

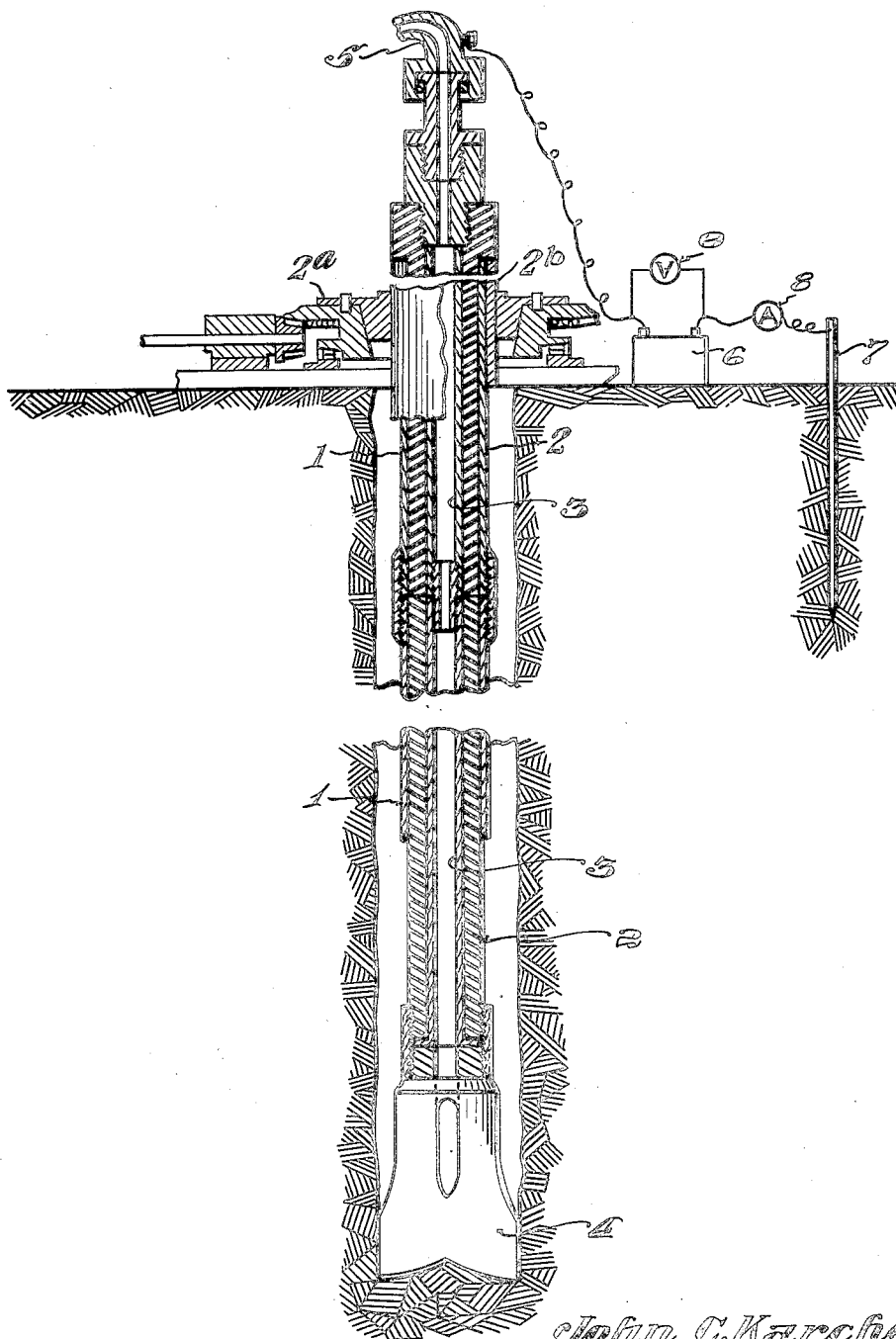
Sept. 19, 1933.

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1,927,664

METHOD AND APPARATUS FOR EXPLORING BORE HOLES

Filed Dec. 17, 1932



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1,927,664

METHOD AND APPARATUS FOR EXPLOR-
ING BORE HOLES

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Application December 17, 1932

Serial No. 647,766

7 Claims. (Cl. 175—182)

This invention relates to certain new and useful improvements in the art of exploring bore holes in the earth's surface and it has particular reference to apparatus designed to visibly disclose at the surface the nature of the formations during actual drilling operations.

The principal object of the invention is to obviate the time and expense of making tests by taking cores and samples which requires that the tools be withdrawn from the hole each time such a test is made. The present invention affords suitable indicating or signalling means located on the surface near the point of operations to visibly or otherwise disclose the nature of the formation continuously without suspending drilling operations.

Heretofore when drilling bore holes in search of minerals, petroleum and gas, particularly when drilling such holes with a rotary drilling device, it has been necessary, as stated, in order to make suitable tests of the formation, to stop the drilling operations and remove the drilling mechanism from the hole and then reinsert a mechanism for taking core, electrical testing or other mechanism; securing the desired information; removing said equipment; re-inserting drilling mechanism and proceeding with the hole. This results in considerable delay so that the time required to bore the hole may be several times as great as would be required if the drilling could proceed without interruption. The present invention provides for the making of observations to test the formations at the bottom of the hole while the drilling proceeds.

This invention provides a number of advantages:—First, that the drilling proceeds uninterruptedly; and secondly, that the drilling can be stopped in the desired formation at any depth and without danger of drilling through the formation. This latter advantage is very important in the drilling of oil and gas wells because if the wells are unknowingly drilled too deeply, they may drill into a water bearing formation below the oil or gas bearing sand and thereby make difficult or prevent the completion of a commercial well.

With the foregoing objects as paramount, the invention has particular reference to its salient features of construction and arrangement of parts which will become manifest as the description proceeds, taken in connection with the accompanying drawing, wherein:—

The figure illustrates the invention applied, in which the drill stem of a standard rotary boring machine is shown, together with the

conventional rotary table constituting the drilling mechanism.

In the figure, 1 designates the rotary drill stem usually made of steel tubing. This drill stem is lined with an insulating liner 2, which extends below the bottom limit of the drill stem 1 and engages the metal drill bit 4. This liner also serves as a bushing to insulate the mud and water swivel 5, from the drill stem proper. The rotary table is designated in the figure at 2a, through which passes the conventional Kelly joint 2b.

A conducting liner consisting of a metallic tube 3, passes the entire length of the drill stem inside of the insulating liner 2, and makes metallic connection between the mud and water swivel 5 and the metallic bit 4, so that an electric current can be made to pass from the battery 6, through the swivel head 5, to the drill bit 4. The electric current then flows into the earth around the bit 4, returning through a low resistance ground connection 7 through the ammeter 8 to the battery 6.

It is obvious that an insulated wire may be run through the drill stem and connected between the swivel head and bit with good results.

A voltmeter 9 is connected across the battery 6. If the voltage across the battery is substantially constant, such as will be the case provided the battery is of sufficiently large capacity and as will be indicated by the voltmeter 9, the amount of current flowing from the bit 4 into the ground will be determined by the resistance of the ground near the bit; because the greater portion of the electrical resistance in the circuit will be in the vicinity of the bit. This is clear, because the electrical connection from the battery to the bit is entirely metallic and consequently has very low resistance, and the return path from the bit to the ground connection 7 is of large cross-section, except in the immediate vicinity of the bit. The ground connection 7 is deliberately made of low resistance by use of a large number of metal rods driven into holes filled with charcoal and salt or other means of securing a low resistance ground connection. With this arrangement most of the resistance in the circuit is in the vicinity of the bit and substantially all the changes in resistance occur around the bit.

Instead of making a ground connection at 7 the electrical connection can be made to the outside of the drill stem 1 by means of a suitable sliding electrical contact on a turned surface of the drill stem and with equally good results.

The well known Wheatstone's bridge or an ohmmeter may be connected into the electrical circuit instead of the voltmeter, ammeter and battery.

Also, equally good results may be obtained by using the heavy metallic liner 3 inside the insulating tubing 2, and thus securing sufficient strength of the drill stem to permit the omission of the outside tube 1. With such an arrangement, of course, an outside ground connection such as 7 must be used. Also, either direct or alternating current may be used.

The invention is operated as follows: The bore hole is started in the usual manner and drilling proceeds by rotating the drill stem with the usual type of driving mechanism (not shown) and as the bit goes down, the voltmeter 9 and ammeter 8 are observed continuously, also, notation is made of the depth of the hole by observing the position of the drill stem. This information can be secured either manually or by means of suitable recording mechanisms for noting these several observations.

As the drilling proceeds the variation in the ratio of the voltage divided by the current will be a measure of the variation in resistance at the drill bit in the bottom of the bore hole.

If the bit is drilling in a formation which has low electrical resistance because of high mineralization and high water content, such as well clays, this ratio will be low. Likewise, if the bit passes into a sand formation or sandstone containing salt or other mineralized water, the observed ratio will continue to be low. If, on the other hand, the bit passes into a formation such as sandstone, containing oil or gas, which are insulators, the resistance in the vicinity of the drill bit will immediately rise with a consequent pronounced decrease in current, thus indicating the presence around the drill bit of a formation filled with oil or gas.

The drilling can then be stopped, the drilling mechanism removed, the hole lined with suitable casing and prepared for producing the oil or gas which has been found.

Manifestly, the construction shown is capable of some modification and such modification as is considered within the scope and meaning of the appended claims is also considered within the spirit and intent of the invention.

What is claimed is:

1. A method for continuously exploring bore holes during process of drilling, which consists in causing an electric current to flow through a conductor insulated from the drill stem of the hole drilling mechanism and connected to the drill bit to cause the current to flow from the drill bit into the earth from which said current is collected and then causing the current to pass through measuring instruments for purposes of observation.

2. A method for exploring the bottom of bore holes while in the process of drilling, characterized by causing an electric current to pass into the swivelhead of the rotary drill stem of the hole drilling mechanism, thence through a metallic conductor insulated from the earth, to the drilling bit, whereby the current will pass from

the drilling bit to the earth, thence to an electrical contact through electrical instruments to the point of origin and observing the variations in the current and in the voltage in time relation to the depth of the bore hole as the drilling proceeds.

3. A mechanism for exploring the bottom of bore holes comprising a drilling mechanism in combination with a drill stem having a metallic drill bit at bottom end insulated from said drill stem, means for making metal electrical connection to said drill bit from a point at the top of said bore hole, means for making electrical connection to ground outside of said bore hole and means for observing the variation in resistance between said connection to drill bit and said ground connection as drilling proceeds.

4. A mechanism for exploring the bottom of bore holes comprising a drilling mechanism in combination with a drill stem, means for producing an electric current, means for passing said current through the drill stem to the drill bit, whence it flows into the earth, means for collecting said current at the surface of the earth and means for measuring said current.

5. A mechanism for continuously exploring bore holes while in the process of being drilled, said mechanism comprising a source of electric current in combination with a rotary drilling machine, said drilling machine being provided with a drill stem containing a conducting liner being connected at the top of the ground to the source of electric current and to a metallic drill bit so that said current may pass through the drill stem to the drill bit without flowing into the earth before it reaches the drill bit, means for collecting said current outside of said insulator near the surface of the ground, means for measuring and recording the amount of said current and the amount of potential necessary to produce the same and means for determining the depth of the hole as the drilling proceeds in time relation to the current and potential measurements.

6. A method of exploring bore holes during the process of drilling, which includes the step of passing an electric current through the drill stem of said mechanism to the drill bit of said mechanism, insulating the electric current from the earth until it reaches said drill bit, to cause said current to flow into the earth through the drill bit, making connection with the earth for return of said current and observing variations in said current as drilling proceeds.

7. A method for exploring bore holes during the process of drilling which include the steps of initially making electrical contact at the top of the ground by means of an electrical conductor connected to the metallic drill bit of said mechanism, insulating said drill bit from the drill stem of said mechanism but maintaining contact with the earth at the bottom of the bore hole, making electrical contact with the earth outside of the bore hole and observing the variation in resistance between said insulated conductor and said earth contact as drilling of the hole proceeds.

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