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METHOD OF DRILLING AND SEALING OIL WELLS

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1 Claim. (Cl. 255—1)

This invention relates to methods of drilling and sealing oil and gas wells, and among other objects, the invention aims to provide a method which will effect very important economies in the cost of completing an oil or gas well. Other objects will appear from the following description of the preferred method and equipment used in connection therewith.

In the accompanying drawings showing diagrammatically an oil well and said equipment,—

Fig. 1 is a vertical sectional view showing the drilling in progress; and

Fig. 2 is a similar view on a larger scale, but showing only the lower part of the pit and showing the effect of heating the walls of the well and the application of a sealing material or compound.

Referring particularly to the drawings, and first to Fig. 1, there is shown a series of strata typical of certain oil fields, comprising a surface stratum 10 of erosional material, a limestone stratum 11 directly beneath the surface stratum, a water-yielding stratum 12 of sandstone, beneath the limestone, a stratum of shale 13 below the sandstone, and a second stratum of sandstone 14 below the shale which will yield gas or oil or both, often under enormous pressure. In accordance with the invention, a pit 16 is first dug deep enough to reach the upper part of the limestone stratum 11 nearest the surface, and large enough to permit the workmen to descend and work in the pit with the various tools and equipment during the drilling and sealing of the well. A heavy floor 17, preferably of reinforced concrete, is built at the bottom of the pit to seal the same and prevent gas pressure from lower strata destroying the pit and the equipment therein.

Extending through the bottom of the floor 17 is a heavy casing 18 which is sealed by the floor and which is connected to a cut-off valve 19 controlled either from the pit by a hand wheel 20 or from the base of derrick 21 by a rod 22 connected to a crank 23. An air pump 24 driven by a motor (not shown) is connected by pipe 25 to casing 18 below the cut-off valve, as shown, and a check valve 26 is provided in the pipe line 28 to check the back pressure.

The drilling is effected either by a rotary drill (not shown) or a churn drill 27 suspended from a cable 28 which is reciprocated by a well-drilling machine (not shown) or by a motor-operated walking-beam 29. During drilling, a heavy air pressure is maintained in the excavation by means of the pump 24. The casing 30 which extends above valve 19 (which must be open during actual drilling) is provided with a packing head 31, of known construction, to hold the air pressure.

As the drilling proceeds, the limestone stratum 11 is penetrated and the top of the stratum of water-yielding sandstone is reached. At this time the drilling tool is withdrawn, and an electric heating element is introduced into the bore. As shown in Fig. 2, the electric heating element comprises a thick walled, hollow, metal core 35 whose diameter is only slightly less than the diameter of the bore, so that as the core is lowered, it will come in contact with the walls of the bore substantially throughout the entire surface thereof, except for the small voids and spaces left in the rock walls by breaking off of rock fragments by the drilling operation. The metal core 35 is provided with electric heating means, which may be a plurality of resistance elements (not shown) enclosed by the core, or an electric arc 36 maintained by terminals 37 which are electrically connected to a source of current by a cable (not shown) enclosed by and insulated from a rope or cable 38 which raises and lowers the core. A transformer 39 located at any convenient point, delivers current at the proper voltage and amperage to the terminals 37 or to the resistances, and a switch 40 permits the current to be turned off, as when the core is being hoisted by a motor-driven drum 41. The transformer 39 may have its points changeable (as is known in the art of transformer making and hence requires no illustration) so that the voltage may be increased as the cable 38 is lengthened, to compensate for the copper loss. The cable 38 will be provided in sections which may be mechanically and electrically connected, end to end.

It will be understood that under the intense heat of the electric arc or of the resistances, the core will become extremely hot, and as it comes in contact with the walls of the bore, it will melt or coalesce the walls and will form (in certain materials) a glass-like, hardened surface with an adhered or metamorphosed area surrounding said surface (indicated by darker areas 42 in the drawings, Fig. 2) which will prevent seepage of water through the pores of the rock into the bore, and thus will seal the bore. In shale strata, such as 13, where caving may occur unless the walls of the bore are artificially strengthened, the heat of the core is effective to melt and coalesce the surface of the bore and to meta-
morphose the areas for at least several inches in all directions around the bore, so that the rock stands without further caving tendency. Preferably the heating of the bore walls takes place alternately with successive steps of drilling, so that the bore can never be flooded, nor can caving on any considerable scale take place. The maintenance of high air pressure in the bore during the entire drilling operation is, of course, essential to the success of the method, as such pressure will hold back the water until the bore is sealed and will aid in preventing caving.

As there cannot be perfect contact between the surface of the heated core and the irregular surface of the bore, the sealing effect, described above, will necessarily be imperfect and dependable in the absence of a sealing medium. In accordance with the invention a layer of sulphur, or sulphur and lime, or a similar mixture or material, is spread over the entire surface of the bore by being poured or dumped through the casings on top of the heated core, which is reciprocated to affect a plastering or spreading of the sealing material. The heat melts the sealing material and the core and air pressure complete the operation. The result is an inner layer or "skin" of sealing material which, in conjunction with the metamorphosed walls and areas previously mentioned, completes the sealing of the bore, and further strengthens the walls of the bore against caving.

The described process continues with alternate drilling and sealing, until the gas or oil bearing stratum is reached, when the drilling operation may cease. The usual casing (not shown) may now be applied in the usual manner, as it will be economically justified for some wells. After the casing is in place, the air pressure may be cut off, and the well will be in production. However, in some cases the well may be put into production without using a metallic casing, the walls of the bore being sufficiently protected by the described treatment to permit the withdrawal of crude petroleum even under pressure.

While electricity as a heating medium is preferred wherever available and not too expensive, it is within the scope of the invention to heat the walls of the uncompleted well by gas or oil flames burning from the core, which may be supplied with gas or oil through a flexible conduit (not shown). The necessary oxygen for combustion is supplied by the air supplied under pressure by the air pump, as described.

Obviously many other changes in the described apparatus may be made, and some modifications in the described process may be resorted to, within the scope of the appended claim.

Having described the preferred method of the invention, what I claim as new and desire to secure by Letters Patent of the United States of America is:

A method of drilling and sealing oil or gas wells comprising, first, digging a pit to a relatively impervious formation and sealing the bottom of the pit; then drilling for a limited distance below the bottom of the pit with the bore constantly maintained under high air pressure; then heating the walls of the bore to metamorphose the material of the walls for some distance around the bore, simultaneously coating an easily melted material which is not affected by crude petroleum over the surface of the bore to provide a sealing "skin" or layer thereon; continuously maintaining said high air pressure during the heat metamorphosis and sealing of the walls and adjacent areas; and alternating further periods of drilling with successive periods of sealing in the manner described.

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