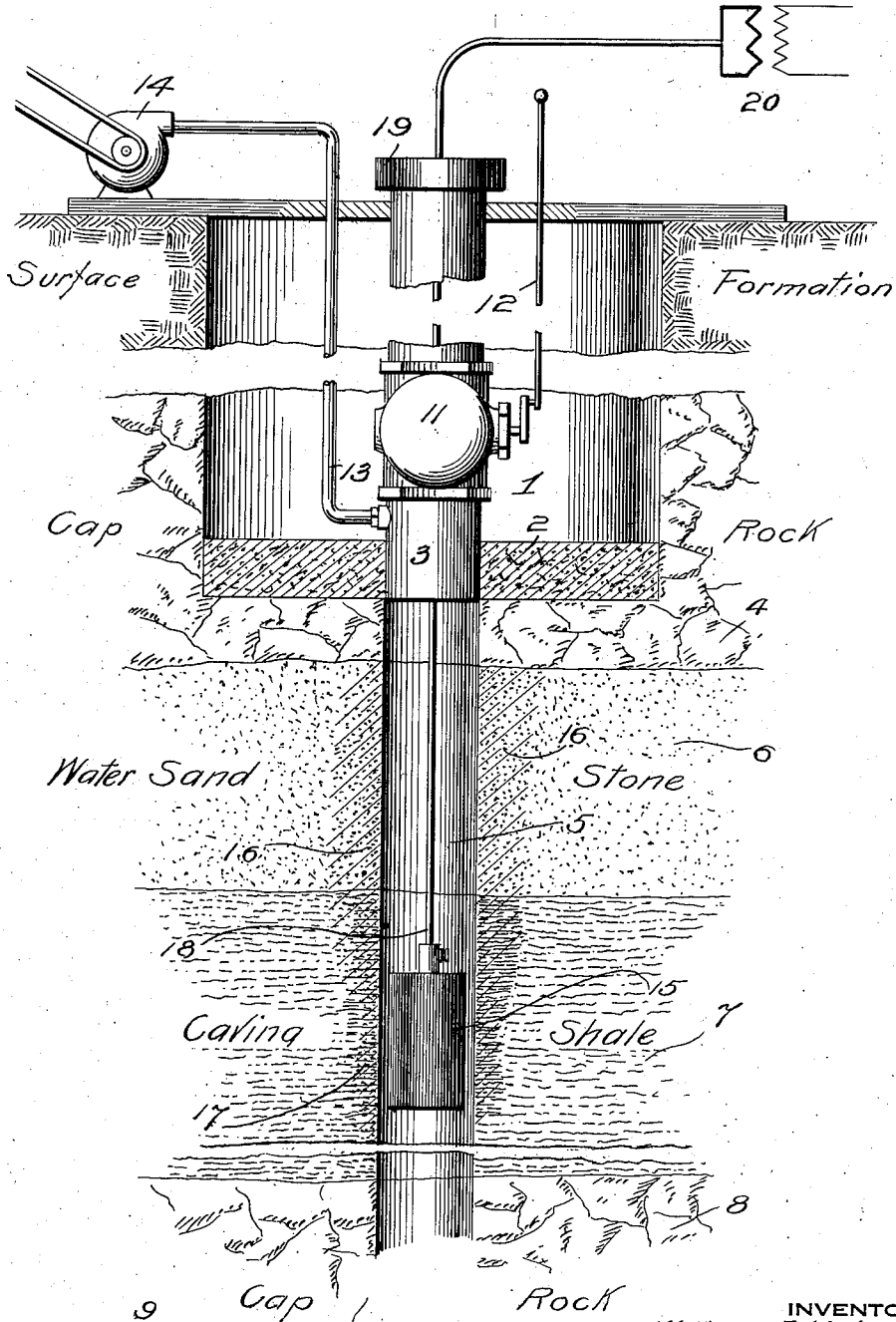


W. E. NOLAN.
METHOD OF SEALING THE WALLS OF OIL WELLS.
APPLICATION FILED APR. 3, 1920.

1,361,282.

Patented Dec. 7, 1920.



WITNESSES

E. E. Duffy

F. T. Chapman

Gas Sand Stone
BY
Oil Sand Stone

INVENTOR

William E. Nolan

E. G. Siggers

ATTORNEY

UNITED STATES PATENT OFFICE.

WILLIAM E. NOLAN, OF TULSA, OKLAHOMA.

METHOD OF SEALING THE WALLS OF OIL-WELLS.

1,361,282.

Specification of Letters Patent.

Patented Dec. 7, 1920.

Application filed April 3, 1920. Serial No. 371,053.

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 Sealing the Walls of Oil-Wells, of which the following is a specification.

This invention has reference to a method of sealing the walls of oil wells and its object is to avoid the necessity of applying casing to the wells to prevent leakage, or seepage or cave-ins.

Ordinarily oil wells are drilled to a great depth and extend through strata which, at many points, may be of so unstable a nature that, unless artificially sustained, very readily cave in. Also the bore frequently traverses water-bearing strata and such water must be excluded from the bore for, otherwise, it would interfere with the production of the oil to the extent of entirely stopping it.

In the ordinary procedure of drilling oil wells, which may reach three or four thousand or more feet in depth, cave-ins and the inflow of water is prevented by employing metal casing following the sinking of the drill into the earth. In such drilling, after the surface layer has been pierced, which layer in some localities, such as the Texas oil fields, may reach sixty or more feet, cap stone strata is encountered, such stone strata usually consisting of limestone, which is impervious to both oil and gas, and to water. As the drill hole progresses past the cap stone strata it may pass through hundreds, or even thousands of feet of shale, which would render the bore practically impossible were it not for the casing. Underlying the shale is usually a layer of cap stone overlying the gas-bearing sand stone which, in turn, covers the oil-bearing sand stone, or sand, as it is commonly known.

In the ordinary procedure of boring an oil well several distinct casings are employed. The well starts with an outer casing of, say, fifteen to twenty inches in diameter, such casing being carried into the earth for, say, four to five hundred feet. Thence follows a hole bored concentrically with the first casing to a depth of say a thousand to twelve hundred feet. The second hole is lined with, say, 12½" casing from the surface of the ground to a depth of one thousand to twelve hundred feet. Then fol-

lows a smaller bore to accommodate from fifteen hundred to two thousand feet of 10" casing followed by a smaller bore to accommodate twenty-five hundred to three thousand feet of 8" casing, and, finally, there is drilled a bore extending into the ground from three to four thousand feet and taking 6½" casing. The different sizes of casing telescoped one within the other, all reaching to the surface of the ground or into a cellar. In an oil well of the depth of say 4,000 feet, which is not at all uncommon in the Texas region, the total amount of casing needed reaches nearly 11,000 feet, sometimes less, but, in any event, representing a length of casing several times that of the depth of the well.

The cost of such a casing together with the work of drilling the well and installing the casing and the losses encountered from various causes will make the cost of sinking a 4,000 foot well reach in the neighborhood of from eighty to one hundred thousand dollars, or more, and oftentimes such a well proves to be a non-productive or dry well, or duster, as they are termed in the oil field. Sometimes the casing may be withdrawn and saved but sometimes the well is a total loss in all respects.

In accordance with the invention the use of casing is entirely avoided and the walls of the bore are sealed against both collapse and leaking by producing a surface fusing of the material of the wall of the bore, such fusion and consequent closing up of the pores of the wall sometimes reaching several feet from such walls laterally into the earth. Such fusing and sealing of the walls is caused by the application of heat which may be accomplished by electrically heating the walls by the employment of an intensity of heat sufficient for the purpose.

The invention not only avoids the expense of metallic casing for the bore but also avoids the expense of installing such casing and the costs due to the frequent failure of the well to produce. The invention of course does not insure a productive well, but several wells may be sunk at a cost no greater than that of sinking a single well in accordance with the common practice.

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

In practising the invention there is first produced a cellar or pit 1 of sufficient diameter and depth, which latter may approximate say 60 feet. At the bottom of the pit there is a layer 2 of cement of sufficient thickness to hold and seal a short length 3 of casing. The cellar 1 is carried down to cap rock indicated at 4 and usually found at less than 60 ft. under ground. If the cap rock is deeper down then the cellar 1 is correspondingly deeper.

After the cellar 1 has been formed and the casing section 3 has been set a bore 5 is carried down from the bottom of the casing 3 through the underlying strata, usually consisting of water-bearing sand stone 6, caving shale 7, cap rock 8 and gas and oil-bearing sand stone 9 and 10, respectively, when the well is an oil producing well and not a dry well. The shale stratum 7 is by far the most extensive one and the arrangement of strata is, substantially, that of the Texas oil fields. Usually oil is struck at from three to four thousand feet and, customarily, such wells are cased in the manner already stated to prevent the entrance of water from the strata 6 into the bore and the caving of the shale 7, which is of an unstable nature, into the bore. In accordance with the invention air under pressure is introduced into the bore 5 as it is formed and sufficient air pressure is employed to hold back the water which may occur in the strata 6 from entrance into the bore. It is to be understood that the formation indicated in the drawing is but a general representation, since the strata may be multiplied and, to an extent, repeated, before the oil-bearing sand stone is reached, but the drawing indicates in general the formation which is encountered in the Texas oil fields and which also occurs in other oil fields.

In order to maintain a desirable air pressure within the bore while being formed the casing 3 is provided at a suitable height with a valve 11 having a controlling rod 12 reaching to the surface of the ground, or to other appropriate point where it may be manipulated. Entering the casing 3 below the valve 11 is a pipe 13 supplied with air under pressure by a force pump 14 driven in any desirable manner, usually by electricity so as to avoid the necessity of em-

ploying steam engines, boilers, etc., in the neighborhood of the well.

The method of drilling oil wells without casing them before described herein forms the subject matter of an application for a method of drilling wells filed by me on March 31, 1920, Serial No. 370,226. The present application has more particular reference to a method of sealing or lining the walls of the bore to avoid the necessity of using metallic casing in the customary manner. For this purpose there is provided an electric heater 15 of suitable capacity to bring about the melting and coalescence of the material of the walls of the bore producing thereby a sort of slag or glass penetrating the walls to a sufficient extent to produce a lining 16, impervious to moisture and strong enough to prevent the collapsing or caving of the shale. The electric heater may be made in accordance with the usual practice of forming electric heaters capable of producing a high degree of heat like that produced in the electric furnace, and the heater 15 is so constructed that it may be moved lengthwise of the bore in close relation to the walls thereof, and, in the confined space of the bore, causing the requisite high temperature. Experience has shown that the material encountered in boring the well will, under the heat employed, melt to a flowing consistency and so cement the shale walls and melt the water-bearing sand stone into a glass-like slag which will naturally run down the walls of the water-bearing sand stone, drying them out and filling up the pores of the sand stone so that the flow of the water into the well bore is effectively prevented. The slag-like formation in the sand stone layer 6 is indicated at 16 and the melted and coalesced shale is indicated at 17. It is unnecessary to continue the heating below the casing shale as the cap rock strata 8 is impervious to water, both rock formations 4 and 8 being formed of lime stone.

Preliminary to the heating operation, whereby the water-bearing and unstable walls of the bore are rendered impervious to water and are stabilized, the bore is made down to the cap rock overlying the gas and oil bearing sand stone with the water held by and caving prevented by suitable air pressure established in the bore. After the bore is produced the drilling tools are withdrawn with the holding pressure still maintained and the heater 15 is introduced into the bore and moved along the latter at a rate and in a manner to cause the sealing of the water-bearing sand stone and the coalescence of the caving shale, thereby producing a permanent lining from materials already present in the walls of the bore and at a cost far less than the usual casing employed.

The heater 15 is furnished with a heating current through a cable 18 extending through the casing 3, the cable 18 being properly sealed where passing through a cap 19 at the top of the casing 3 and which cap may be above ground. In the drawing there is indicated a transformer 20 with which the cable 18 is connected, the transformer being of the character to furnish the heating current. No attempt is made to show in the drawing the type of transformer, or transformers, which may be employed, since these features are all familiar to electrical engineers.

After the walls of the bore are sealed against the admission of water and so coalesced that caving can no longer occur, the air pressure may be cut off and the heater withdrawn and the well put into service in the usual manner.

The invention eliminates to a large extent the necessity of the use of expensive casing and the various troubles which occur with such use, for oftentimes in introducing the casing various troubles occur resulting in the total loss of the casing and of the well for the collapsing of the casing and the impossibility of withdrawing casing causes the abandonment of wells which have not yet reached the oil bearing strata, which abandonment would not be necessary where the well is formed and lined in the manner hereinbefore described.

The heating outfit may be used repeatedly and so entails little or no cost after the initial installation, except for current, and while such cost may be considerable it is not to be compared to the cost of casing and the sinking of such casing with attendant losses, sometimes resulting in the total loss of the well.

While the transformer 20 is shown as located above ground it is understood that the transformer may be and preferably should be located in the bore as near as practicable to the heater, since the heating current is a very low voltage current of great amperage requiring heavy conductors.

What is claimed is:

1. The method of sealing the walls of oil wells which consists in electrically heating the walls of the water-bearing and caving

strata of the formation through which the well is bored, with the heat of an intensity to cause the melting and coalescing of the material of the walls.

2. The method of sealing the walls of oil wells which consists in subjecting the walls to the action of heat of an intensity to cause the melting and coalescing of the material of the walls and at the same time subjecting the walls to internal pressure holding the material against flow and collapse of the walls until the melted material has cooled and set.

3. The method of sealing the walls of oil wells which consists in subjecting the walls to the effect of electrically produced heat in close heat transferring relation to said walls for a time and with the heat of an intensity to produce the melting of the material of the walls and its flow and coalescence into the form of a lining, thereby sealing the walls against the flow of liquids therethrough and the collapse of the walls when they have cooled to the normal temperature of the well.

4. The method of sealing the walls of oil wells traversing water bearing and collapsible or caving strata which consists in establishing, in operative relation to the portions of the walls to be sealed, electrical heat conditions to dry out and melt the water bearing material to self-coalescing softness and to melt the caving material to coalescing softness whereby when the walls cool there is produced a slag-like lining impervious to liquids and sealed or anchored against caving.

5. The method of sealing the walls of oil wells traversing water-bearing and unstable or caving strata, which consists in electrically heating the walls while subjected to internal pressure, to a degree causing the softening and melting of the material of the walls to produce coalescing thereof while held by the internal pressure and continuing the internal pressure after the heat is cut off until the material of the walls has set and thereby formed into a natural casing.

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

WILLIAM E. NOLAN.