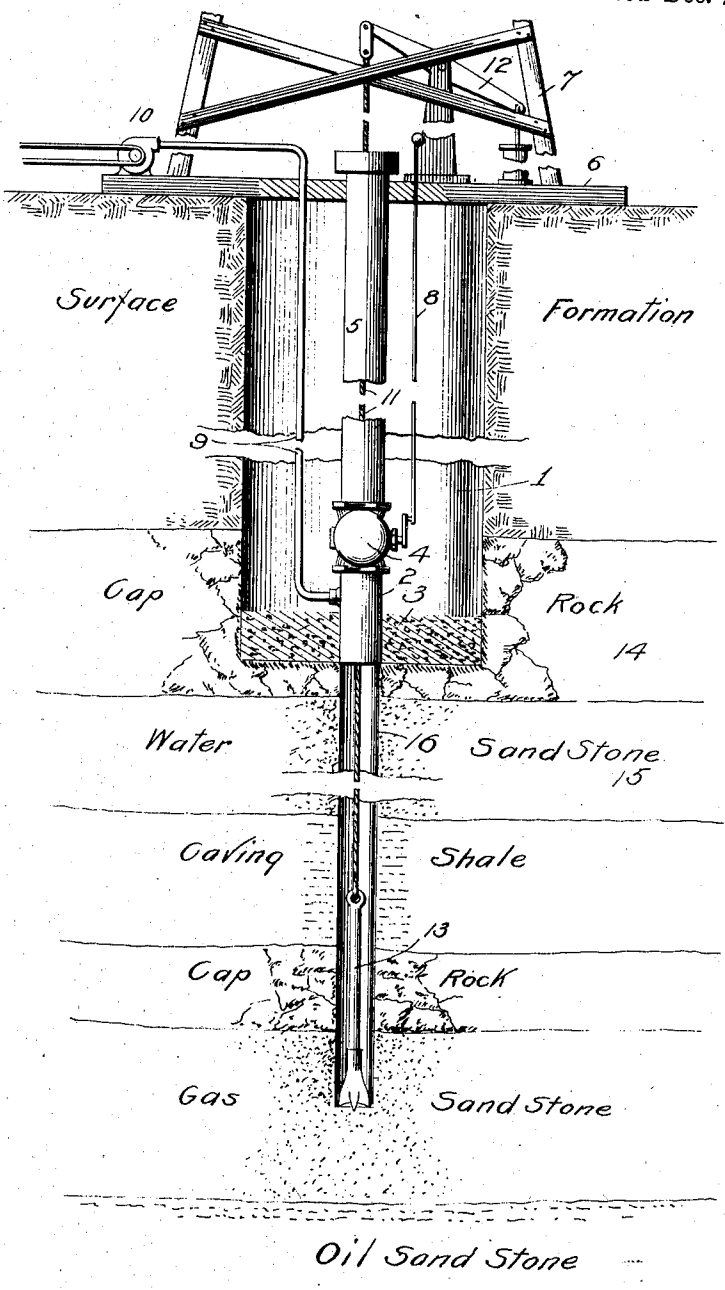
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METHOD OF DRILLING WELLS.

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WITNESSES

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METHOD OF DRILLING WELLS.

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To all whom it may concern:

Be it known that I, WILLIAM E. NOLAN, a citizen of the United States, residing at Tulsa, in the county of Tulsa and State of Oklahoma, have invented a new and useful Method of Drilling Wells, of which the following is a specification.

This invention has reference to a method of drilling wells, and more particularly oil wells, and its object is to provide for the drilling of wells without simultaneously casing them, whereby the cost of drilling is greatly reduced, sometimes to such an extent that the well may be drilled and its productivity ascertained at a cost considerably less than half what it has heretofore cost, so that, in case of a non-productive well, the loss is correspondingly reduced.

It has heretofore been the custom, in drilling oil wells, to start with a relatively large bore and incase the well, then produce through the first casing a smaller bore and case said second bore and step down the bores in succession with corresponding casings until the oil producing sand is reached.

A typical formation may consist of a surface layer under which is cap rock covering water-charged sand stone, and such sand stone covers a layer or layers of caving shale which may cover a layer of cap rock overlying gas sand stone, in turn covering oil sand stone.

Such a formation varies considerably in different localities. Sometimes the oil is found near the surface and again several thousand feed deep. Usually gas sand and oil-bearing sand covered by cap rock, such as limestone, occurs three or four thousand feet down with hundreds or thousands of feet of shale overlying it, and upon the shale, which is of unstable nature, water-containing sand stone is found held from the water escaping by limestone or similar cap rock found a few score feet below the surface of the ground.

In drilling a test bore which may subsequently become the permanent bore a cellar excavation fifty or sixty feet deep or thereabout is formed down to the cap rock, and from the bottom of the cellar a bore is started, such bore being of suitable diameter to accommodate a casing six or eight inches, or somewhat larger, in diameter. The bottom of the cellar is provided with a heavy coating of cement through which the casing is carried and, entering the casing above the bottom or sealing layer is a pipe permitting the introduction of air under pressure.

Having made the necessary preliminary preparations the boring then proceeds and may continue through various strata until ultimately the oil sand is reached. The drill, in its course, passes through water-bearing strata, caving shale, impervious cap rock and finally reaches gas sand and oil-bearing sand. It has heretofore been found necessary to provide casing to keep out the water and to prevent the caving shale from filling up the bore, which materials frequently clog the well and prevent it from producing.

In drilling a well the use of air pressure for holding back the water and caving shale avoids the necessity of using casing for a like purpose and also eliminates many troubles which have been met by oil well drillers and the heavy preliminary costs and frequent mishaps which have to be met.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawing forming part of this specification, with the understanding, however, that the invention is not confined to any strict conformity with the showing in the drawing, but may be changed and modified so long as such changes and modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

The figure of drawing is a more or less schematic representation of an oil well formed in accordance with the invention.

In order to convey an idea of the cost and difficulties of drilling an oil well in the Texas field where the oil-bearing sands are from three to four thousand feet down it is customary to drill a hole which will accommodate from four to five hundred feet of $15\frac{1}{2}''$ casing, then to sink a hole through the preliminary casing to a depth of a thousand to twelve hundred feet, to accommodate $12\frac{1}{2}''$ casing, to be followed by 1500 to 2000 feet of $10''$ casing, 2500 to 3000 feet of $8''$ casing and finally 3000 to 4000 feet of $6\frac{5}{8}''$ casing, the different sizes of casing telescoping one into the other and all reaching to the surface of the ground or into a cellar.

The casing necessary for a 4000 foot well, therefore, reaches nearly 11,000 feet or proportionately less, but in any event representing a length of casing several times that of the depth of the well. Moreover such casing is expensive and the cost of drilling a well may reach from eighty to one hundred thousand dollars or more, and the work often goes for naught. Again, difficulties are encountered in sinking the casing because of the buckling of the casing, and the sticking of the collars connecting the sections of the casing.

The invention contemplates the formation of a cellar 1, which may be an excavation of suitable diameter to admit workmen and tools, and this excavation may be in the neighborhood of 60 feet in depth. At the bottom of the cellar is a short length of casing surrounded at the bottom end, the casing being upright, by a flooring 3 of cement or other suitable material so that the casing where passing through the bottom of flooring 3 may make a substantially gas-tight connection therewith. The cellar 1 may be conveniently carried downwardly to the cap rock encountered some distance below the surface of the ground in the Texas formation. The casing 2 is provided at a suitable height above the flooring 3 with a cut-off valve 4 and from thence there is a casing continuation 5 continued to the surface of the ground through the basic portion 6 of a derrick 7.

The valve 4 is shown as provided with a reach rod 8 so that it may be readily controlled from the surface of the ground.

Leading into the casing 2 is a pipe 9 which may be carried to the surface of the ground and is there connected to an air-pump 10 arranged to force the air under pressure into the casing 2.

Extending through the casing 2 and its extension 5 is a rope or cable 11 with a walking beam operating means 12, and at the end of the cable 11 below the casing 2 is a drill tool 13, preferably of the ordinary reciprocatory type and consequently needing no particular description.

When the drilling is begun it may start in the cap rock formation indicated at 14 and will then continue downwardly, ultimately reaching the water stratum or sand indicated at 15.

Ordinarily it is necessary to introduce casing into the bore, which latter is indicated at 16, in order to prevent the water from entering the bore. By the present invention the entrance of water into the bore is prevented by using air pressure in the bore by means of the pump 10 and pipe 9, such air pressure being sufficient to hold back the water. Ultimately as the drilling proceeds, the water sand is traversed and the drill enters the shale formation underlying the water sand. Such shale formation may be of relatively great depth and ordinarily it has been found necessary to case such formation in order to hold back the shale from caving. However, in accordance with the present invention the shale cannot cave on account of the superior pressure exerted by the air, so that the shale walls of the bore are held against caving as effectively as though a casing were present.

Ultimately the drill reaches the cap rock underlying the caving shale and overlying the gas sand and oil. When the cap rock has been traversed and the presence of oil has been ascertained, the drilling tool may be withdrawn and a casing is then introduced, but such casing may be of the same size throughout its length and either of the smallest size employed or the next larger size. It is necessary to maintain the air pressure within the bore while the casing is being introduced below the water stratum and the caving shale so that there may be no danger of cavings entering the bore. After this has been accomplished the air pressure may be released and the well becomes a producing well.

In digging such a well only the smaller sizes of casing are required and usually only the smallest size commercially employed. This represents a very material saving in the cost of casing, which usually begins with a 15″ or 20″ size and is ultimately reduced to $6\frac{5}{8}$″. By the invention the size of the casing need not exceed 8″ and may be as small as $6\frac{5}{8}$″, these being standard sizes.

By the invention the expense of casing, and such casing represents a very material outlay of money, is in most part eliminated when, as often occurs, the boring proves to be futile.

In the ordinary procedure of drilling and casing the drilled hole as the drilling proceeds it sometimes becomes necessary to draw the casing. Occasionally this may be done with considerable ease and again it cannot be done. In deep wells the withdrawing of the casing may result in pulling the casing apart because of the resistance offered by the pressure of the material which has collapsed against the casing. Under such circumstances the well frequently becomes a total loss and must be abandoned. Should it occur in a well drilled in accordance with this invention that the well must be abandoned after the casing has been applied, the greatly reduced cost of the casing which ordinarily consists of a number of telescoped concentric tubes, but, by the invention is reduced to a single tube, represents a far smaller loss than will occur with a well drilled in the ordinary manner. In fact, with other things being equal, the well drilled in accordance with the invention and costing less than half of the ordinary drilled

well costs, would, if the work becomes a loss, represent less than half of the loss incurring with an ordinary drilled well.

In the practice of the invention, it is necessary from time to time to withdraw the drilling tool and to introduce a bailer, or, when the drilling is finished, to line the bore in some appropriate manner to prevent the caving of the walls of the bore, without material loss of the air under pressure employed to sustain the collapsible walls of the bore while the drilling is proceeding, and when the well is finished, introducing a permanent means for sustaining the walls of the bore after the temporary air pressure is released.

It is customary in drilling wells to support the drilling tools, bailers, etc., on the lower end of wire cables, such as the cable 11, and such cable is passed through a packing head of ordinary construction at the upper end of the short length of casing and also through the cut-off valve 4, suitable packing being employed at both points. It is customary to hold the cap at the upper end of the length 5 of casing by screws or other readily removable means so that when it is desired to remove a drilling tool to replace it with a bailer, or to introduce other devices in place of the drilling tool, such tool or device is raised through the valve 4 which is then cut off so as to retain the air pressure, and on the loosening of the fastening devices for the cap, the latter, as well as the cable and tool, is lifted from the well. Then another tool or device, including another cap, is lowered into the casing extension 5 and the cap is fastened in place, after which the valve 4 may be opened and the implement then lowered into the already-formed well as far as may be desired, the cap preventing the escape of the compressed air holding the walls of the well from collapsing. In this manner, bailing or the sealing of the walls of the well, particularly where collapsible, as through shale or water bearing strata, is readily accomplished without such reduction in air pressure as might permit caving of the walls of the well.

What is claimed is:

1. The method of drilling deep oil wells, which consists in producing with a drilling tool, a bore in most part of substantially constant diameter down to the formation in which oil is sought, and at the same time producing air pressure in the bore as the sole means for holding back the collapsible walls of the bore where such occur, until the drilling of the collapsible portions is completed, and then lining the bore with pressure-resistant material.

2. The method of drilling deep oil wells, which consists in producing with a drilling tool, a bore of substantially constant diameter down to the formation in which oil is sought, with the bore corresponding in diameter to that standard for the oil-bearing formations, and at the same time producing and utilizing air pressure in the bore as the sole means for holding back the collapsible walls of the bore, where they occur, until the drilling is completed, and then, after the productiveness of the well has been ascertained, introducing a metallic casing, whereby to permit the air pressure to be released.

3. The method of forming deep oil wells, which consists in producing with a drilling tool, a bore of substantially constant diameter down to the formation in which oil is sought, with the diameter of the bore corresponding substantially to that standard for the oil-bearing formation, producing in the bore as the latter progresses, air pressure sufficient to prevent collapsing of the walls of the bore where of a collapsible nature, and to hold back flow of water into the bore where passing through water-bearing formations, with the air pressure maintained until the productiveness of the well is ascertained, and then providing a lining for the bore resistant to pressures in and normal to the well tending to collapse the walls of the well, the lining also serving to hold back the flow of water into the well from water-bearing formations.

4. The method of drilling deep oil wells which consists in producing a bore to the formation in which oil is sought, and holding the walls of the bore, while being formed, against collapsing solely by air pressure maintained in the bore during the drilling operation.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature.

WILLIAM E. NOLAN.