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Jan. 6, 1942. F. W. JESSEN 2,269,269

WELL LOGGING

Filed July 15, 1940

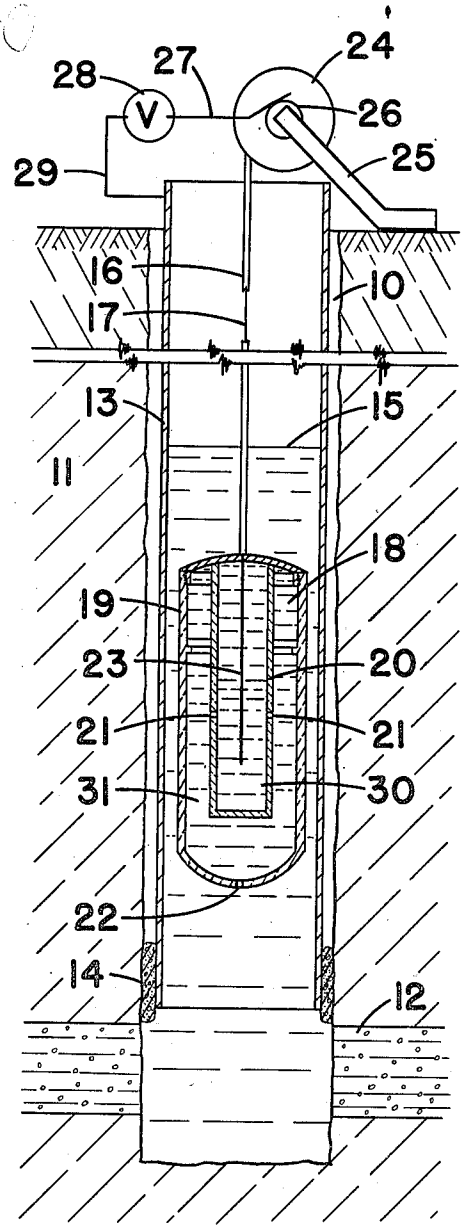


FIG. 1.

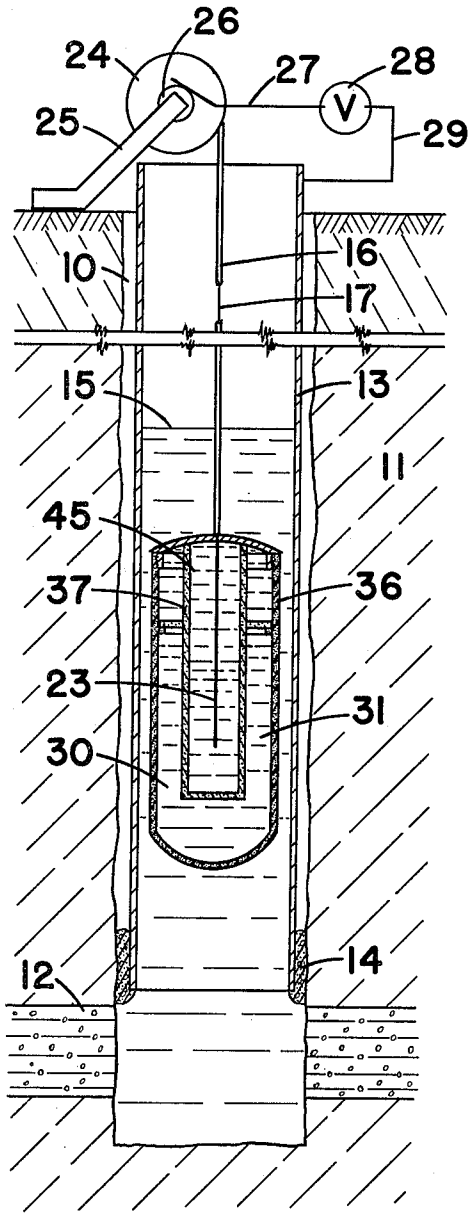


FIG. 2.

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UNITED STATES PATENT OFFICE

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WELL LOGGING

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6 Claims. (Cl. 175—182)

The present invention is directed to means and a method for determining the point of termination of a metal used in lining a conduit.

It is an object of the present invention to determine the casing seat of a cased bore hole.

It is another object of the present invention to determine the position in a string of pipe of a section of a pipe constructed of different material than the adjacent portion thereof.

It is a further object of the present invention to move a galvanic cell along the bore of a cased hole containing liquid to determine discontinuities in the metal used in the casing by observing fluctuations in the potential of the galvanic cell.

Other objects and advantages of the present invention may be seen from a reading of the following description taken in conjunction with the accompanying drawing in which:

Fig. 1 is a view, partly in cross section, of one modification of the present invention showing a galvanic cell in a bore hole containing fluid; while

Fig. 2 is another modification which may be used in practicing the present invention.

Referring specifically to the drawing and first to Fig. 1, a bore hole 10 penetrates non-producing formation 11 down to producing formation 12. The bore hole is provided with a casing 13 extending down to the producing formation 12, as is customary in the art, and provided with the conventional cement plug 14 at its lower end to prevent the flow of fluid in the space between the casing and the bore hole. The casing contains fluid, the upper surface of which is indicated by numeral 15.

Suspended in the bore hole by cable 16 containing a single conductor 17 is the galvanic cell or battery 18. The cell comprises an outer cup or shell 19 and an inner cup or shell 20. Fluid communication between the interior of shells 19 and 20 is maintained by means of openings 21 of capillary dimensions arranged in the shell 20. Fluid communication between the interior of shell 19 and the bore hole fluid is maintained by means of openings 22 of capillary dimensions placed in shell 19. Arranged within shell 20 is a conductor member 23 which is electrically connected to the conductor 17 arranged within the suspended cable.

At the surface of the ground a reel 24 supported by stand 25 and provided with slip rings 25 is arranged for supporting the cable so that the galvanic cell may be raised or lowered in the bore hole as desired. Conductor 27 electrically connects the slip rings to one side of a potentiometer 28, while the other side of the potentiometer is electrically connected to casing 13 by means of conductor 29. The interior of shell 20 has an electrolyte 30 placed therein, while the space between shell 19 and shell 20 has electrolyte 31 placed therein.

It will be evident that when shell 18 is lowered into the bore hole so that opening 22 is below the surface level 15 of the fluid in said hole, a complete galvanic cell or battery is formed and a potential will be set up in said cell and will be indicated by the potentiometer 28. The value of the potential will be dependent upon the size of the cell, the kind and concentration of the electrolytes used in the cell, and the material used for the conductor 23 as well as the material forming the casing of the well. If the shell is removed from the neighborhood of the casing, the cell becomes incomplete and a change in potential will occur.

It will be apparent that as long as the shell 18 is lowered in the casing the distance between opening 22 and the metal of the casing is substantially constant. If only one metal, for example steel, is used for constructing the casing, the potential indicated by the potentiometer will remain substantially constant as long as the shell is submerged in liquid in the casing. When the shell 18 passes below the bottom of casing 13, the distance between opening 22 and the metal of the casing will be increased and will cause a change in the potential indicated by instrument 28 located at the surface of the earth. In this manner, the lower end of the casing or the casing seat, as it is commonly called, may be easily and readily determined.

Another application of the present invention is in the determination of a portion of a conduit which is constructed of different material than the remainder. It is known to the art at the present time to insert a length or several lengths of pipe in the string of pipe used in casing wells which is of different metal than the remainder of the casing. Pipes constructed of metal, such as aluminum, magnesium or alloys of these metals are much more readily drillable than are pipes constructed of ferrous materials. It is sometimes desirable to insert lengths of pipes made of these drillable metals in a steel casing string so that several formations may be readily accessible to the bore hole.

If a piece of aluminum or magnesium pipe is inserted in a casing, its position may be readily located by the use of a galvanic cell or battery as above described. As the galvanic cell passes

from the steel casing to the easily drillable casing, a change in potential in the circuit occurs which is indicated by potentiometer 28.

Another method of constructing a galvanic cell suitable for use in the present invention is illustrated in Fig. 2. As in Fig. 1, a cable 16 containing a single conductor 17 may be used to suspend the cell. The cell 45 is constructed of an outer porous cup 36 having arranged therein an inner porous cup 37 in which is arranged a strip of metal 23 which is electrically connected to conductor 17. Arranged within the space between the two cups is an electrolyte 31, and arranged within the inner cup is electrolyte 30. The cups used contain a large number of capillary openings which allow electric current to be conducted through the walls by the means of the electrolytes and a diffusion of ions through the walls of the cells. This cell may be used in the same manner as the cell illustrated in Fig. 1.

As has been above explained, a large number of combinations are available to be used as the conductor 23 and electrolytes 30 and 31 in the cell. A preferred combination, however, is the use of a copper strip as element 23, a solution of copper sulfate as the electrolyte 30, and a solution of ferrous sulfate as the electrolyte 31. Other arrangements which give very satisfactory results are the use of lead or silver conducting strips for the element 23 with a corresponding soluble salt of this same metal arranged within the inner cell. It is unnecessary that the electrolytes 31 and 30 have the same acid radical. For example, one of the electrolytes may be a sulfate, while the other may be a chloride.

Salts other than iron salts may be used as the electrolyte 31 in the device, but it is preferred to use a salt having as its cation the same metal to which it is adjacent. In like manner, the electrolytes used in the inner cell may have a different metal as its anion than the metal used as the inner strip, but here again it is preferred to have the strip and an ion of the same metal. The construction of galvanic cells and their use are well known to the art. Accordingly, any of the methods for constructing galvanic cells or batteries so that the metal wall of a conduit forms one electrode and a portion of the cell may be moved through the conduit, may be used to carry out the present invention.

While I have disclosed specific modifications for carrying out the present invention, it is not my intention to be limited by the specific devices disclosed, but to claim the invention as broadly as the prior art permits.

I claim:

1. A device for locating the discontinuities of the metal forming a metal conduit comprising a container having in its walls at least one passage of capillary dimensions, a second container of smaller dimensions than the first arranged inside of said first container and provided with at least one passage in its walls of capillary dimensions, a metal strip arranged within said second container, an electrolytic solution arranged within said container for contact with said metal strip, the cation of said electrolyte being the same metal as that of which said strip is composed, an electrolyte in the space between said first and second cell, the cation of which is the same metal as that forming the major portion of said casing, a single conductor electrode arranged to support said cell with one end of the conductor of said cable electrically connected to said metal strip, the other end of the conductor of said cable being attached to a potentiometer and an electrical connection between said potentiometer and the metal of said conduit.

2. A device in accordance with claim 1 in which the conduit is constructed of iron, the strip in said cell is copper, the electrolyte in the smaller cell is copper sulfate and the electrolyte between said larger and said smaller cells is ferrous sulfate.

3. A device in accordance with claim 1 in which said containers are constructed of unglazed ceramic material.

4. A method for determining the discontinuities in a metal of a conduit containing conducting fluid comprising the steps of passing through said conduit an outer cell having at least one opening of capillary dimensions in the wall thereof, and having arranged therein a smaller container having at least one passage in said wall of capillary dimensions with a metal strip arranged within the smaller container, an electrolyte within said smaller container in contact with said metal strip, and a second electrolyte between said first and second containers, said metal strip being electrically connected to the conduit by an electrical conductor having therein a potential indicating device, and observing the potential indicated as the container is passed along the bore of said conduit.

5. A method for determining the discontinuities in the metal of a metal conduit containing conducting fluid comprising the steps of arranging a galvanic cell with said metal conduit forming one electrode thereof, so that a portion of said cell may be moved longitudinally in said conduit, moving said movable portion longitudinally in said conduit, while displaying the potential of said galvanic cell.

6. A device for locating the discontinuities of the metal forming a metal conduit containing a conducting fluid comprising an electrolytic cell, the metal wall of said conduit being used for one electrode thereof, a relatively small piece of a metal different from that of said conduit being used for the second electrode thereof, a container having at least one opening of capillary dimensions surrounding said second electrode, an electrolyte in said container in contact with said second electrode, a second electrolyte surrounding said container and an electrical connection connecting said two electrodes, said connection including a potential indicating device.

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