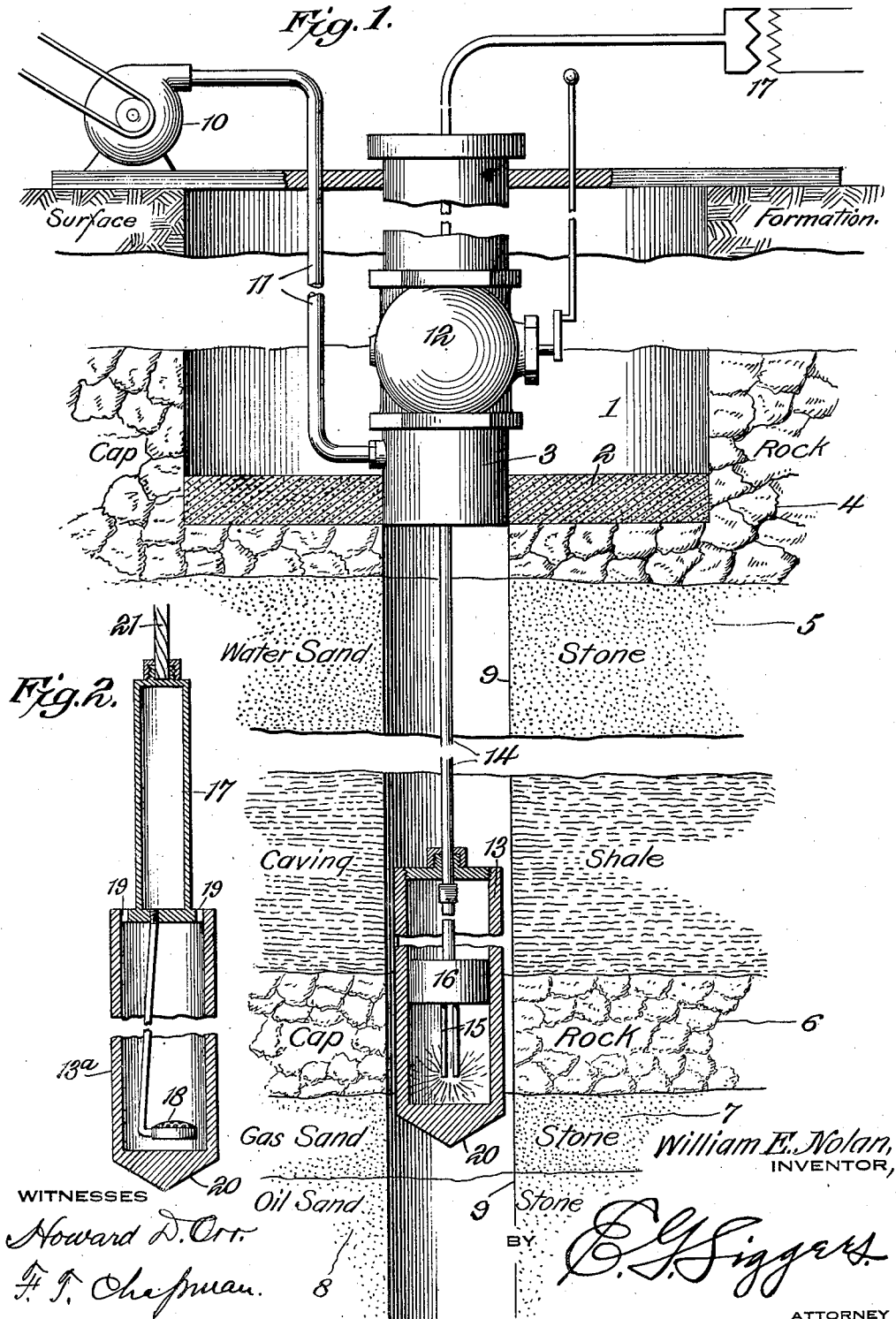


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METHOD OF SEALING THE WALLS OF DEEP WELLS.
APPLICATION FILED APR. 28, 1920.

1,398,563.

Patented Nov. 29, 1921.



UNITED STATES PATENT OFFICE.

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Specification of Letters Patent.

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

This invention has reference to the method of and means for lining oil wells where- by the use of the customary metal casing is avoided, the cost is very materially reduced and numerous expenses and failures are done away with.

The strata through which bores for oil are made may be quite similar in different parts of the country and usually consist of surface dirt, limestone underlying it, followed by water-bearing sandstone, then many hundreds or even thousands of feet of a formation known as shale, which is of a friable, crumbly nature, then more limestone and more sandstone, or sand, as it is ordinarily termed, such sand containing gas and oil. In the Texas oil fields the oil bearing strata may occur three or four thousand feet below the surface of the ground.

Such a well when lined with metal casing is highly expensive to produce, costing, with the casing, from eighty to one hundred thousand dollars or more.

If such a well prove non-productive, which sometimes occurs, the boring of the well and oftentimes the metal casing thereof, are a total loss and even when the casing is recovered the loss is very heavy.

As explained in my applications No. 370226, filed March 31, 1920, for method of drilling wells; and No. 371053, filed April 3, 1920, for method of sealing the walls of oil wells, it is feasible to omit the usual metal casing with its high expense and many disadvantages, and to provide a bore of relatively small size, whereby the cost of boring is reduced, and to seal the walls of the bore in such manner as to prevent the influx of water from the water-bearing strata and to seal the walls against collapse by coating them with a strongly adherent, resistant material preventing collapse or crumbling or caving of the walls.

In accordance with my application No. 371053, the lining is non-metallic and as efficient as, or more efficient than, the usual metal casing and also representing but a small fraction of the cost of such metal casing. A similar effect may be produced by

employing an initially flowable casing which may be produced from cement in a more or less fluid condition forced and held against the walls by a suitable core which latter is heated in order to quickly dry and harden the cement.

Like conditions may be produced by the use of sulfur, or a mixture of sulfur and lime, or fire-clay in a semi-fluid condition, the sulfur, or mixture of sulfur and lime, being rendered fluid or flowable by heat produced within the core.

Sulfur is advantageous either alone or as an ingredient of a mixture, where it may be obtained in large quantities and within ready transportation distance of the oil field, as, for instance, the Texas oil fields. Furthermore the sulfur, or sulfur mixture, produces a hard smooth and tenacious coating impervious to both water and oil, thus sealing the walls of the well against both influx of water and the collapse, or caving, of the shale.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings forming part of this specification, with the understanding, however, that the invention is not confined to any strict conformity with the showing in the drawings, 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.

In the drawings:

Figure 1 is a schematic representation of an oil well produced in accordance with the invention.

Fig. 2 is a longitudinal central section through a fluid burner which may be employed in the practice of the invention.

In practising the invention there is first formed in the surface of the ground a pit, or cellar, 1 of sufficient depth, say about 60 feet, and of suitable diameter to admit certain workmen and certain mechanisms or structures. For the protection of the bottom of the pit a layer or flooring 2 of cement or other suitable material is provided. Traversing such layer in the upright axial line of the pit is a short length 3 of casing. The cellar 1 is carried to cap rock indicated at 4 and which may be considered as consisting of limestone which in turn overlies a layer or layers of shale often being some

thousands of feet thick. The shale rests upon other cap rock 6 in turn resting upon gas sand 7 which in turn covers oil sand 8, the layers 7 and 8 corresponding to, or consisting of, sandstone and comprising the gas and oil bearing strata from which the oil is obtained.

For the purpose of drilling and in order to hold back the flow of water into the bore of the well being drilled, and also to prevent caving of the walls of the bore where traversing the unstable shale, a sufficient air pressure is maintained within the bore, indicated at 9 and there is provided, say at the surface of the ground, means for producing such air pressure such as an air pump 10 connected by a pipe 11 to the casing 3 into which it discharges and this casing may be capped by a valve 12 so that the air pressure may be maintained in the bore sufficiently to hold the walls intact and prevent the flow of water into the bore.

In order to effect the sealing of the bore walls *in situ* there is provided a core 13 carried by a rope or cable 14 from the surface of the ground so that the core may be located at any desired point or points along the bore. Within the core 13, which is hollow, there are located suitably related electric arc terminals 15 so disposed that on these terminals being connected up in an electric circuit and current supplied an arc is produced.

The core 13 is made of refractory material such, for instance, as alundum obtainable on the market in suitable manufactured shapes.

The core 13 is made of a size to move freely along the bore 9 and the electrodes 15 between which the arc or arcs are formed are carried by a supporting block 16 so as to be about equidistant from the inner walls of the core 13.

The cable 14 may be conveniently formed of suitable conductors connected to the terminals of the transformer 17 at the surface of the ground, or in any other suitable location, permitting currents of appropriate character to be fed to the arc terminals 15, whereby an intense heat may be produced within the core 13 at a temperature sufficient to raise that of the walls of the bore to a degree causing the softening, melting and final coalescing of the shale forming the walls of the bore.

While electrically produced heat is the most easily managed, the heating of the walls of the bore may be otherwise accomplished. The invention may, however, be carried out with other sources of heat capable of being localized in the bore in close heating relation to the walls thereof and capable of adjustment along the bore, whereby the glazing effect upon the walls may be accomplished. As an example, reference is directed to Fig. 2 where there is shown a core 13^a similar to

the core 13, and made of the same or equivalent material. The core 13^a carries a tank or reservoir 17 for a supply of fluid fuel, such as gas, and the reservoir 17 is connected to a burner 18 lodged in the core 13^a and connected to the tank 17. The core 13^a may be provided wherever necessary, with perforations 19 permitting the escape of the products of combustion from the burner 18 to rise to the top of the well to be there disseminated.

It is evident that the cores 13 and 13^a, and the means for heating them while within the bore of the well, are sufficient to indicate that numerous other means for the purpose may be employed without it being necessary to illustrate and describe various other forms for the purpose.

During the boring operation, or after it has been sufficiently completed, the walls of the bore may be effectively sealed against leakage or caving by the local application of heat, either produced electrically as indicated in Fig. 1, or by the means of a fuel and suitable burner as indicated in Fig. 2.

In the practice of the invention and in order to properly distribute the heat and the material constituting the lining when such material is other than the shale constituting the walls of the well, the core is moved up and down thus causing a distribution of the heat and of the softened and flowable material. For this purpose the lower end of the core is more or less pointed, as indicated at 20, in both Figs. 1 and 2. In the structure shown in Fig. 2 the core is supported by a cable 21 so that the core may be moved up and down the same as the core 13 in Fig. 1.

In the practice of the invention the boring is continued below the casing section 3, which may be, for example, an 8" casing or in some instances smaller, until the shale has been penetrated for a suitable distance, say fifteen or twenty feet, and then the boring tool is withdrawn and the heating element represented by the core 13 or 13^a inserted. The treatment by heat is continued until a molten or flowable condition is produced in the case of the shale or the like and a glass-like surface covers the walls of the bore rendering such surface, when cooled and hardened, impervious to water and cementing the shale against caving tendencies. In the case of the production of the coating from cement, the latter is applied to the soft state and heated, and at the same time smoothed and dried until firm by the heating element or elements housed in the core.

When the preliminary portion of the bore has been thus coated or cased, the heater is withdrawn and the boring tools introduced and the boring continued to as great a depth as may be deemed advisable in accordance with the nature of the material bored. In this manner the well is produced by alter-

nate boring and coating or casing by forming the casing as needed within the well, until the oil sand is reached and the flow of the well is assured.

5 What is claimed is:

1. The method of lining the walls of the bores of deep wells, which walls are of crumbly nature, which consists in spreading a lining material over the walls, while such
10 material is subjected to the action of heat, and withdrawing the heat while the lining material hardens.

2. The method of lining deep wells, which consists in applying to and localizing on the
15 walls of the bore of the well a lining material capable of responding to the action of heat, with the thickness of the lining determined by the clearance between a movable core and the walls of the bore, with the core inclosing
20 a source of radiant heat.

3. The method of producing and lining deep wells, which consists in first producing a bore of determined depth, with the walls of the bore sustained by air pressure, then
25 producing a smooth layer of material on the walls of the bore over a localized area thereof by a suitable core, producing heat within the core of an intensity to affect material constituting the lining of the walls and ultimately allowing the lining to harden.
30

4. The method of producing lined deep wells, which consists in first forming a bore to determined depth, then introducing a core into the bore with the core having means for

generating heat therein of an intensity to
35 soften lining material between the core and the walls of the bore, moving the core in the bore to spread the lining material, and permitting the solidification of the lining material into a self sustaining layer capable of
40 sealing the bore against leakage and cavings thereinto.

5. The method of lining the bores of deep wells, which consists in introducing a core into the well bore in loosely fitting relation
45 thereto, introducing sulfur between the core and the walls of the bore and softening the sulfur by heat generated in the core, and moving the core lengthwise of the bore to spread the softened sulfur over the walls of
50 the bore.

6. The method of lining deep wells, which consists in providing a core loosely fitting the well bore and movable therealong, introducing a mixture of sulfur and lime into
55 the space between the core and the wall of the bore, heating the mixture by the application of heat thereto produced within the core and conducted through the walls of the latter to the mixture, and moving the core
60 lengthwise of the bore to spread the heated and softened mixture over the walls of the bore for the production of a lining when the mixture has cooled.

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

WILLIAM E. NOLAN.