May 12, 1931. C. F. JACKSON 1,804,692

METHOD AND APPARATUS FOR WORKING OIL SANDS

Filed Sept. 27, 1926 4 Sheets-Sheet 1

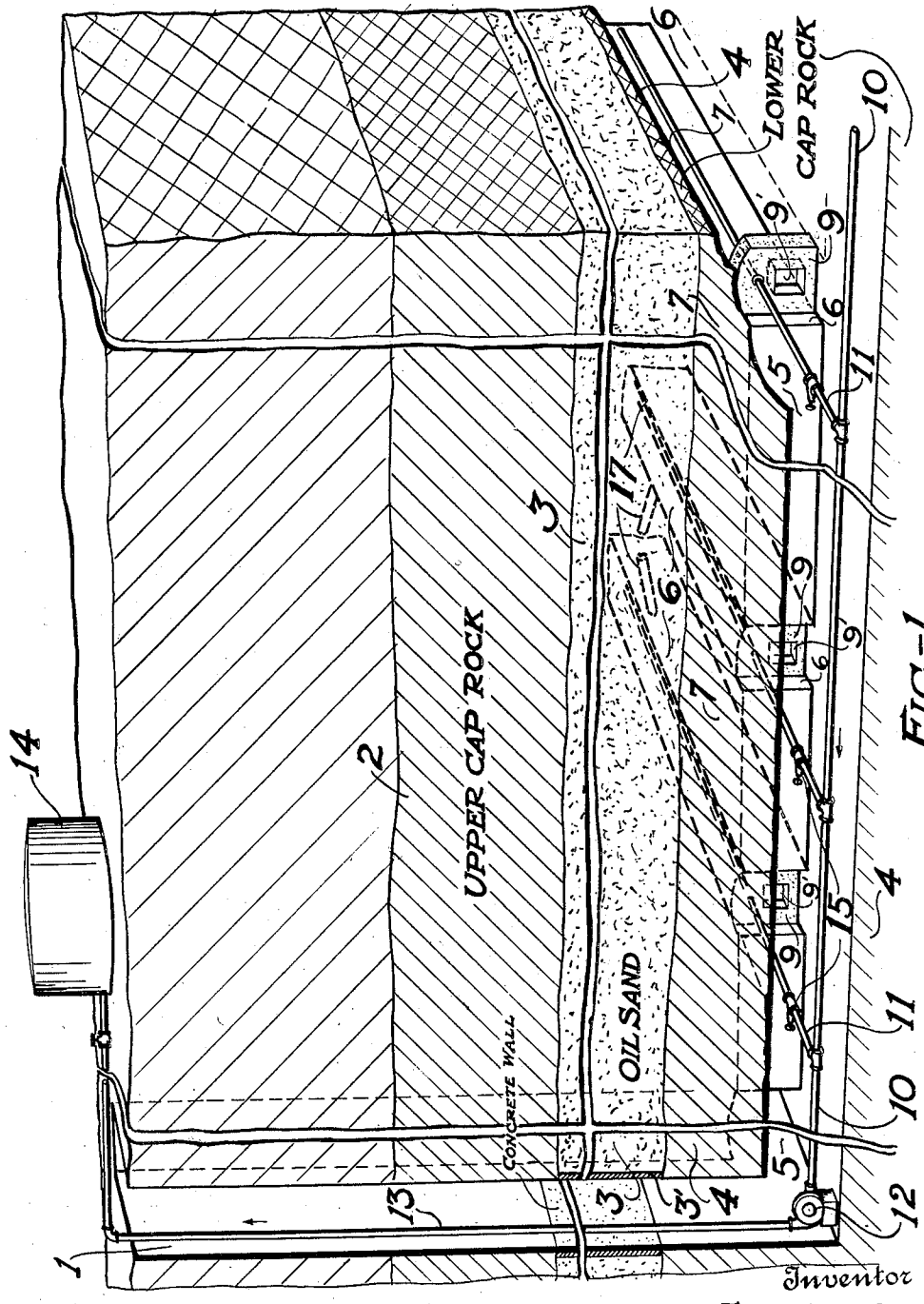


FIG.-1

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METHOD AND APPARATUS FOR WORKING OIL SANDS

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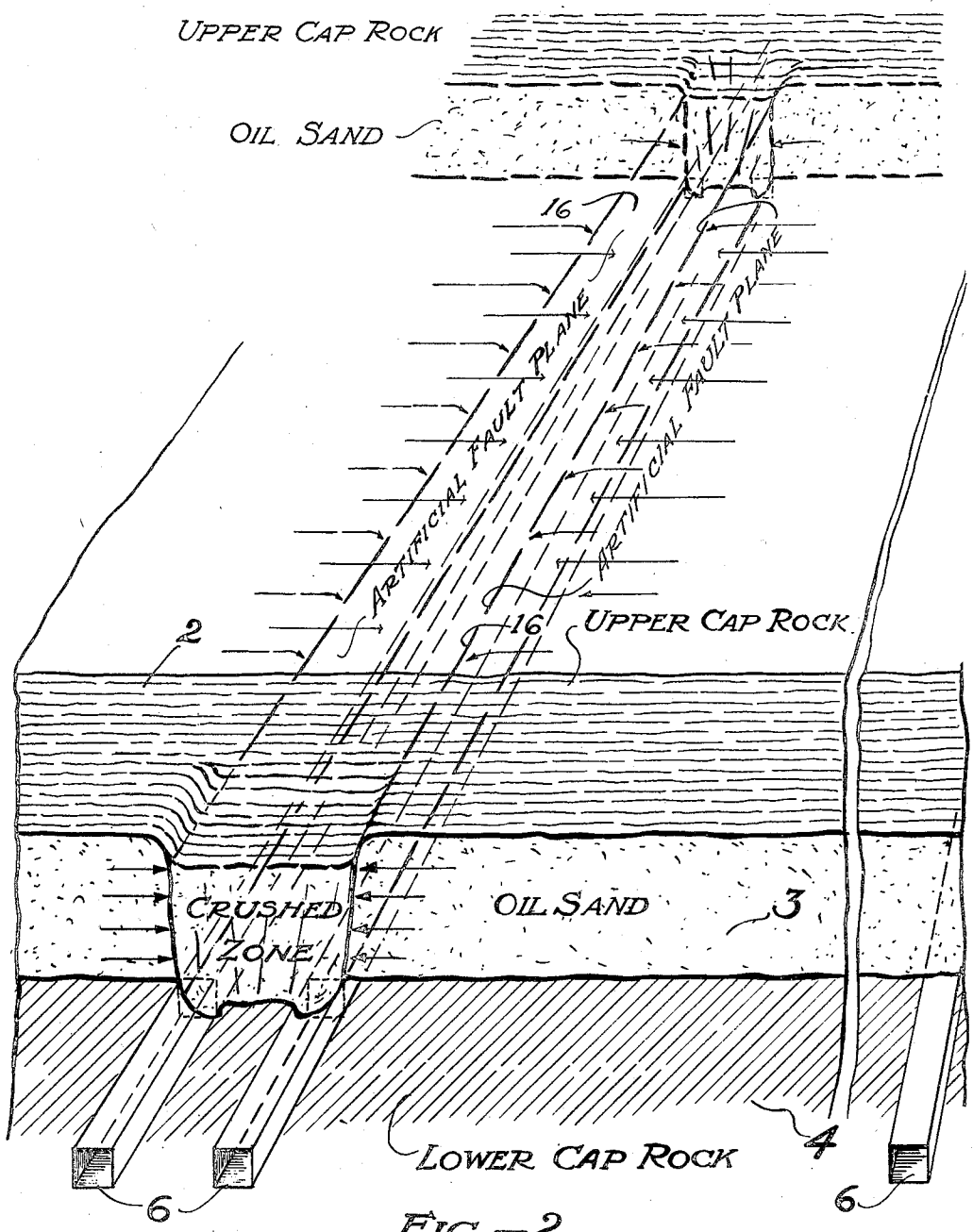


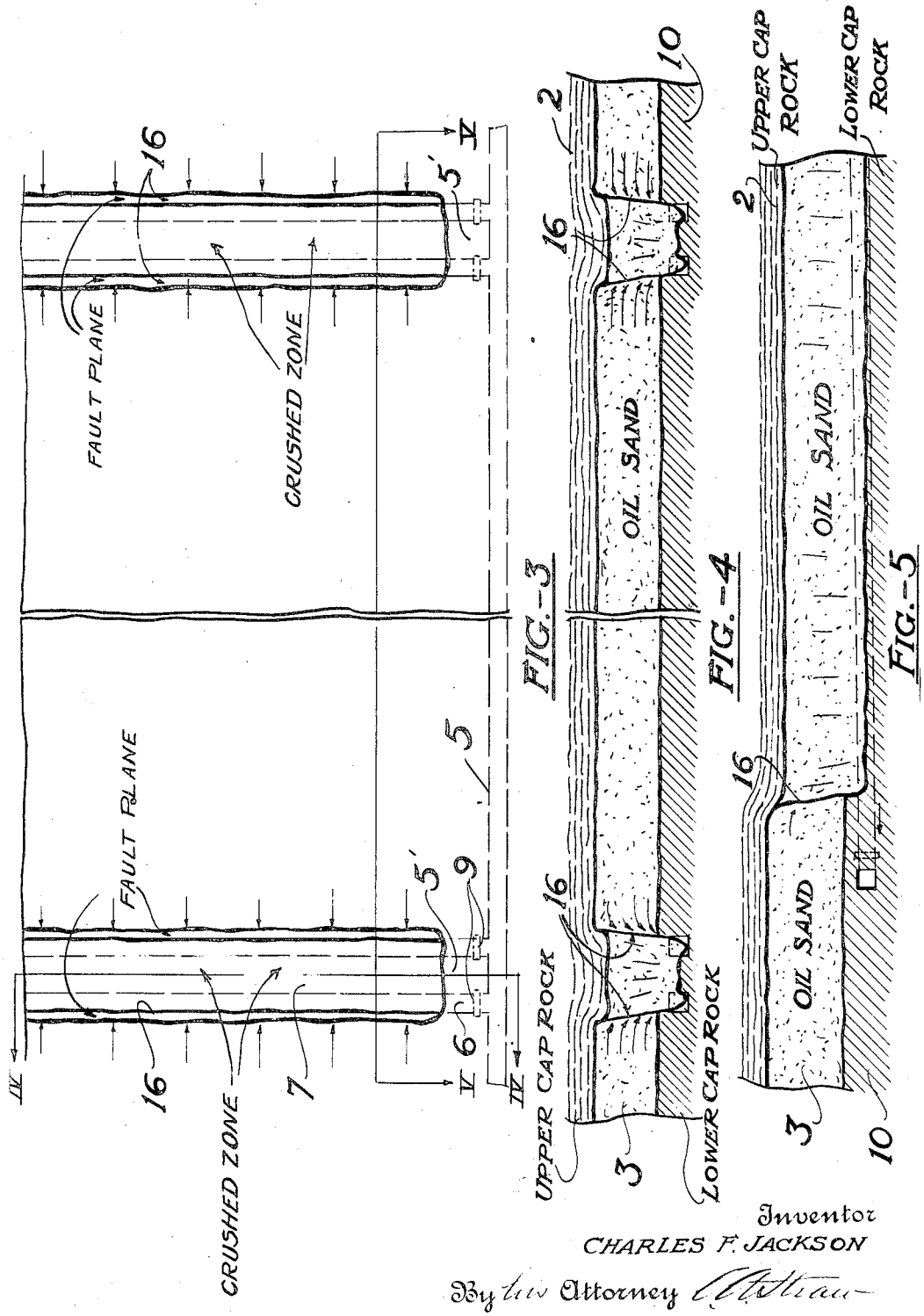
FIG. —2

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METHOD AND APPARATUS FOR WORKING OIL SANDS

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METHOD AND APPARATUS FOR WORKING OIL SANDS

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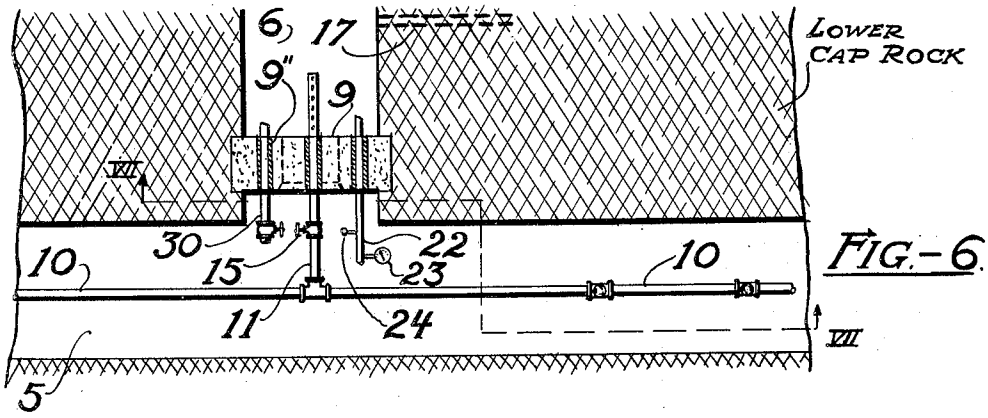


FIG.-6.

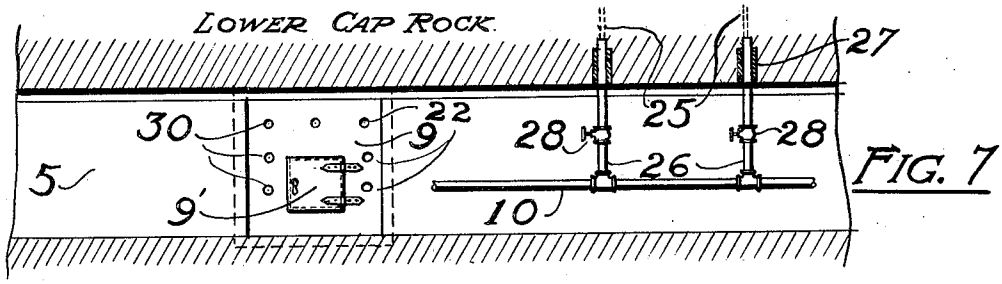


FIG. 7

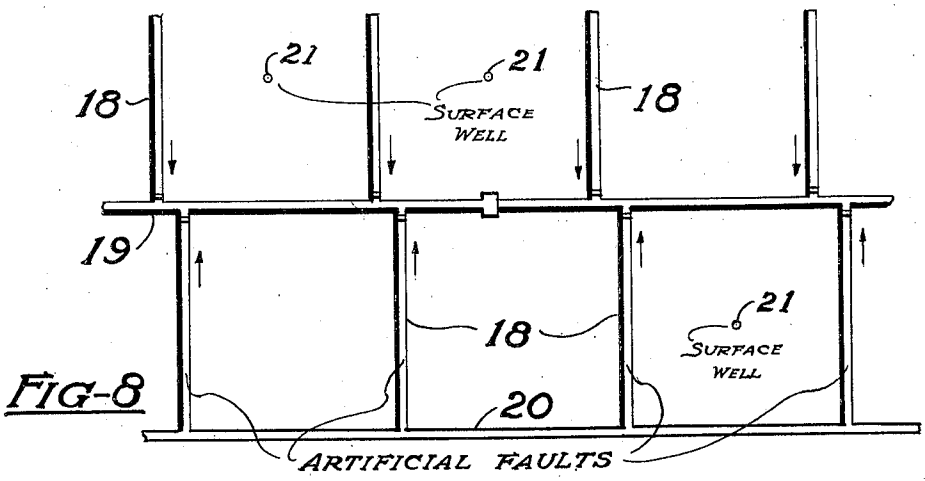


FIG-8

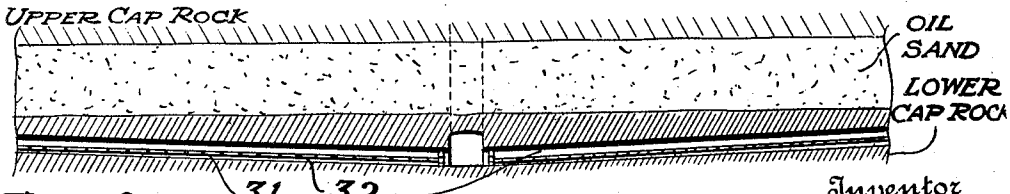


FIG.-9

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Patented May 12, 1931 1,804,692

UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR WORKING OIL SANDS

Application filed September 27, 1926. Serial No. 137,871.

This invention relates to improvements in the recovery of oil from the earth by mining operations, and comprises the formation of an extensive disrupted area or artificial fault in an oil-bearing stratum. Oil is collected from the drainage zone thus formed.

The invention will be fully understood from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a diagrammatic perspective and sectional view through a mine gallery installation, according to the invention, before the formation of the artificial fault;

Fig. 2 is a fragmentary view similar to Fig. 1 and showing the condition after the fault has been formed;

Fig. 3 is a plan view corresponding generally to Fig. 2, and Figs. 4 and 5 are sections taken respectively on the lines IV—IV and V—V, Fig. 3;

Fig. 6 is an enlarged horizontal section through one of the mine galleries;

Fig. 7 is a vertical section on the line VII—VII of Fig. 6;

Fig. 8 is a plan view illustrating a preferred arrangement of the artificial faults; and

Fig. 9 is a diagrammatic vertical section showing another form of mine gallery.

Referring first to Figs. 1 to 5 of the drawings, reference numeral 1 denotes a mine shaft traversing an upper cap rock 2 overlying an oil-bearing stratum or oil sand 3. The shaft is sealed from the oil sand by a concrete wall 3, or other suitable means.

The shaft penetrates the lower cap rock 4, and a mine gallery or tunnel 5 is driven from the bottom of the shaft through the lower cap rock, or other substantially impervious stratum beneath the oil sand. Branch galleries 6 are formed from one or both sides of the main gallery 5, and extend in a generally parallel direction beneath the oil sand. All the galleries are as close to the sand as is practicable and safe.

The branch galleries 6 serve, first, as a means for securing access to the wall of rock 7 lying between adjacent galleries 6, and secondly as a reservoir or drainage basin into which the oil flows after that wall of rock has been disrupted, as subsequently described.

Heavy bulkheads or partitions 9, of concrete or other suitable material, are set near the entrance of each branch gallery. The bulkheads are preferably imbedded in the rock on all sides, as shown in Figs. 6 and 7, to increase the strength of the bulkheads, and prevent leakage of fluids around them into the main gallery 5. A door 9′ is provided in each bulkhead.

A collecting pipe 10 is laid in the gallery 5, and is connected with nipples 11 which pass through the bulkheads 9 and into the branch galleries 6. The pipe 10 is connected through a suction pump 12 with a pipe 13 which leads to the above-ground storage tank 14. Valves 15 are installed in the nipples 11, so that the flow of fluids from the region behind the bulkheads may be controlled.

After the bulkheads and collecting system have been installed, the wall of rock 7, lying between the branch galleries 6, is shattered by blasting. In some cases the blasting may extend to overlying strata, to increase the rapidity of settling. The wall 7 may first be weakened, if necessary, by cutting away portions, or in any other suitable way. The rock must be so disrupted that it will not support the weight of the oil sand and other strata above it. The débris of the rock wall 7 is forced out into the galleries 6 by the descending oil sand. There is usually a considerable period of slow settling, causing artificial faults, indicated by numerals 16, Figs. 2 to 5, to be formed.

Oil drains into the faults from an extensive area of sand, and gravitates into the branch galleries 6, which serve as adequate collecting reservoirs. By producing artificial faults in this way, a very large exposed sand surface is formed and the drainage of oil is correspondingly rapid. Moreover, all horizontal partings of shale, limestone, or other impervious rock in the sand stratum are broken so that oil has easy passage from the top of the sand to the bottom at the fault line and thus drains into the reservoirs. The oil is

taken off through the nipples 11 to the collecting pipes 10 and 13.

To insure safety in the main gallery 5, a relatively thick rock barrier 5′ (Fig. 3) is left between the gallery and the area of disrupted rock. As shown in Figs. 1 and 6, the drill holes 17 for the explosive charges are not formed close to the main gallery.

The bulkheads 9 are preferably installed before the explosive charges are set off. By leaving the doors 9′ in the bulkheads open, ample space is provided for the exit of gases formed by the explosion. When the doors 9′ are closed, the main gallery 5 is completely shut off from the branch galleries 6. It will be noted that the pipes 11 are sealed in the bulkheads by sealing material 9″.

The workings will be provided with the usual ventilation fans, and the like, which are well-known in the mining industry.

The size and spacing of the branch galleries will depend upon the nature of the sand to be worked. In applying the invention to well consolidated sands, the parallel branch galleries should be about 5 x 7 feet, in cross section, and about 15 to 20 feet apart. The pairs of galleries should be arranged at intervals of 400–500 feet, though in some fields adequate drainage may be obtained with artificial faults formed by the aid of pairs of galleries a thousand feet or more apart. No artificial faults are formed near enough to the shaft to cause caving of the shaft. Where an oil sand is very thin and in other cases, instead of two parallel galleries, only one gallery may be driven; then the roof of this gallery may be weakened by slabbing off the rock on one or both sides of the gallery, until the roof caves in and the sand settles down.

In Fig. 8 I have illustrated a preferred arrangement of artificial faults 18. These faults extend in opposite directions from the main gallery 19. In some cases it is desirable to provide a main gallery on both sides of the area to be worked, and in Fig. 8 a second main gallery 20 is illustrated.

The method of operation described is well adapted for use with various expulsive agents or flow-facilitating agents, such as air, gas, or water, or with the use of vacuum. For example, air or gas may be passed into the oil sand through surface wells 21, Fig. 8, drilled to tap the sand. This air or gas introduced under the proper pressure, say about 100 pounds per square inch, passes outward from the well toward the artificial faults, and expels the oil from the interior portions of the sand into the faults, from which it drains into the collecting pipes.

It is desirable to insert one or more test pipes 22 (Figs. 6 and 7) through the bulkheads 9. Each of these pipes is equipped with a pressure gauge 23, a liquid gauge 24, and any other measuring or indicating instrument that may be useful. It is sometimes desirable to take off fluids at different levels from the branch galleries, and for this purpose a series of pipes 30 may be installed at varying heights through the bulkheads. These pipes are provided with control valves and are connected with a collecting system (not shown).

Instead of introducing air or other expulsive agent through a surface well, it may be passed in through nipples extending through the bulkheads 9. Either a scrubbing gas or super-heated steam may be forced into the drainage faults 16, and through them into the oil-bearing stratum.

Mine wells 25 (Fig. 7), comprising nipples 26 sealed in the lower cap rock by sealing material 27 and penetrating the oil sand, serve for the collection of oil along the line of the main gallery 5. The mine wells are provided with control valves 28. These wells may be used as a means for introducing an expulsion agent by connecting them with an air or gas line, or the like.

In Fig. 9 I have shown an installation adapted for use where the sand is not well consolidated. In this installation large perforated pipes 31 are laid along the branch galleries 32. These pipes provide adequate drainage, even though the galleries become substantially filled with the loose sand working down from above, which may become more or less compacted. Fig. 9 also illustrates an idea which is useful in both consolidated and loose sands; that is, the upward inclination of the branch galleries from the main gallery. In this way a gravity flow of oil is produced toward the main gallery from an extensive area of sand.

It may be necessary, in some cases, to apply a coating of cement, or other impervious material, to the rock around the bulkheads; otherwise, if this rock is porous, oil will seep out from the branch galleries into the main gallery. A coating of cement applied by a cement gun will prevent difficulty from this source. A cement gun may also be employed to line the floors and part of the sides of all reservoir galleries to prevent the escape of oil into the pervious rock, should this precaution be necessary.

It should be noted that the artificial faults need not follow section lines or form squares. For instance, in a monocline most of the faults (possibly all of them) would run parallel along the strike. The fault lowest on structure will receive all water rising up the dip and when pumped out is kept from encroaching on the rest of the sand. Or a suitable wall may be built in a fault at any place to wall off water or prevent the escape of oil or gas. This wall may be formed by filling the fault with cement or the like.

It will be understood that the foregoing description of the invention is illustrative of preferred forms only, and that various changes and alternative arrangements 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. The method of operating an oil field, which comprises forming a main gallery with a pair of adjacent and substantially parallel branch galleries a short distance below the oil-bearing stratum, drilling holes for explosive charges in the region lying between the branch galleries, except near the main gallery, exploding charges in said holes to disrupt and weaken said region, whereby the oil-bearing stratum is caused to settle with the formation of an artificial fault therein, preventing access from said branch gallery to the main gallery, except through collecting pipes, and withdrawing oil through said pipes.

2. The method of operating an oil field, which comprises forming a main gallery with a pair of adjacent and substantially parallel branch galleries a short distance below the oil-bearing stratum, installing a partition between each branch gallery and the main gallery, fitting a collecting pipe in each partition, disrupting and weakening the region between the branch galleries, whereby the oil-bearing stratum is caused to settle with the formation of an artificial fault therein, and withdrawing oil through said collecting pipes.

CHARLES F. JACKSON.