

June 23, 1931.

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1,811,560

METHOD OF AND APPARATUS FOR RECOVERING OIL

Filed April 8, 1926

4 Sheets-Sheet 2

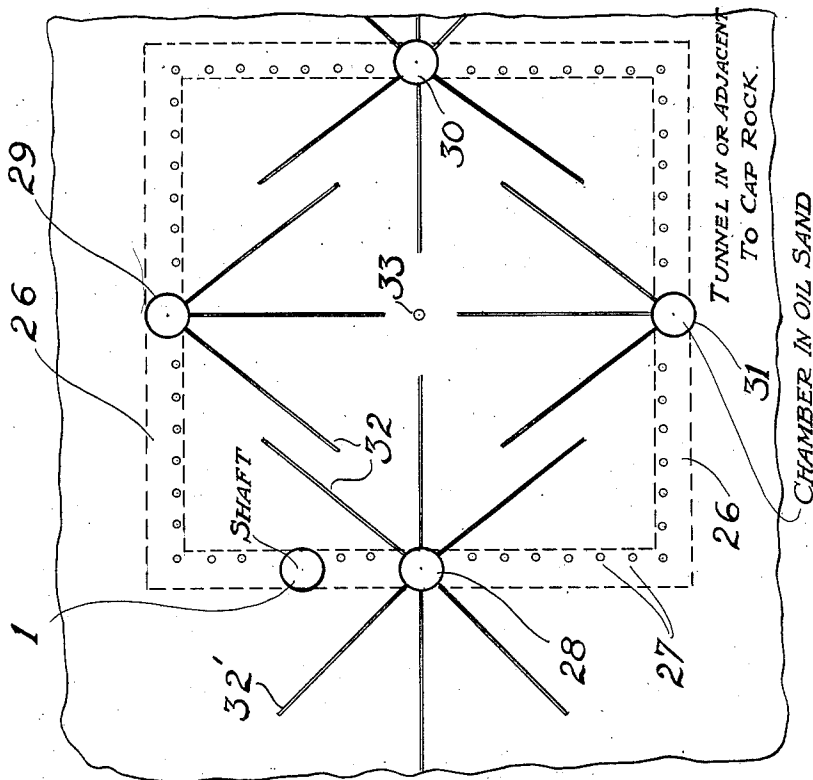


FIG. 4

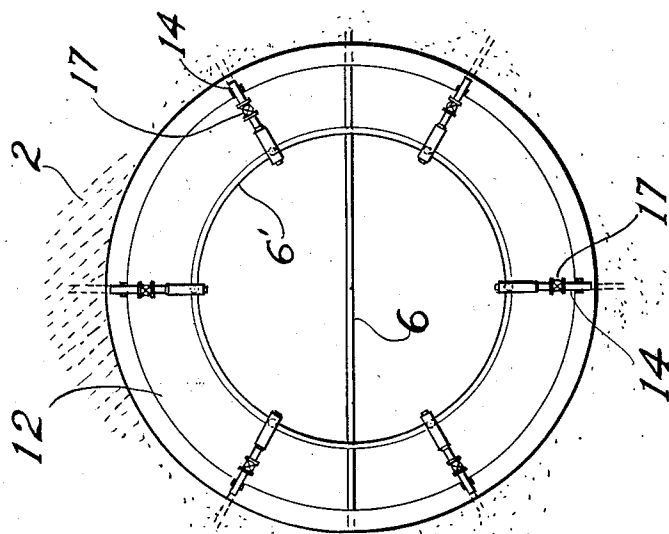


FIG. 2

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4 Sheets-Sheet 3

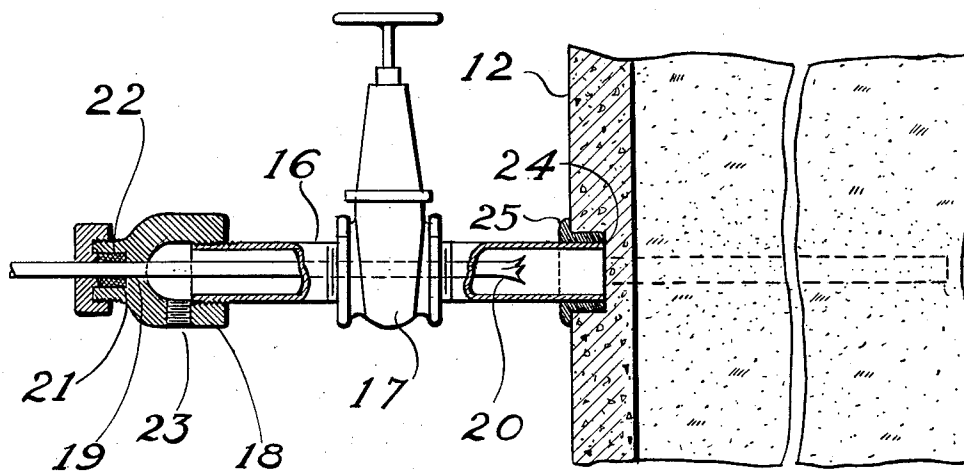


FIG.-3

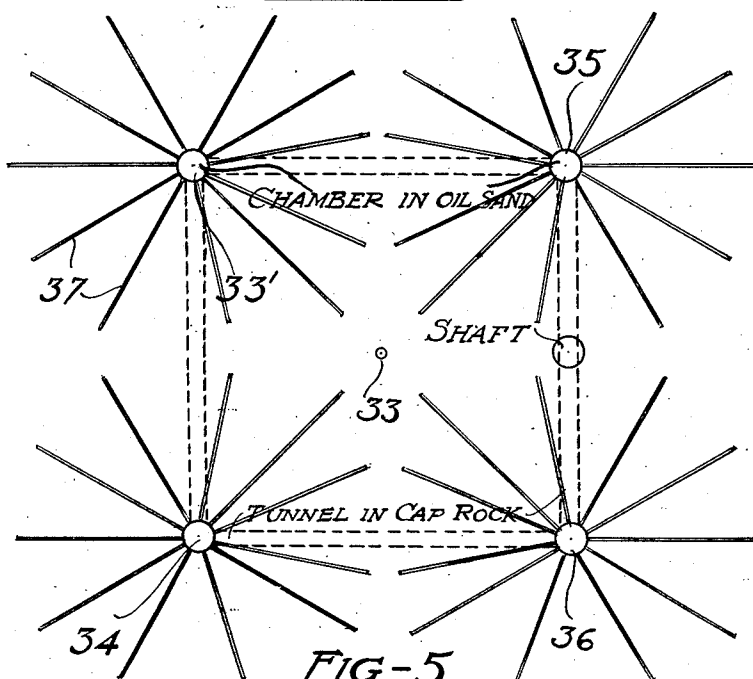


FIG.-5

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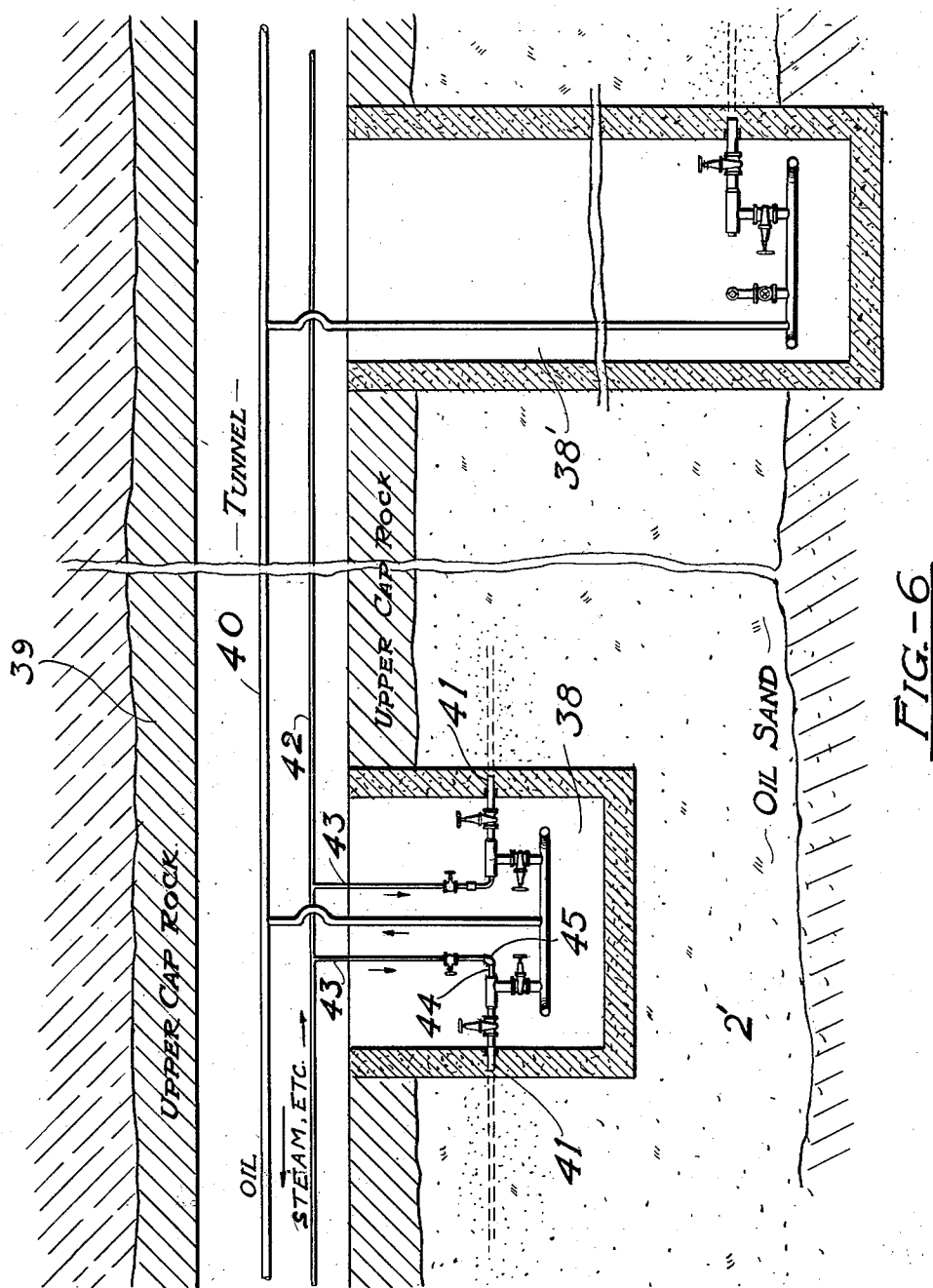
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR RECOVERING OIL

Application filed April 8, 1926. Serial No. 100,531.

This invention relates to improvements in the recovery of oil from the earth by operations of the general type described and claimed in my United States Patents Nos. 1,634,235 and 1,634,236 granted June 28, 1927, of which the present application is a continuation in part. The invention will be fully understood from the following description, taken in connection with the accompanying drawings, in which

Fig. 1 is a diagrammatic vertical section showing an oil recovery system installed in accordance with my invention;

Fig. 2 is an enlarged horizontal section taken on line II—II, Fig. 1;

Fig. 3 is a longitudinal section through a preferred form of connection for drilling into the oil sand;

Figs. 4 and 5 are diagrammatic horizontal sections illustrating methods of tapping extended areas of oil sand; and

Fig. 6 is a fragmentary vertical section illustrating an alternative to that shown in Fig. 1.

Referring first to Figs. 1 and 2, a shaft 1 is sunk from the surface of the earth to a point adjacent an oil-bearing stratum 2. In the embodiment of the invention illustrated in these figures, the shaft is sunk through the sand 2 and into the lower cap-rock 3. A suitable impervious wall 4, which may advantageously be of concrete, is provided around the shaft where it traverses the oil sand, so as to prevent escape of gas, oil, or water into the shaft. A mine gallery or tunnel 5 is driven from the foot of the shaft in a direction generally parallel to the plane of the oil-bearing stratum 2. Mine galleries extending in as many directions from the shaft as is desirable may be provided.

The gallery 5 traverses the lower cap-rock 3 and is isolated thereby from the oil-bearing sand 2. An oil-collecting pipe 6 is arranged in the gallery and is provided with nipples 7 sealed in the lower cap-rock by impervious material 7a. Such material may be tar, lead turnings, or the like. These nipples form "mine wells" and are preferably arranged at relatively closely spaced intervals throughout the gallery. Each nip-

ple is provided with a valve, so that flow therethrough may be controlled as required. A pump 8 forwards the oil through pipes 9 and 10 to a surface reservoir 11. The system so far described resembles that shown in my prior applications above referred to.

In accordance with the present invention, I excavate one or more chambers 12 in the oil sand and drill or bore outwardly from these chambers into the sand. The chamber 12 is preferably walled and roofed with concrete 13. The present process is not recommended for use in fields where very high gas pressure prevails; in low pressure fields the excavation and concreting of the chamber 12 may be accomplished without undue difficulty. The usual precautions should of course be taken against fire and the effect of any gas upon the workmen.

A number of nipples 14 are fitted in perforations 15 formed for them in the wall of the chamber 12. The nipples are sealed in the wall by an impervious material 14a, or they may be set in place while the concrete is still plastic. They do not extend quite through the wall. It is desirable that all gas, oil and water be excluded from the workings, and after the chamber 12 has been completed no opportunity is given for access of such fluids from the sand to the chamber, gallery, or shaft except through the pipe system. A valve 14' is provided in the pipe connecting each nipple with the header 6', which discharges through pipe 6'' into the main collecting pipe 6. The flow through these nipples may be individually and selectively controlled.

Precautions against inflow of fluids while drilling are not essential in most of the fields best suited for working by my process. I prefer, nevertheless, to employ a drill fitting of the type shown in Fig. 3, because it is convenient and provides safeguards against any unexpected rush of gas or oil. The fitting comprises a nipple 16 having a gate valve 17 installed at an intermediate portion. The rearward end of the nipple is screw-threaded or otherwise arranged to receive a cap 18, which is centrally perforated for passage of the hollow stem 19 of the drill bit 20. A

stuffing box 21 containing packing 22 forms a part of the cap and seals the drill stem. The cap also contains one or more lateral openings 23 screw-threaded or otherwise arranged for connection to the gas-, oil- or water-collecting pipes.

In operating this type of drill fitting a hole 24 is first drilled in the wall of the chamber 12, but not through into the sand, or the nipple may be set in the concrete, as above mentioned. The gate valve is opened and the drill passed through it into the forward portion of the nipple. The cap 18 is then screwed in place and drilling may be commenced. Additional sections of drill stem are added as the drill penetrates the sand. Water for flushing the hole is passed into the hollow drill stem and is withdrawn with the cuttings from opening 23. When it is desired to remove the drill, it is drawn back past the open gate valve 17, which is then closed. The cap may accordingly be safely taken off and the drill removed, since flow is stopped by the gate valve. The invention is not limited to the use of this particular mechanism; other suitable drill fittings will serve, frequently even though they provide no means for preventing escape of fluids when withdrawing the drill.

By drilling laterally from the chamber in the manner described, I am able to effect a very complete recovery of the oil from the sand. This is due not only to the extended area for drainage of oil into the collecting system, but also to the fact that the sand is tapped at the bottom. In this way the effect of gravity is utilized to the greatest extent. The drilled holes may be run at any desired angle from the chamber. One method of working a tract or lease of forty acres, in the form of a square, is shown in Fig. 4 in which a tunnel or mine gallery 26 is excavated around the margin of the field. A number of collecting nipples 27 forming mine wells, preferably 132 on each side of the tract, are formed in the manner shown in Fig. 1. In addition, chambers 28, 29, 30 and 31 are excavated respectively at about the middle point of each side of the tract. These chambers are like those described in connection with Fig. 1.

From the chambers lateral holes 32 are drilled out into the sand in such manner as to tap the greatest possible area. A radiating arrangement as shown is desirable. No difficulty is experienced in drilling to the desired distance in most sands. Usually the formation is not too hard to prevent passage of the drill, but is sufficiently strong to stand boring without caving. Two or three inch diameter holes may be drilled through the usual oil sand without any substantial danger of being stopped by caving of the sand. Drilling proceeds satisfactorily up to a lat-

eral distance of 500 to 1000 feet or more from the chamber.

A well 33 is preferably sunk in the interior of the tract to serve as an inlet for air, gas, or other fluid. When such well is provided, the fluid is best forced through it into the oil sand. In this way pressure is always exerted upon the oil and prevents the formation of low pressure areas that would retard flow. A single well is usually sufficient for this purpose, but more may be provided if desirable.

Although not absolutely essential, the introduction of air or other gas is highly desirable. When oil is withdrawn from the bottom area of the oil sand, as in accordance with the preferred form of the present invention, there is a tendency for the upper portion of the sand to retain by capillarity a considerable amount of oil. I have found that this oil may be expelled in large part, if the pressure prevailing in the sand is not allowed to fall substantially. For example, if the initial pressure in the sand is 30 lbs. per sq. in., I force in air through the central well to maintain this pressure throughout the period of oil withdrawal. This causes the oil level to fall regularly, and the absorption and retention of oil in the upper areas is for the most part avoided.

If the operator has a tract adjacent to that enclosed by the gallery shown in Fig. 4, holes 32' may be drilled outwardly to tap it. A single mine gallery and chamber may thus serve as a point of attack for a very large area. The arrangement of the chambers shown is merely illustrative. They may be placed at the corners of the tract or elsewhere, as may be most convenient in view of the particular conditions to be met.

The corner arrangement of the chambers, illustrated in Fig. 5, is particularly suitable for working a number of adjacent units. As shown, the chambers 33' 34, 35, and 36 are formed at the corners of a forty-acre tract and the radiating holes 37 are formed in all directions into that tract and those adjoining it. A central pressure well 33 is provided, as described above. I may dispense with the mine wells formed from the gallery, when a large number of holes are drilled from the chambers.

To facilitate the flow of oil I may use heat, suction, pressure or other agencies. Heating may be accomplished for example in the manner described in my above mentioned application Serial No. 14,448, closed or open steam pipes being inserted in the oil-collecting nipples. Ordinarily it is unnecessary to use flow-facilitating means in view of the very extended area of drainage openings formed by the lateral drilling into the sand from the chambers.

Fig. 6 illustrates an embodiment of the invention in which one or more chambers or pits 38, 38', are excavated through the upper

cap-rock 39 into the oil-bearing sand 2'. Each pit 38, 38', is preferably provided with walls and floor, of concrete, or equivalent material. Suitable covers for the pits, or run-ways for the passage of the workmen, will be provided. An oil-collecting pipe 40 and nipples 41 are provided. A pipe 42 for steam, compressed air, or other fluid, has branches 43 passing into the pit 38, and entering the nipples 41. If it is necessary to clean out the holes, a fluid under pressure is injected through pipes 43 and into the nipples through pipes 44. An easily removable joint 45 should be provided between pipes 43 and 44, so that additional sections may be added to the latter. For the removal of sediment it is desirable to extend pipe 44 into the hole, until the obstructing mass is reached, and then inject steam, compressed air, or water, through the pipe. The sediment will be swept out by the fluid between the pipe and the wall of the hole. Suitable provision for receiving the sediment-carrying fluid will be made; for example, a tank with a pump line leading to the earth surface. Superheated steam is suitable for use when the effect of heat in facilitating flow is desired.

If the sand is underlain by water, the pits should not be excavated below the upper region of the sand. As the oil is withdrawn from this region the water will rise and force the oil ahead of it. If hydrostatic pressure of this nature is not available, it is usually best to sink the pit (as 38') as near as may be to the bottom of the sand. By drilling at the bottom, gravity flow is best utilized. Air or other gas may be injected, as described above, to force the oil level downward. In some cases the same sand may be worked with pits of varying depth. Ordinarily, however, a sand will require tapping either at the top or at the bottom.

It will be understood that the thickness of cap-rock and oil-bearing strata varies greatly. The drawings do not purport to show any particular thickness. The tunnels outside the sand may often be formed in strata lying above or below a relatively thin cap-rock.

Various changes and alternative arrangements in the above-described illustrative procedure may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention as broadly as the prior art permits.

I claim:

1. Method of recovering oil from the earth, comprising forming a gallery adjacent and generally parallel to the oil-bearing stratum, forming a chamber within the oil-bearing stratum but spaced therefrom by a wall of impervious material, drilling a plurality of elongated openings from said chamber and into the oil-bearing stratum in a plane substantially parallel to the gallery, and indi-

vidually and selectively controlling simultaneous flow from a number of said openings.

2. Method of recovering oil from an oil-bearing stratum, comprising forming a mine gallery adjacent and generally parallel to the stratum but spaced therefrom by a substantially impervious material, excavating a chamber from the mine gallery into the oil-bearing stratum, sealing the chamber with respect to the stratum, drilling laterally from the chamber into the stratum in a plane substantially parallel to the gallery, and collecting the oil from the drilled openings through a system sealed with respect to the chamber and the mine gallery.

3. Method of recovering oil from the earth, comprising sinking a shaft to a point adjacent an oil-bearing sand, forming from the shaft a mine gallery adjacent the sand but spaced therefrom by cap-rock, excavating in the sand a chamber communicating with the mine gallery, isolating the chamber from the sand by means of a wall of impervious material, drilling laterally from said chamber a plurality of elongated openings into the sand in a plane substantially parallel to the gallery, and collecting the oil from the drilled openings in a pipe system.

4. Method according to claim 3, in which the gallery is run through the lower cap-rock and the chamber is made in the overlying oil-bearing sand.

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