

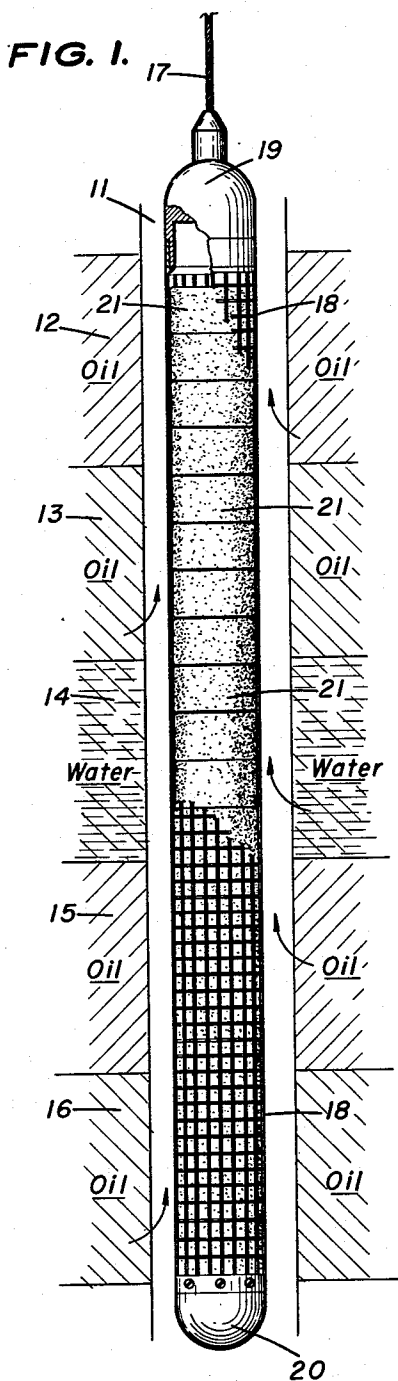
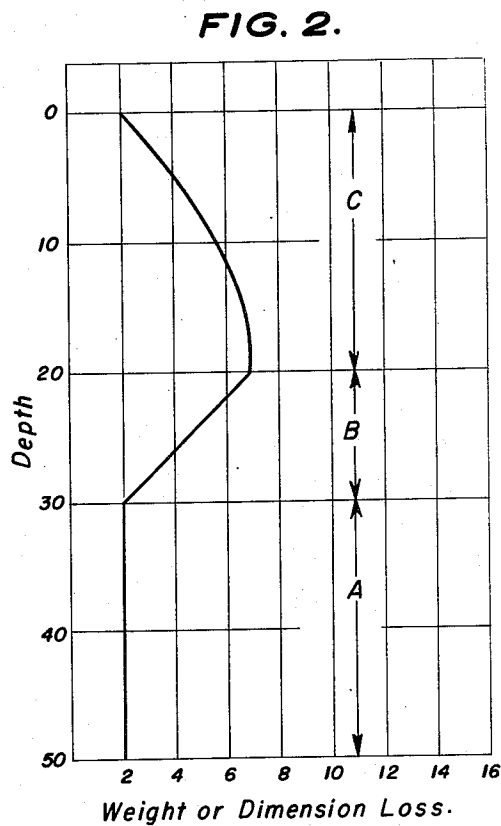
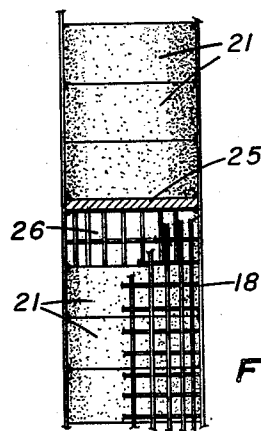
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APPARATUS FOR INDICATING ENTRY OF FLUIDS IN WELL BORES

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APPARATUS FOR INDICATING ENTRY OF FLUIDS IN WELL BORES

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The present invention is directed to apparatus for locating fluid entry into a well bore. More particularly, the invention is directed to apparatus for locating entry of water and/or oil into a well bore in earth formations.

The present invention may be briefly described as an apparatus for locating fluid entry in a well bore which comprises an elongated cage adapted to be lowered and raised in a well bore in which is arranged a plurality of plugs or bodies which are soluble in a fluid from said well. The plugs or bodies are arranged one upon another and are thus exposed to the well fluid upon lowering same in a well. The cage is provided with means such as a cable or wire line for lowering and raising the cage in said well bore.

The cage may be a cylindrical wire mesh cage or it may be composed of a suitable tube provided with perforations or slots and the like which will allow well fluid to contact the plugs or bodies which are arranged in the cage. The cage has attached to it a wire line or cable for lowering or raising the cage in a well. The cage is also provided with a suitable closure means which may be threadably engaged therewith. Preferably the cage has a closure means both on the top and the bottom for ready access thereto and for arranging and retaining plugs or bodies therein and removing plugs or bodies therefrom.

The plugs or bodies employed in the practice of the present invention may be either oil soluble plugs or bodies or water soluble plugs or bodies depending on the fluid whose entry is to be detected in a well. The oil soluble materials may be secured from a large number of solid organic materials, such as paraffin wax, naphthalene, asphalt of a suitable penetration, sulfur and the like.

The water soluble materials may be selected from the inorganic salts and the salts may be selected, depending upon the solubility desired, from, for example, sodium chloride, sugar, sodium sulfate, and the like; magnesium chloride and other water soluble materials may be used.

The invention will be further described by reference to the drawing in which

Fig. 1 is a partial sectional view of the apparatus of the present invention arranged in a well bore;

Fig. 2 is a plot of data illustrating the use of the present invention showing that the entry of water may be determined from the middle 10 feet of a 50 foot producing interval; and

Fig. 3 is a sectional view similar to Fig. 1 illustrating how the plugs or bodies 21 may be supported or retained in the cage 18.

Referring now to the drawing, numeral 11 designates a well bore which traverses a plurality of formations 12, 13, 14, 15, and 16. It will be noted that formations 12, 13, 15 and 16 are oil bearing sands, whereas formation 14 is a water bearing sand. The apparatus of the present invention is located in the well 11 by lowering same from the earth's surface on a wire line or cable 17. The wire line or cable 17 supports the cage 18 which may be constructed of a wire mesh and which is provided with a top closure means 19 which may be threadably connected to the cage 18 and a bottom closure member 20 which may be also threadably connected to the cage 18.

Arranged within the cage 18 is a plurality of water soluble plugs or bodies which may be plugs or bodies of sodium chloride. These plugs or bodies may be designated by the numeral 21 and are arranged one upon the other. It will be noted that the apparatus of the

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present invention is arranged in the well bore 11 such that the water formation or sand 14 is intermediate the upper and lower ends of the cage 18.

In practicing the present invention the cage 18 may be loaded with water soluble plugs or bodies, such as plugs or bodies of sodium chloride of about 1 foot intervals and, after loading the cage 18, the closure members 19 and 20 are securely fastened to the cage 18 and the cable 17 attached to the closure member 19 and the assembled cage lowered into the well bore 11. Well fluid is allowed to flow from the formations 12 to 16, inclusive, for a sufficient length of time to allow the water from the formation 14 to dissolve at least partially the plugs or bodies 21. Since the water would contact the plugs or bodies 21 to the greatest extent adjacent the formation 14 the plugs or bodies 21 adjacent the formation 14 would be dissolved to a greater extent than the plugs or bodies adjacent the formations 12, 13, 15 and 16. Thereafter, after the device of the present invention has remained in the well bore a sufficient length of time, the apparatus is raised by the cable 17 and the plugs or bodies removed by opening closure member 20. The retrieved plugs or bodies may then be weighed or measured, such as by caliper, to determine the extent of dissolution of the plugs or bodies by the water from formation 14. A plot of data may be obtained, such as in Fig. 2, in which the depth may be plotted against the weight or dimension loss of plug or body 21.

Referring now to Fig. 2, it will be noted that the depth which shows the length of the borehole in which the cage 18 is arranged is plotted against the weight or dimension loss. It will be noted that the greatest dissolution of the plugs or bodies 21 occurs in the section B which corresponds to formation 14, whereas the dissolution in section A of the plugs or bodies is relatively uniform with a decreasing dissolution in section C of Fig. 2. Sections A and C correspond, respectively, to formations 16, 15, and 13 and 12. From these data it may be determined that water entry is being encountered at a specific depth in the well bore.

Referring now to Fig. 3 in which identical numerals will be employed to designate identical parts, the cage 18 is provided with at least a supporting or retaining means 25 on which the plugs or bodies 21 may be arranged. With this modification of my invention, it is possible to provide a space between a series of plugs or bodies 21; thus, in the embodiment of Fig. 3, the grid or supporting bars 25 are arranged at an intermediate point in the cage 18 and plugs or bodies 21 may be supported thereon while other plugs or bodies 21 may be supported on the closure member 20 which also serves as a retaining or supporting means allowing an open space, such as 26, to be provided in the cage 18. It may be desirable to provide an embodiment such as in Fig. 3 when it is desired to have water and oil soluble plugs or bodies arranged in the cage 18 but separated from each other.

The invention may be employed in determining points of fluid entry, the rate of fluid entry, and for determining the relative points of entry of different types of fluid. For example, the plugs or bodies 21 may be composed of water soluble plugs or bodies in the upper section and oil soluble plugs or bodies say in a lower or intermediate section. After a given period of time during which the cage 18 with plugs or bodies 21 are in a well bore the soluble plugs or bodies may be recovered and measured to determine the incremental loss corresponding to depth measurements in the well bore.

The time the apparatus of the present invention including the soluble plugs or bodies remain exposed to well fluid will depend on several factors such as the type of plug or body used, the rate of fluid flow into or from the well bore, and the relative percentages of well fluid, such as oil or water, to be detected. A time in the range from about 5 or 10 minutes to about 24 hours should suffice in most instances. As a general rule, the plugs or bodies should be exposed to well fluid at a given depth for a time sufficient to dissolve the plug or plugs at least partially.

While my invention has been described as employing a plurality of plugs or bodies, it is within the purview there-

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of to have an elongated plug or body arranged in a cage and lowered in a well bore.

The nature and objects of the present invention having been completely described and illustrated, what I wish to claim as new and useful and to secure by Letters Patent is:

1. Apparatus for locating fluid entry into a well bore which comprises, in combination, an elongated cage adapted to be lowered and raised in a well bore, a plurality of bodies soluble in a well fluid arranged in said cage, said bodies being of sufficient size and soluble in the well fluid coming into contact with said bodies to dissolve the bodies a sufficient amount to indicate relative intrusion of said fluid into said well and a cable secured to said cage and extending to the earth's surface for raising and lowering said cage in said well bore.

2. Apparatus in accordance with claim 1 in which the bodies are water soluble.

3. Apparatus in accordance with claim 1 in which the bodies are oil soluble.

4. Apparatus in accordance with claim 1 in which a portion of the bodies are water soluble and another portion are oil soluble.

5. Apparatus for locating fluid entry into a well bore which comprises, in combination, a cylindrical wire mesh cage adapted to be lowered in a well bore, a plurality of soluble bodies arranged one upon another in said cage, said bodies being of sufficient size and soluble in the well fluid coming into contact with said bodies to dissolve the bodies a sufficient amount to indicate relative intrusion of said fluid into said well and a cable secured to said cage and extending to the earth's surface for raising and lowering said cage in said well bore.

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6. Apparatus in accordance with claim 5 in which at least part of the bodies are water soluble.

7. Apparatus for locating fluid entry into a well bore which comprises, in combination, a cylindrical elongated cage adapted to be lowered and raised in a well bore, at least one body soluble in a well fluid arranged in said cage, said body being of sufficient size and soluble in the well fluid coming into contact with said body to dissolve the body a sufficient amount to indicate relative intrusion of said fluid into said well and a cable secured to said cage and extending to the earth's surface for raising and lowering said cage in said well bore.

8. Apparatus for locating fluid entry into a well bore which comprises, in combination, an elongated cage adapted to be lowered and raised in a well bore, at least one body soluble in a well fluid arranged in said cage, said body being of sufficient size and soluble in the well fluid coming into contact with said body to dissolve the body a sufficient amount to indicate relative intrusion of said fluid into said well, means for retaining said plug in said cage, at least one closure means arranged on one end of said cage, and a cable secured to said cage and extending to the earth's surface for lowering and raising said cage.

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