preserve the gauge of the hole and to assure that the full bottom of the hole is cut away. The slight amount of actual drilling performed by the cutters of the bit will not tend to wear the cutters materially. It will be possible therefore to rotate the bit with a far smaller expenditure of power than under normal drilling conditions. A lighter drill stem can be used and lighter drilling equipment at the surface. It is desirable, however, that the pumps handling the drilling mud be powerful enough to deliver the flushing fluid with force sufficient to cut the bottom of the hole, when the particles of abrasive material are delivered thereto.

With this method of drilling it will be obvious that great economy in drilling machinery will be obtained, and furthermore the drill stem may remain in the hole for long periods of time without its being necessary to withdraw the drill bit to sharpen the cutters. The reaming blades which act to direct the abrasive material into the chambers 7 and 13 act also to maintain the gauge of the hole and a straight hole may be cut due to the fact that only a light weight is necessary upon the drill. The abrasive particles which are employed in the drilling operation may be used for a material length of time before they lose their cutting efficiency and new particles may be supplied in the stream of flushing fluid whenever it becomes necessary to do so. The method of drilling therefore leads to more speedy and continuous drilling and with a smaller consumption of power in operation. The further advantages will be obvious to those skilled in the art.

What is claimed is:

1. A drill bit of the character stated including a head for attachment to a drill stem, cutters on the forward end thereof, a central continuous imperforate fluid conducting chamber through said head, constricted discharge nozzles in the lower end of said chamber directed in front of said cutters, an abrasive containing compartment above each of said nozzles, each compartment having a narrow slotted upper opening to receive abrasive material and a lower discharge opening into which one of said discharge nozzles projects.

2. A drill bit of the character stated including a head for attachment to a drill stem, cutters on the forward end thereof, a central fluid conducting chamber longitudinally through said head, said chamber being imperforate except for discharge nozzles in the lower end of said chamber directed in front of said cutters, compartments in said head for containing particles of diamond substitute, means to direct particles into said compartments and a passage from each compartment to permit discharge by gravity of said particles therefrom into the path of fluid from said nozzles.

3. A drill bit of the character described including a head, an imperforate fluid passage therethrough, cutters at the lower end of said head, fluid discharge nozzles from said passage adjacent said cutters, abrasive containing compartments in the wall of said head above said nozzles, narrow longitudinal inlets to said compartments, and discharge passages for abrasive material from said compartments to said nozzles.

4. A drill bit for wells including a head, cutters on the lower end thereof, a fluid conducting

passage longitudinally of said head, discharge nozzles from said passage at the lower end thereof, compartments in said head for heavy hard particles, a slotted opening in each compartment to receive particles of abrasive material separating out from the material abraded from the well bottom, a reaming blade to the rear of each opening and a passage from said compartment downwardly to slowly feed said abrasive particles to the discharge nozzle below the same.

5. A method of drilling deep wells including rotating a drill therein, delivering a jet of flushing fluid against the bottom of the well under high pressure, feeding into said jet particles of heavy abrasive material to cut away the formation being drilled through the impact of said particles and fluid, circulating the fluid, cuttings, and particles, upwardly so that the heavier particles tend to settle from the rising stream, catching the particles of abrasive material adjacent said drill, and feeding such particles back through said drill to said jet for repeated use, and removing the material thus cut in suspension in said flushing fluid.

HERBERT J. HAWTHORNE.