Nov. 9, 1926. 1,606,651.

G. A. MACREADY

AUTOMATIC FORMATION SAMPLER FOR DEEP WELLS

Filed July 25, 1922 2 Sheets-Sheet 1

Fig. 1.

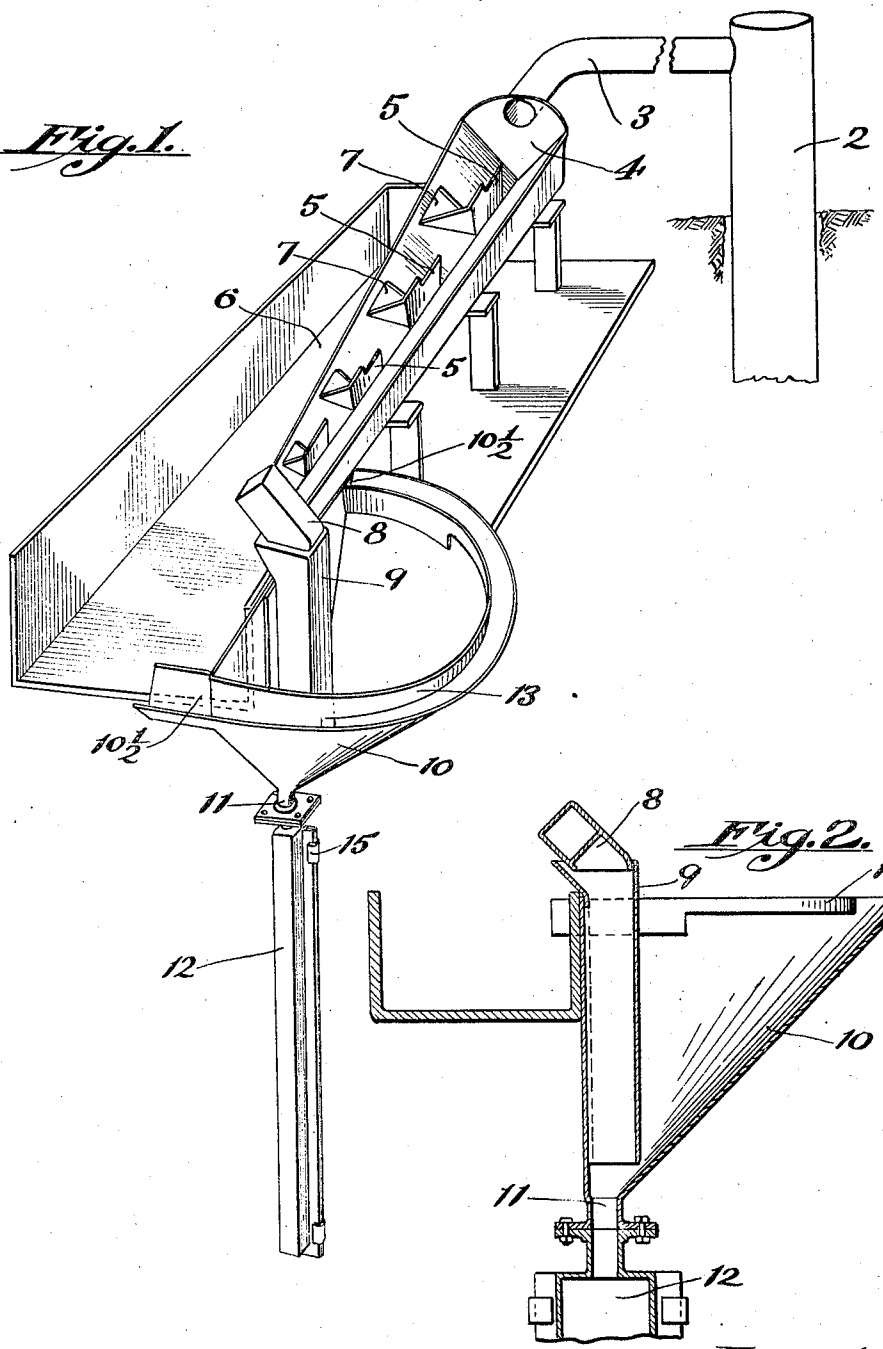

Fig. 2.

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Fig. 3.

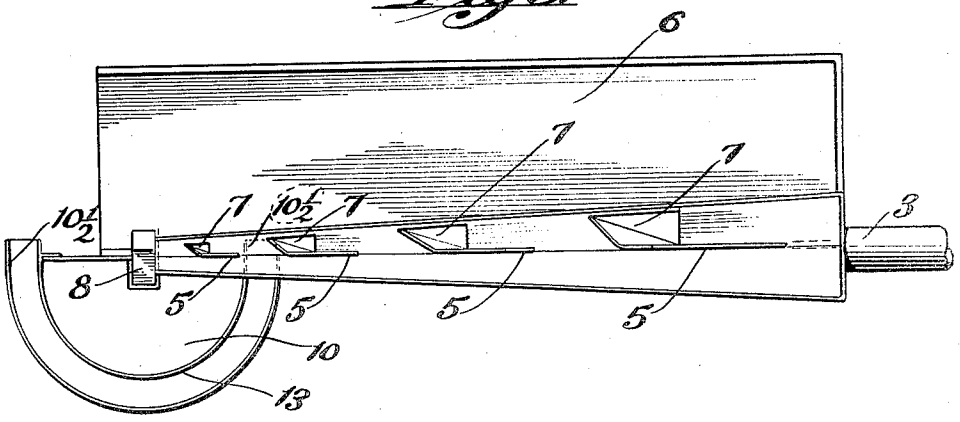


Fig. 4.

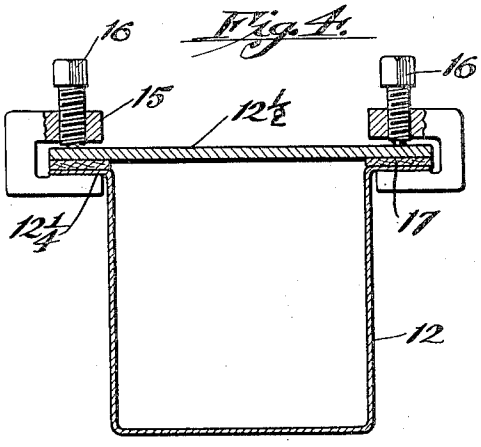


Fig. 5.

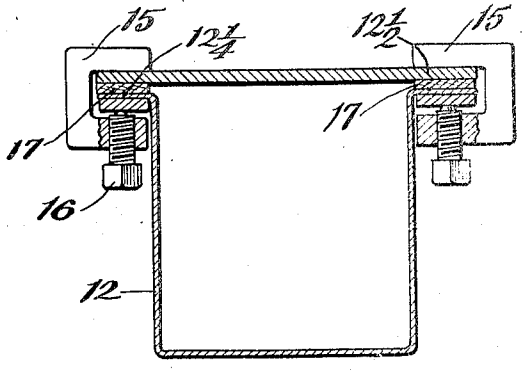
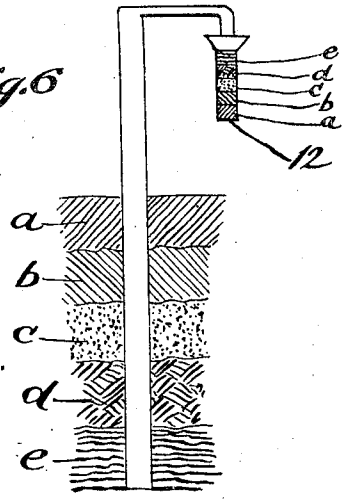


Fig. 6



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UNITED STATES PATENT OFFICE.

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AUTOMATIC FORMATION SAMPLER FOR DEEP WELLS.

Application filed July 25, 1922. Serial No. 577,434.

This invention relates to sampling apparatus, and more particularly to apparatus for taking samples from deep well cuttings.

It is an object of the present invention to provide means for automatically effecting a progressive collection of formation substance especially in deep well drilling methods and by use of deep well apparatus. It is another object to provide a method whereby an accurate, reliable and constantly aggregated sample deposit is obtained during the cutting of the well. An object is to obtain a sample of the well formation which sample will indicate clearly the arrangement of the solid material through which the well tools are driven.

Another object is to provide an apparatus to automatically and constantly aggregate a substantially continuous sample deposit of the solid materials through which a well drilling tool is being driven so as to indicate positively the order and character of the strata encountered at the bottom of the well.

Other objects and advantages will be made manifest in the following specification of an embodiment of the invention illustrated in the accompanying drawings, in which—

Figure 1 is a perspective of an apparatus whereby the improved sampling method may be practiced.

Fig. 2 is a vertical section through the settling pan and the formation box.

Fig. 3 is a plan of the apparatus.

Fig. 4 is a transverse section of a form of the formation box.

Fig. 5 is a transverse section showing a different type of clamp applied to the box.

Fig. 6 is a diagrammatic view indicating the method of collecting and depositing the successive strata from the well in the formation sample box.

The present invention has broadly for its object to provide a simple method for constantly segregating and cutting out any desired proportion of the circulating mud or the cuttings discharged from the well and the treatment of the segregated portion in such manner that the solids therein will be progressively deposited in such manner as to indicate accurately the character of the formation encountered by the cutting tools of the well.

In my present method, the cuttings or circulating mud, as the case may be, are led from the well hole 2 by any suitable discharge pipe 3 into an apparatus in which the flowing liquid is automatically divided into any desired proportions, the selected proportion constituting an actual part of the cuttings and liquid coming from the well and, therefore, bringing with it solids and other materials that are encountered.

The flowing liquid is discharged into a suitably arranged, constructed and designed trough 4 which, preferably, is given a slight downward slant from its upper end at the supply connection 3. Along this trough there are arranged successive cutting blades 5, preferably in the center of the bottom of the trough, the latter being in the present instance shown as of V-shape in cross section, so that the solids in the fluid will collect at the bottom and the initial cutter will divide the liquid into two streams, one side passing to the usual launder or sluice 6 which leads the material to the usual dump hole from which the mud, if desired, may be recirculated through the well. It will be seen that a portion of the liquid from the well passes from the first cutter 5 to the next and that at each cutter there is arranged a discharge opening 7 leading into the launder 6. The second cutter in the series will substantially divide the stream, and the third cutter will again divide the stream until at the discharge end of the trough 4 there will be only a small desired proportion of the volume of liquid originally discharged into the head end of the trough.

At the discharge end of the trough there is arranged a discharge chamber 8 leading into a vertical tube 9. This tube is substantially centrally disposed in a settling means which may consist of a conical or semiconical pan or receptacle 10 which, in the present case, is shown arranged adjacent to the launder or sluice box 6. The tube 9 extends downwardly well toward the bottom of the pan 10 and this is provided with a constricted outlet 11 so as to check the escape of the liquid therefrom, the fluid backing up in the pan 10, while the solids pass quickly and directly down through the outlet at the bottom of the pan and into a vertically arranged receiver which may be termed the formation sample box 12. This is of any suitable design and construction and is preferably of comparatively great length as to its diameter or transverse dimensions.

It is desirable to provide for the segregation or collection of such oil as may be brought from the well in the cutting liquid

so that the presence of oil may be readily detected, and to that end there is provided an intermediate partition or barrier at the upper part of the pan. This partition is in the form of a circular bend 13 spaced a suitable distance from the rim of the pan 10 and being concentrically arranged as to the axis or center of the pan and thus surrounding the tube 9. Therefore, when the liquid backs up in the pan, the oil, being lighter, will rise substantially straight up through the water and thus will collect on the surface of the water within the fence-like, inner rim-forming band or member 13. This will surround the floating oil on the water surface and yet will permit the flow of water up to the channel between the band and the pan rim. The channel around the band has outlets 10½ leading the flowing water to the waste launder 6.

The small proportion of the total cuttings passing into the tube 9 soon fills the formation box 12 with water and this backs up to the top of the pan 10 and overflows through the outlets 10½; meanwhile the solids may gradually settle in unagitated condition through the tube 9 into the formation box 12 in which they will stack up in regular sequence but in inverse order as to the formation in the wall, as is clearly shown in Fig. 6, where the strata *a* is first encountered in the well hole, and the cuttings from this are transferred, in greatly reduced proportion, to the formation box 12 where the strata *a* is deposited, for instance, in the bottom of the box and subsequently the strata *b*, *c*, *d* and *e* are pulled up inversely in the box 12 as shown.

The presence of oil in the cuttings is readily detected, since this will rise to the quiet zone within the partition 13 and be held against escape, while the water may continuously flow through the top outlet 10½ from the pan, there being no bottom discharge in the formation box.

When the drilling has been conducted for the desired period, the formation box 12 may then be removed, and in order to provide for convenient inspection of the accumulated solids therein, the box may be of sectional form or is preferably provided with a removable side 12½ which may be quickly removed when the box is deposited in a horizontal position without disturbing the natural deposit of the solids in the box, since these will be substantially packed in the same and will fill the box from end to end and from face to face. The removal of the cover 12½, therefore, discloses the collected particles exactly in the order in which they flowed from the well and samples may be taken and analyzed in the usual manner.

In Fig. 4 the box is shown as having flanges 12¼ upon which the cover rests, and this is held in place by suitable clamps 15 having means to embrace the edges of the flanges and cover and provided with set screws 16. Another arrangement of the clamps is shown in Fig. 5 wherein the set screws 16 are placed underneath of the flanges 12¼ and press against washers or protecting shims 17 which may be applied to the contiguous flanges to prevent the direct impingement of the screws 16 thereon.

From the above it will be seen that I have provided an extremely simple and practicable, inexpensive, reliable and accurate method of apparatus for automatically and constantly taking samples from the well cuttings and liquid and have, therefore, rendered it possible to discover with certainty the nature and order of the formations encountered in the bottom of a well.

There may be instances in which it might be desirable to add a small quantity of clear water to the settling tank with the cuttings stream to dilute and cause more efficient settling of the cuttings.

While the apparatus is adaptable to various types of well drilling processes, it is especially adaptable for rotary methods.

An important advantage of this method of apparatus enables the collected samples to be retained in the order of their collection for future reference and further, during a drilling operation, successive sample boxes can be utilized for receiving and holding successive formation samples.

Further embodiments, modifications and changes may be resorted to within the spirit of the invention as here claimed.

What is claimed is:

1. The method of determining the character and order of formation of material encountered in a well, which consists of continuously taking a proportion of the cuttings and liquid coming from the well, discharging the liquid and cuttings into a settling chamber, and allowing the solids in the liquid to settle out of the liquid in their natural order without mixing or grading.

2. The method of obtaining formation samples in well drilling, which consists of continuously taking a proportion of the fluid coming from the well, discharging it into a quiet settling chamber, and allowing the solids in the fluid to quietly settle in a vertical column.

3. The method of collecting formation samples during the drilling of a deep well which consists in continuously taking a suitable proportion of the material coming from the well, leading the said proportion into a settling chamber, permitting the natural settling of the solids from said chamber, segregating the oil by flotation from the water in said chamber, and continuously discharging the water during the drilling, and settling and flotation process.

4. An organized apparatus for obtaining

formation samples from deep well cuttings which comprises means for continuously taking a true and suitable proportion of the cuttings and liquid directly from the well during drilling, a settling and overflow chamber into which the said proportion is discharged, and a solid collecting box forming a leg of said chamber into which the solids in the selected proportion of the material are permitted to settle in the order in which they are discharged from the well.

5. An organized apparatus for obtaining formation samples from deep well cuttings which comprises means for taking a true and suitable proportion of the cuttings and liquid directly from the well, a settling chamber into which the said proportion is discharged and having a liquid overflow, and a solid collecting box extending down from said chamber and into which the solids in the selected proportion of the material are permitted to directly settle substantially without agitation so that the solids may be deposited and stacked in the direct order in which they discharge from the well during the drilling process.

6. An organized apparatus for obtaining formation samples from deep well cuttings which comprises means for taking a true and suitable proportion of the cuttings and liquid directly from the well, a settling chamber into which the said proportion is discharged, a discharge tube leading from said means down into the said chamber, a solid collecting box extending down from the bottom of said chamber and into which the solids in the selected proportion of the material are permitted to settle, and means in said chamber for segregating the oil content rising in said chamber from the liquid coming from the well.

7. An organized apparatus for obtaining formation samples from deep well cuttings which comprises means for taking a true and suitable proportion of the cuttings and liquid directly from the well, a settling chamber into which the said proportion is discharged, a solid collecting box communicating with the bottom of said chamber and into which the solids in the selected proportion of the material are permitted to settle, means in the chamber for segregating the oil content rising in said chamber from the liquid coming from the well, and means for continuously discharging from said chamber the water content from the substance coming from the well.

8. An organized apparatus for obtaining formation samples from deep well cuttings which comprises means for taking a true and suitable proportion of the cuttings and liquid directly from the well and having a settling chamber into which the said proportion is discharged, a solid collecting box communicating with the bottom of said chamber and into which the solids in the selected proportion of the material are permitted to settle, means in the chamber for segregating the oil content from the liquid coming from the well, and means for continuously discharging from said chamber the water content from the substance coming from the well without disturbing the deposit of the solids in the formation box.

9. In a deep well formation sample collecting apparatus, a settling chamber, an elongated sample collecting formation box adapted to be secured in upright position to said settling chamber to receive the desired sample, said box having a longitudinal removable side for uncovering the collected sample in stack form substantially without disturbance.

10. In a deep well formation sample collecting apparatus, a settling chamber, a sample collecting formation box adapted to be secured in upright position to said settling chamber to receive the desired sample, said box having a longitudinal, removable side for uncovering the collected sample substantially without disturbance.

11. In a sample collecting apparatus for testing well product for oil, a chamber in which a liquid body may become approximately quiescent, a collecting box secured beneath said chamber, and means for confining oil rising to the surface of the liquid in the chamber while permitting water to pass therefrom, so as to provide for detection of oil in the flowing liquid.

12. An apparatus for obtaining formation samples from deep well cuttings comprising a settling chamber, a collecting box communicating with said settling chamber, means providing an outlet for said settling chamber, and a wall disposed within the chamber whereby oil may be segregated from liquid placed in said chamber by flotation and liquid may be continuously discharged therefrom.

13. An apparatus for obtaining formation samples from deep well cuttings comprising a settling chamber, a collecting box communicating with said settling chamber, said collecting box having a removable side, and means comprising a wall disposed within the chamber and adjacent the top thereof whereby liquid may be continuously admitted to said chamber and discharged therefrom and oil incorporated in said liquid may be segregated therefrom.

In testimony whereof I have signed my name to this specification.

GEORGE A. MACREADY.