Aug. 6, 1940. K. GROSSE ET AL 2,210,582

METHOD FOR THE EXTRACTION OF PETROLEUM BY MINING OPERATIONS

Filed Sept. 12, 1938 6 Sheets-Sheet 1

Fig. 1

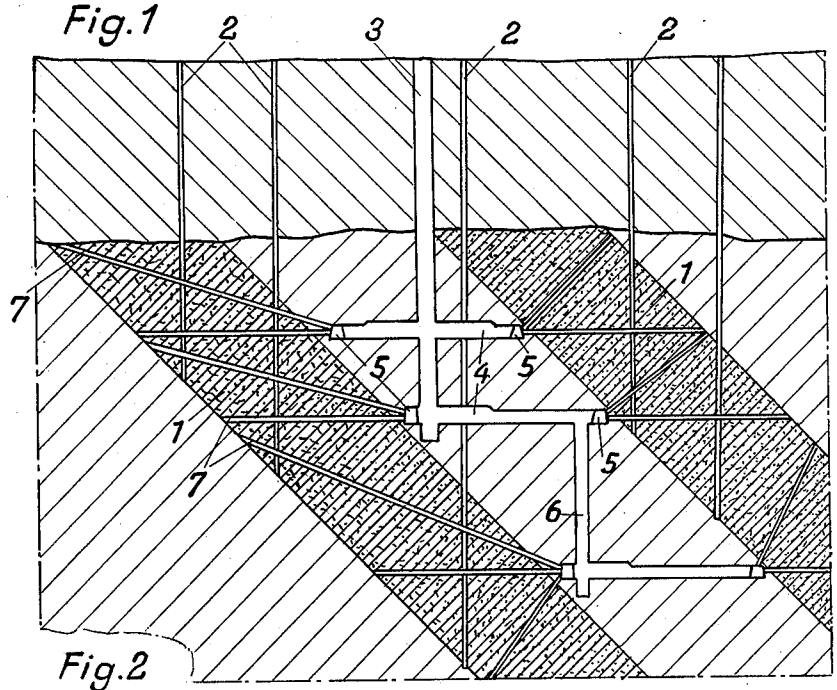
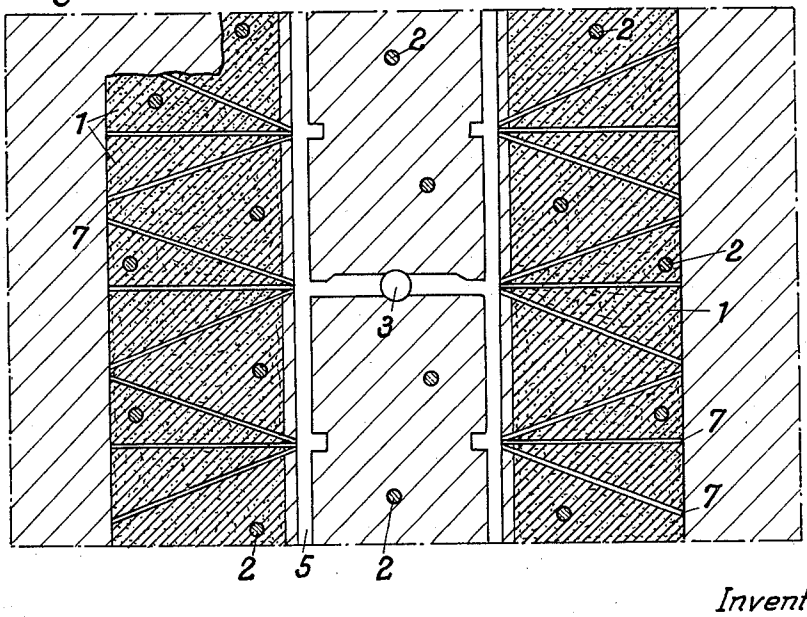


Fig. 2



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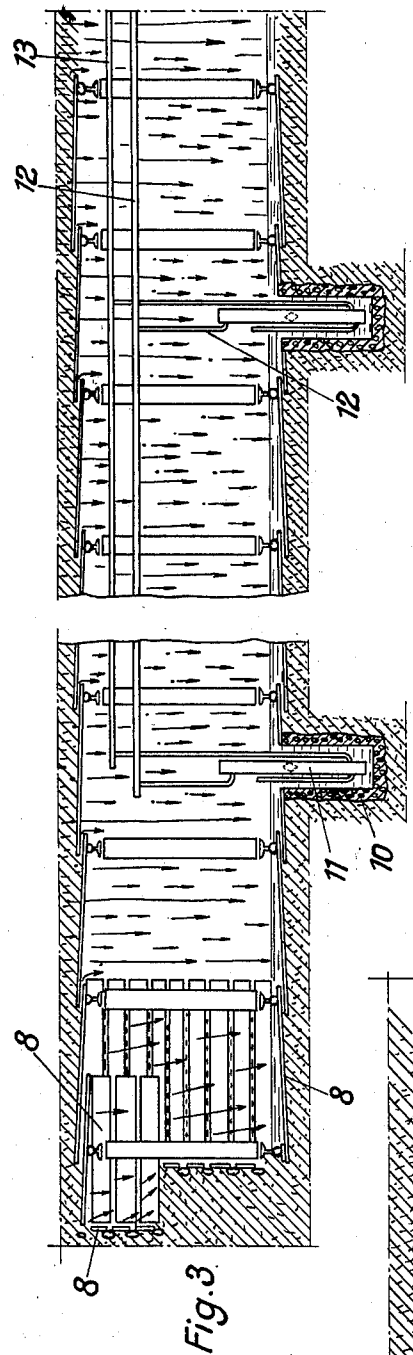


Fig. 3

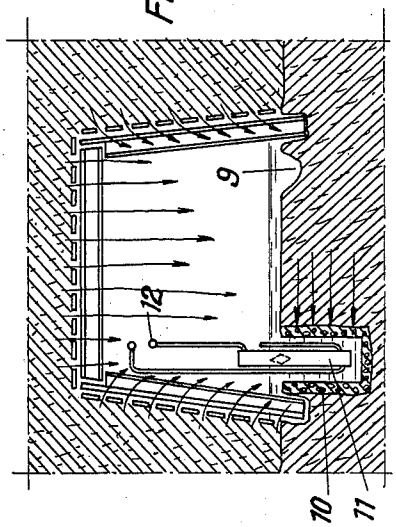


Fig. 4

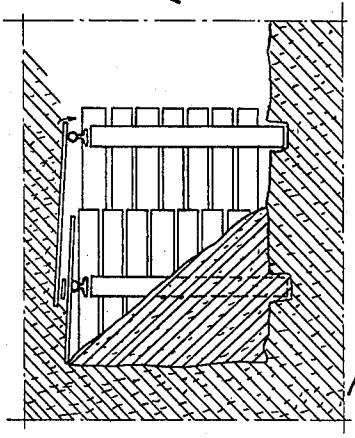


Fig. 5

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METHOD FOR THE EXTRACTION OF PETROLEUM BY MINING OPERATIONS

Filed Sept. 12, 1938 6 Sheets-Sheet 3

Fig. 6

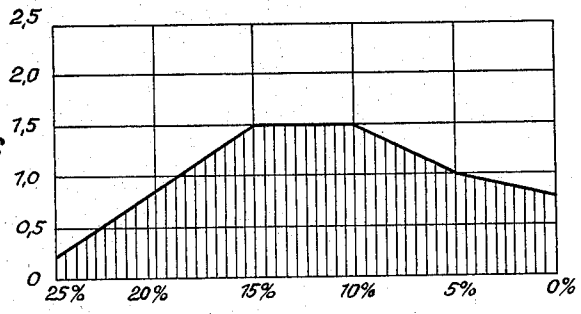
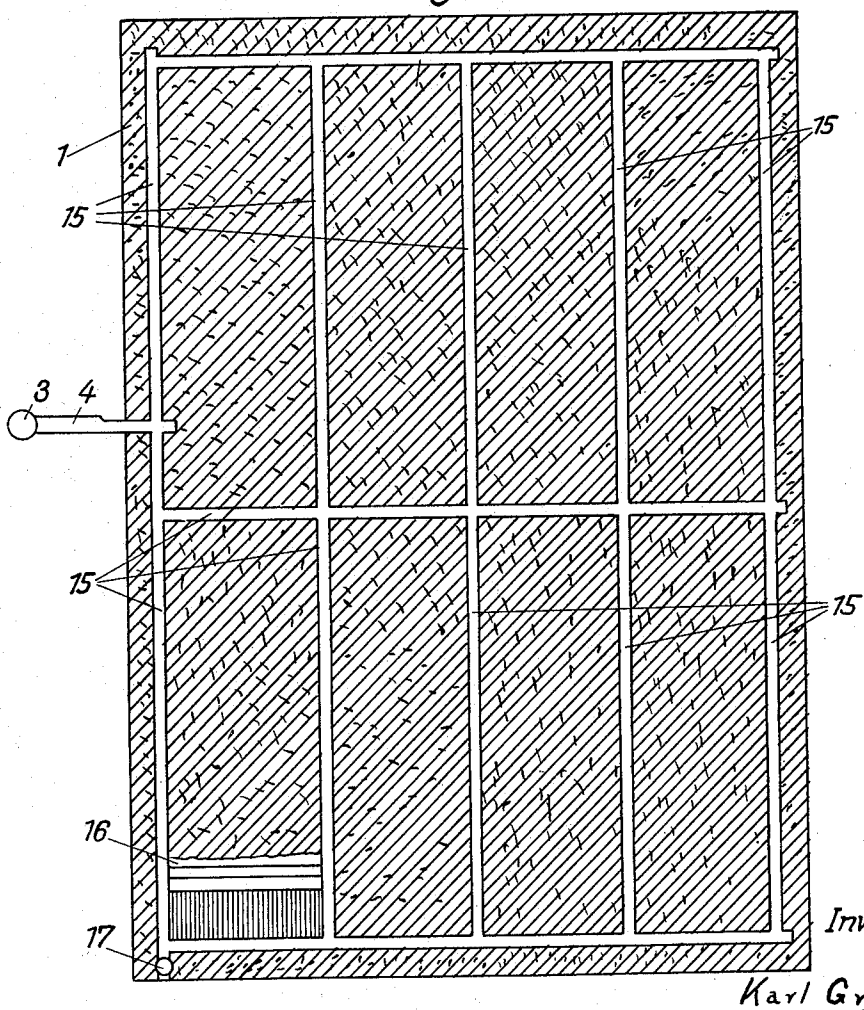


Fig. 7



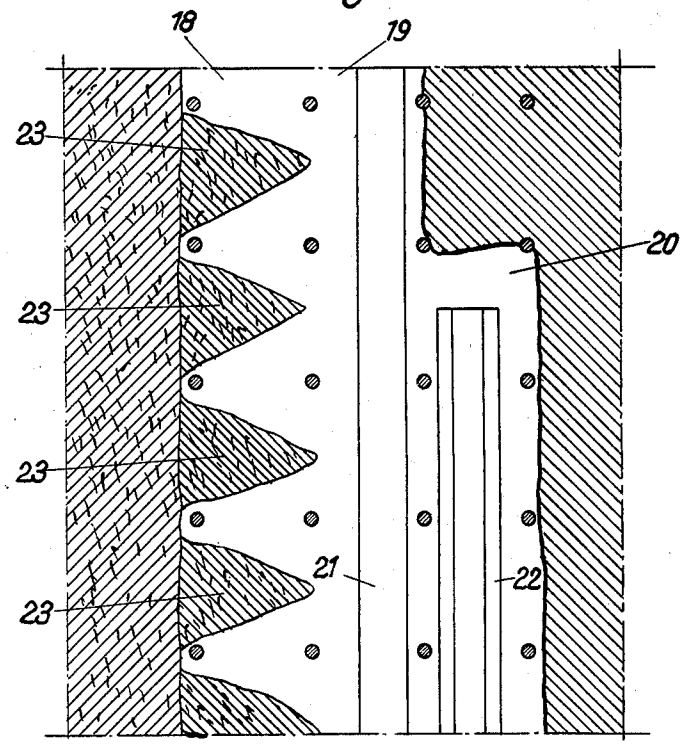
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Aug. 6, 1940. K. GROSSE ET AL 2,210,582

METHOD FOR THE EXTRACTION OF PETROLEUM BY MINING OPERATIONS

Filed Sept. 12, 1938 6 Sheets-Sheet 4

Fig. 8



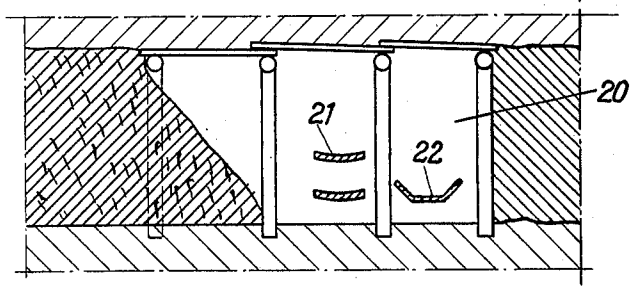


Fig. 9

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Aug. 6, 1940. K. GROSSE ET AL 2,210,582

METHOD FOR THE EXTRACTION OF PETROLEUM BY MINING OPERATIONS

Filed Sept. 12, 1938 6 Sheets-Sheet 5

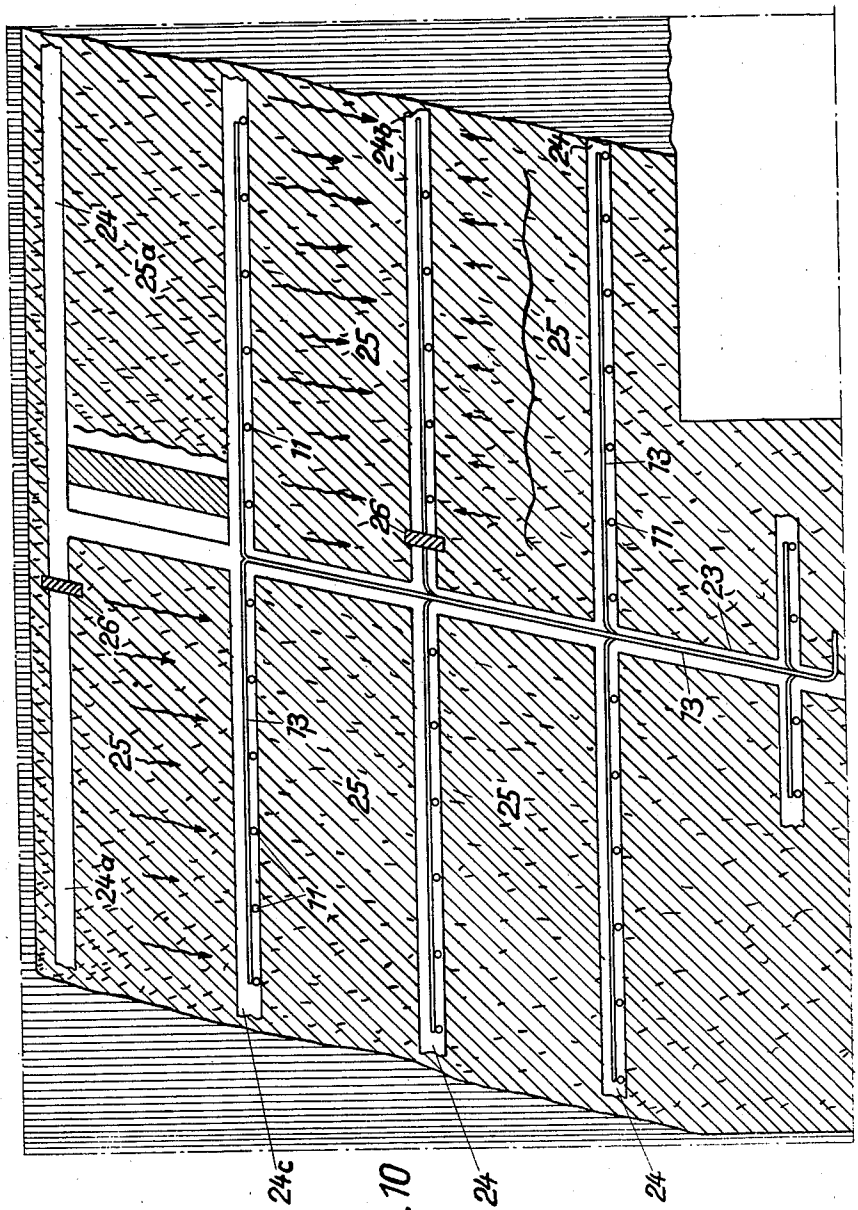


Fig. 10

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METHOD FOR THE EXTRACTION OF PETROLEUM BY MINING OPERATIONS

Filed Sept. 12, 1938 6 Sheets-Sheet 6

Fig. 11

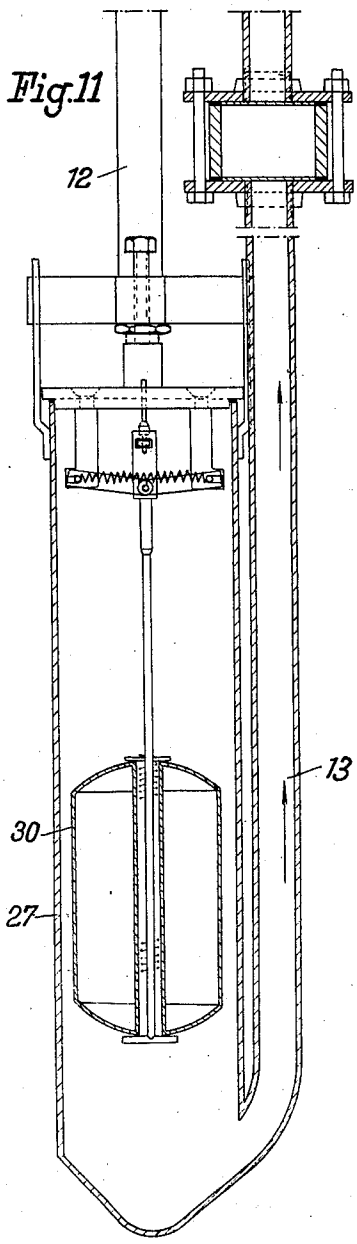
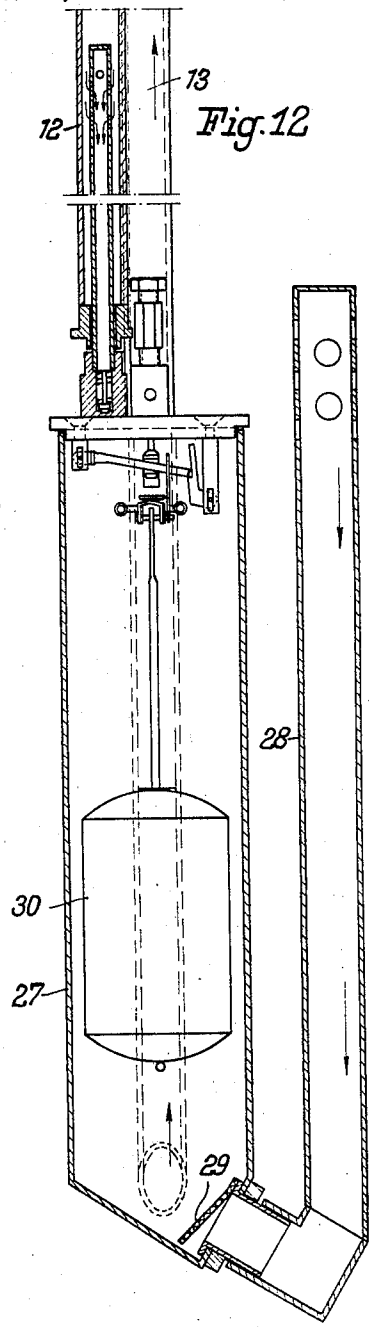


Fig. 12



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Patented Aug. 6, 1940 2,210,582

UNITED STATES PATENT OFFICE

2,210,582

METHOD FOR THE EXTRACTION OF PETROLEUM BY MINING OPERATIONS

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Application September 12, 1938, Serial No. 229,480
In Germany September 11, 1937

15 Claims. (Cl. 262—1)

In view of the fact, that petroleum cannot be extracted completely by boring operations alone and that partly the degree of yield is even an extremely low one, it has already been suggested by various interested parties to work the petroleum deposit by means of mining methods. The suggestions which have become known in this direction principally aim at rendering the deposits accessible by driving drifts above or below the deposit in order to subsequently tap it and to convey petroleum, escaping from the borings above ground. In connection with the tapping of the deposit by borings measures have further been suggested, according to which the extraction of the oil or petroleum is to be furthered by forcing in gas, gaseous media or chemicals.

Furthermore, it has also been already suggested, when driving a shaft, to degas the petroleum deposit in the first instance to the furthest possible extent by borings and subsequently to sink a pit horizontally in the layer or stratum enclosing the petroleum for the purpose of driving a network of drifts underneath the deposit and to tap it in the usual manner by borings.

All these known methods embody the tendency to remain, when recovering the petroleum by mining methods, outside the deposit proper and to approach the latter merely by tapping operations. But also these known methods are fundamentally subject to the drawback, characterising actual boring operations, that the petroleum can never be wholly recovered.

The present invention relates to a method of extracting or recovering petroleum, in which all disadvantages of the known methods have been eliminated and which creates for petroleum mining a solution wholly meeting not only all demands which can be made from a technical and safety point of view, but also renders it possible to recover the petroleum to such an extent that practically not a drop is left back. The method according to the present invention essentially consists therein, that the deposit is first degassed to the furthest possible extent and petroleum partly preliminarily recovered. Subsequently it is completely drained by means of a drift system driven through the deposit proper until complete stability has been attained, whereupon the rock, containing petroleum, is recovered by immediate mining operations. In connection with the method according to the present invention a drift network is thus driven or sunk in the deposit proper, for the purpose of procuring a drainage system partly removing the petroleum from the floating deposit and rendering it stable for subsequent mining operations. The removed oil sand is then dressed or washed according to a certain dressing method, so that an almost complete recovery of the oil, contained in the deposit, is attained.

In connection with the method according to the present invention, all measures preceding the driving of the drift network and the extraction of the oil from the deposit proper are aiming, from the very beginning, at the complete recovery of the oil as far as this is possible. During the last-mentioned working phase it is possible to watch the deposit immediately with regard to the progress of the extraction of the petroleum and to influence this in such a manner, as may be required by the finally following mining operations. In accordance therewith, a further suggestion of the present invention consists therein, to carry through the preliminary recovery of the petroleum through the medium of the borings applied from the outside only so far as to render the driving of drifts within the deposit possible and to continuously supervise its progress by means of rock samples, core samples or the like until the time for tapping the deposit appears to be appropriate. In the method according to the present invention the deposit is thus first to be rendered ready for tapping operations. This will essentially be attained that by means of preliminary boring operations from above ground sufficient borings are pushed into the deposit in order to ensure as extensive a degassing as possible. The recovery of oil simultaneously carried through must not exceed a degree of recovery which is required for carrying through economic mining operations in connection therewith.

According to the suggestion embodied in the present invention, the number of borings provided above ground is generally smaller than would be required for the extraction of oil by boring operations alone. Similarly, as far as the prevailing conditions require and render it possible, the preparation of the deposit can be effected by upper and under walls, in connection with which these borings are not to serve the purpose of entirely draining the deposit of petroleum either, but merely for attaining the aim, to render the deposit accessible for immediate petroleum mining operations, not only from a technical, but also from a safety point of view.

As soon as a deposit, by reason of the aforementioned measures, is considered ready for mining operations, the mining operations proper can be commenced, viz. as drainage of the deposit being, for the time being, yet in a floating state. In connection herewith it must be pointed out particularly, that the method in accordance with the present invention furnishes the possibility of taking up immediate petroleum mining operations at a time, when the complete recovery of the petroleum to the last residues, which

are retained, in consequence of surface and limiting face tension, by the petroleum carrier, has not yet been attained. This ensures for petroleum mining a reliable economic basis, because, generally speaking, an excessive recovery of petroleum from the deposit by boring operations which is still further increased by the known methods, such as repressuring or flooding, extracts, on the one hand, too much petroleum from the deposit to ensure subsequent economic mining operations and, on the other hand, leaves considerable residues of petroleum in the deposit which will then be finally lost to economic life and purposes.

In the method according to the present invention, the drainage of the deposit with the aid of the drift network can be carried through to a degree of recovery by providing the proper number of drifts and dimensioning the drifts, which, on the one hand ensures an economic dressing of the oil sand. In connection herewith the driving of the drifts at gallery driving speed and planning of the drift network according to the method embodied in the present invention, i. e., at the distance of the running and dipping drives, are so related to each other that, on the one hand, a satisfactory degree of recovery is attained and, on the other hand, the deposit is rendered stable within so short a period, that the complete extraction of the oil sand on a large scale according to any desired mining method may be carried out immediately. In accordance with the present invention, for instance, the roofs are driven prior to the driving of the floors, so that the petroleum is recovered in a downward direction, whereby unnecessary double measures are avoided.

In consideration, that the drive of the drifts is effected in floating rock (quicksand) and partly with complete piling, not only in the roof and at the face, as well as in front of the breast there is, on the other hand, the necessity of providing sufficient filter possibilities for the recovery of petroleum from the sand, without creating a possibility for the latter to subsequently shift. To this end, apart from leaving corresponding joints between the timbering, appropriate filter materials are provided and accommodated between the facing boards and the deposit, e. g., straw, heather, filter cloths and the like. In drifts, which for a longer life have been brick-lined, filtering material is also provided behind the brick lining. For the purpose of allowing the oil to pass through, openings are provided in the brickwork in an appropriate manner, be it by leaving a space betwen the joints or by walling in pipes. When walling in pipes, the latter are connected in the drift directly to the pipe system, into which the petroleum, accumulating behind the brickwork, is let off from time to time. In this way a contamination of the sole through the petroleum will be avoided. It is a matter of course, that at this point also the tapping of the deposit by means of filter boreholes in the most different directions has to be considered. It is, furthermore, necessary, to provide in the sole a sufficient number of filter wells which, apart from the extracting of petroleum from the oil sand below the sole, serve the purpose to collect the petroleum oozing into the drift, subsequently being fed to the wells by appropriate appliances, e. g., channels, no matter what material they are made from.

In this and a similar manner, the drainage is regulated by increasing or reducing the filtering process ad lib., in the method according to the present invention.

According to a further suggestion embodied in the present invention, the degree of petroleum extraction can be effectively regulated by setting the filtering process or the drainage of the entire drift system or part sections thereof under pressure or under-pressure. In consequence thereof, a further increase of the extraction of petroleum can be advantageously attained, by setting the drift system or its sections continuously or intermittently under an under-pressure, with the aid of the ventilation. In connection herewith, the continuous or intermittent under-pressure can be produced either by means of ventilators, as for instance, by increasing the efficiency of the main ventilator beyond the extent actually required for ventilating purposes, special ventilations or by throttling the standard air current. The latter, particularly, can be realized in such a manner, that at the proper times the introductory shaft is covered up, whilst the ventilator is allowed to suck. In part fields of the workings, the depression increase can be attained either by suitably tightening up the ventilation channels and connecting the latter to boreholes or by creating in suitable drifts, which have been particularly carefully tightened, a vacuum, which causes petroleum to be extracted from separate workings. All these measures are also permanently carried through whilst having in view the aim proper of the present invention, viz. the stabilization of the deposit for the purpose of mining.

It goes without saying that in connection with the method according to the present invention also the measures known per se, according to which water, steam or air is forced into the deposit, or an addition of chemicals is effected, which destroy the surface tension of the petroleum adhering to the grains of sand or work as displacement medium, can be employed.

The petroleum, collecting in the drifts, is automatically forced into a pipe system extending throughout the working and that by means of pressure apparatus which, after the float principle, either works by compressed air, steam or also electricity or are built-in in the oil sumps along the sole. The present invention also experienced a further preferred development, by accommodating draining pipes in provisionally driven drifts for catching the petroleum oozing out, which do not require to be kept open subsequently. As soon as the working condition of these draining pipes requires it, they may be cleaned at regular or irregular intervals by means of steam, water, air or gaseous media or, finally, by any desired mechanical means. In accordance with the suggestion embodied in the present invention it will further be possible to use these draining pipes for pressure or depression methods.

The quantity of petroleum extracted will then be constantly controlled by installing suitable measuring appliances. The aforementioned method is important for reasons of safety in so far as it renders permanent working in the drifts provided for the recovery of petroleum unnecessary, except when repairing work has to be carried out.

As soon as the deposit has been stabilized, so that it can be said to be ready for mining operations, which in turn has to be ascertained in a suitable manner by constant examinations of the petroleum carrier in order, as already previ-

ously mentioned, not to carry the petroleum extraction too far so that there would be a risk of the mining operations becoming uneconomical, the latter can be prepared for and carried through in accordance with appropriate methods.

In consideration of the fact, that mining operations are to be prepared and carried out at that moment at which the required stability has just been attained, the petroleum carrier is extracted according to special methods. In connection herewith it should be borne in mind that the degree of stability attained with the aid of the aforementioned measures is not, what can be called, a considerable one, nor that it can be a very considerable one, as it usually is in other branches of mining. In consequence thereof, the extraction must take place secured by piling, whereby in specially developed methods auxiliary working and main working is utilized and the place is created for the placing of the work whilst driving the roofs and leaving a special rock-staple for each nog length.

Leaving a rock-staple will ensure that the deposit, still in the lower limits of its stability, will not reach the breast or front but be held until the completion of the timbering or lining. A special peculiarity of the extraction of the petroleum deposit, which is in contradistinction to methods developed in other branches of mining is that the pressure wave is so regulated, that it rests on the stowing and not on the breast or front. Also in this instance, that the working is carried through similarly to the driving of drifts, that it progresses from the top to the floor and the hanging pillar of a set of working is worked, as far as possible, previously to the floor.

In the method according to the present invention the worked hollow spaces are, furthermore preferably walled again, for which purpose the washed petroleum sand should be used as far as possible as cogging material. For this purpose the washed out petroleum sand is suitably mixed with an appropriate loosening material, as, e. g., saw-dust, slag or the like, in order to reduce its degree of moisture, particularly, if clay is contained therein, and so to reduce its tendency to cake. The introduction of the gobbing from above ground into the underground workings is best effected in a dry form, viz. through suitable boreholes, which were systematically provided previously for that purpose at the time of rendering the deposit ready for mining purposes, so that, according to the condition of working a suitable borehole was available or, if necessary, could easily be newly provided, if required. From the gobbing sole to be considered, the gobbing material is taken in an appropriate manner, as far as possible by using shutes to the gobbing point proper. In connection herewith it has been ascertained, that the extraordinarily strong sog, produced by the dropping of the gobbing material, can be utilised for ventilating purposes not only in the gobbing borehole, but also in the shutes. This mode of working can, f. i., be used for phase-wise or sudden exhaustion of bad intakes in front of dead faces and corresponds, as a whole, to the principle of the water-jet pump.

Furthermore, the gobbing boreholes can be used not only for conveying the gobbing material into the underground working, but also for the conveyance of the lining material, e. g., props, caps and laths. These are thrown from above ground down a depth of several 100 m. In order to prevent the material thus thrown down, from being damaged, suitable sand bolsters or such made from peeled off bork, should be used. This method has, furthermore, been developed in such a manner that, for the purpose of retarding the velocity of fall, especially in connection with considerable depths, the borehole is immediately covered up after the objects in question have been dropped in.

The petroleum sand obtained in the drifts or when working is conveyed to the pit eye and thence above ground. The conveyance to the pit eye is effected according to the usual methods using, as far as possible, shutes for that purpose which are provided with suitable trap bridges or cascade grates which simultaneously ensures a disintegration of the larger pieces. In this connection the belt conveyor has been adopted again in the first instance, because this embodies the advantage of allowing the drifts to converge to the smallest possible cross section, in connection with which material or persons can be conveyed by means of these belts. The employment of rubber belts stands in the foreground, the risk of decomposition in this case being met by providing the rubber belt with a coating of moist sand, gobbing sand or sand with an inconsiderable percentage or content of petroleum.

Further advantageous examples of performance of the present invention can be gathered from the drawings in which the invention is elucidated with the aid of a few examples of performance.

Figs. 1 and 2 show the initial steps for mining a petroleum deposit according to the present invention in schematic representation in cross-sectional and plan view.

Figs. 3 and 4 show the driving of drifts in quicksand and

Fig. 5 in dry rock,

Fig. 6 is a graphic representation for elucidating the suitable speed in driving drifts, whilst

Fig. 7 illustrates a schematic plan view of a part of a set of workings.

Figs. 8 and 9 show a working in plan and cross-section and

Fig. 10 a further schematic representation of a set of working, whilst

Figs. 11 and 12 represent an example of performance of a conveyor device for oozed oil.

According to Figs. 1 and 2 the petroleum deposit is, in the first instance, preliminarily extracted through borings 2 from above ground, in connection with which less boreholes are sunk than is usual with the ordinary boring methods. After terminating the preliminary petroleum extraction operation through the boreholes 2 or simultaneously with it, the deposit is explored by means of a shaft 3 being sunk, as far as this is possible, in petroleum-free partition rock, and by cross cuts 4, as well as by floors and tops 5. Where working conditions render it necessary, the deposit can further be opened up partly by working under an edit, e. g., above a blind shaft 6. Proceeding from the drifts 5, the deposit is preliminarily exploited by means of horizontal and sloping borings 7 up to a degree which renders it possible, that now the drive of drifts can be effected within the deposit proper. According to the prevailing conditions, which may vary very considerably with the fine or coarse grain or with the firmness of the petroleum-containing layers, the horizontal or sloping borings can also be dispensed with for further preliminary deoiling, in order to immediately start with driving drifts within the deposit proper. If the preliminary extracting operations through the me-

dium of above-ground borings or by means of horizontal and sloping borings have not proceeded further and that the rock is still in a floating state, the drive of drifts according to Figs. 3 and 4 is to be effected. The faces, the sole or floor and the roof and even the fore-heads are, in connection therewith, sustained by piling, the joints of the separate laths are tightened by filtering material as, e. g., straw, heather or the like, in order to retain the rock whilst allowing the petroleum to pass through. The petroleum escaping into the drift is collected in the channels 9 and fed from there or immediately to the filter well 10, arranged at a distance, in which the pressure apparatus 11 are located. The latter are, e. g., actuated by compressed air, taken from an air conduit 12 and work in accordance with the principle of the steam traps, periodically forcing the oil, which has meanwhile collected, into a petroleum pipe 13. The kind of petroleum conveyance just referred to possesses, relatively to the conveyance by pumps or other means, quite extraordinary advantages.

According to the present invention, the preliminary extraction of petroleum and, if necessary, the drive of drifts is to be carried through in such a manner that the rock at the head end is no longer in a floating state but already rendered stable to such an extent, that a lining or timbering of the drift drive is effected in the manner, as shown in Fig. 5 representing dry rock, where instead of the head lining a rock pillar 14 is left standing in the first instance until the auxiliary as well as the main working is finished. The manner, in which this state of stability in dependence upon the petroleum deposit of the rock is to be attained, has been illustrated schematically in the graphic representation according to Fig. 6.

In the representation according to Fig. 6 the petroleum content has been represented on the abscissa including water in weight-percents, whilst on the ordinate the driving efficiency per layer has been plotted. The representation allows of recognizing without any difficulty whatsoever that the driving efficiency being found rises, in the first instance with decreasing petroleum content up to a maximum; this most favorable driving efficiency at about 15 to 10% oil or petroleum content. If the petroleum content is still further decreased below this limit, the driving efficiency also drops again considerably, because then the extraction possibility of the rock will become less favorable. According to the suggestion embodied in the present invention, the preliminary extraction and the drift drive must be so adjusted, that the deposit exhibits the most favorable moisture content situated, by way of example, between 15 and 10%, at which the stability possesses its optimum within the meaning of the present invention. It goes without saying, that the limits of 15% or 10% are not to be understood to be absolute, because these may vary considerably according to the nature of the deposit. Thus, a finely grained sand is stable already at a greater content of petroleum, whilst with a coarsely grained sand the preliminary extraction must be carried on further to attain the same stability. The accurate limits thus depend upon the working conditions prevailing at the time and in connection herewith it is important, that also the preliminary extraction through the medium of the drift system for the preparation for the mining operations is carried through to such extent, that also for the immediate exploitation of the deposit even by mining operations this most favorable stability is attained, at which the floating condition of the rock is not attained or reached by a narrow margin.

In Fig. 7 the petroleum deposit has again been characterized by the reference numeral 1, the shaft by the numeral 3 and the cross-cut exploration by the numeral 4. The set of workings proper is sub-divided by the drainage drifts 15 into separate sections, the interdistance of which depends upon working conditions and is so chosen, that the maximum stability, illustrated in Fig. 6 is attained for mining purposes. Subsequently, the mining operations proper are carried out according to suitable methods, as shown at 16 by way of example. The numeral 17 characterizes a borehole, through which gobbing and other material is conveyed from over-ground. In the represented example of performance as seen in Fig. 7 the winning is effected from above progressively, because in the example of performance, on which the representation has been based, the necessary condition for mining has already been attained in this part of the deposit by drainage. It certainly goes without saying that working conditions can well be imagined, at which mining is taken in hand at first in the lower part of the deposit.

As can be gathered from Figs. 8 and 9, the mode of working is essentially identical with a breast-wall usual in pit coal mining. It consists of the set of workings 18, the hurrying panel 19 and the gobbing panel 20. The conveyance in the hurrying panel is suitably effected by means of the conveyor belt 21, whilst in the panel 20 the gobbing material is advantageously conveyed by means of a shaking trough 22. The face of workings is taken in hand in a manner similar to that shown in Fig. 3, so that between the separate working sections in the first instance pillars 23 are left standing in front of the face of the workings, until the complete lining which, in the roof, is effected by timbering, has been placed in position. Only then will the pillars 23 be removed, as well, if this should be necessary, a panelling of the face of the working, whatever may be required by working conditions. In connection herewith it is of extraordinary importance to so carry on the mining operations in regard to rapidity of the working and the introduction of the gobbing, that the pressure wave is made to rest on the gobbing panel 20 and the actual set of workings 18 is released.

According to Fig. 10, the petroleum deposit is subdivided by the main drift 25 and the running drifts 24 in separate sets of working 25. The running length of the set of workings is, according to the present invention, to be dimensioned at 150 to 250 m., whilst the flat working height amounts to about 50 to 100 m., depending, with regard to its dimensioning, upon the condition of the deposit. In the represented example of performance it has been assumed, that in the working 25 mining operations have already started. Under this supposition the drift 24*a* and the drift 24*b*, shown in the represented example of performance, have been closed up by the dam 26, in connection with which the drift 24*a* is set under over-pressure, for the purpose of forcing the petroleum, still contained in the working section, into the drift 24*c* located underneath. The oozing drift 24*b*, however, is set under under-pressure for the purpose of accelerating the extraction of petroleum in the adjoin-

ing working sections. The numeral 13 is again made to characterize the oil pipings and 11 the separate filter-wells or pressure apparatus.

In the device for conveying oozed petroleum, shown in Figs. 11 and 12 by way of example, resembling a pressure apparatus, the petroleum collecting piping has also been characterized by the numeral 13 and the pressure piping which is fed with compressed air, by the numeral 12. The oozed petroleum is fed through the piping 28 with return valve 29 to the housing 27. The petroleum level, rising in the housing 27 actuated thereby in an upward direction a float 30 attached to a rod, until the float, by means of suitable devices, which can be gathered from the drawings, opens in its highest position the inlet valve of the compressed air piping 12. The compressed air, subsequently penetrating into the housing 27 effects the conveyance of the petroleum which has meanwhile collected in the housing 27 into the oil piping 13, in connection with which the return valve 29 is closed owing to the increase in pressure. Between the float 30 or its guide rod and the inlet valve for the compressed air, appropriate elements, for instance, in form of a sling-belt, have been arranged with the result that the float opens or closes only when in its uppermost or lowermost position. In connection herewith the arrangement has been made, that the float in its lowermost position simultaneously also opens the ventilation valve.

The essence of the present invention is, however, in no way confined to the represented examples of performance, it is rather possible to effect the realization in any other desired manner according to the prevailing mining and working conditions. Essential is for the sense of the present invention, that all measures serving mining operations are so arranged from the very beginning, that a stability of the deposit is attained, which allows of immediately winning petroleum-containing rock.

It should, finally, be pointed out, that the conveyance of the recovered oozed petroleum, as suggested according to the present invention, with the aid of pressure apparatus actuated by compressed air, can also be used with advantage in all such cases, where as complete a mining of the petroleum-containing rock is not the final aim of exploring the deposit by means of mining methods, but rather the extraction of the petroleum by means of the drainage system. This suggestion embodied in the present invention thus possesses for itself independent importance independent of the total method on which the present invention has been based.

What we claim is:

1. A method for obtaining petroleum from an oil sand deposit which comprises drilling into said deposit a number of borings, degasing said deposit through said borings, removing oil through said borings until the condition of the deposit permits the sinking of a drift network system into said deposit, sinking said drift network system, draining by varying the pressure in the drifts of said drift network system of said deposit until the oil sand has attained a consistency permitting it to be mined, and recovering the oil sand proper by mining operations.

2. A method of the kind described in claim 1 in which the preparation of the oil sand into a suitable state for mining comprises placing alternate drifts of the drift network system under super-atmospheric pressure and placing the intermediate drifts under sub-atmospheric pressure.

3. A method of the kind described in claim 1 in which the sinking of the drift network system comprises the steps of driving the sloping drifts and then driving the horizontal drifts.

4. A method of the kind described in claim 1 in which the recovery of the oil sand by mining operations includes the step of exploiting the deposit from the roof to the floor of the working.

5. A method of the kind described in claim 1 in which the recovery of the oil sand by mining operations includes the step of introducing into the exploited deposit a mixture of sand from which the oil has been extracted and a loosening material such as sawdust, slag or the like.

6. A method of the kind described in claim 1 in which the recovery of the oil sand by mining operations includes the step of tamping the old workings with cleaned oil sand.

7. A method of the kind described in claim 1 in which the recovery of the oil sand by mining operations includes the step of regulating the pressure wave so that said pressure wave lies in the cogging field.

8. A method of the kind described in claim 1 in which the recovery of the oil sand by mining operations includes the step of exploiting the deposit of oil sand in such relationship to the tamping of the exploited deposit that the pressure wave rests in the cogging field.

9. A method of the kind described in claim 1 in which the recovery of the oil sand by mining operations includes the step of tamping the old workings with a filling material.

10. A method for obtaining petroleum from an oil sand deposit which comprises drilling into said deposit a number of borings, degasing said deposit through said borings, removing oil through said borings until the condition of the deposit permits the sinking of a drift network system into said deposit, sinking said drift network system, draining said deposit until the oil sand has attained a consistency permitting it to be mined, and recovering the oil sand proper by mining operations.

11. A method of the kind described in claim 10 in which the sinking of the drift network system comprises the steps of driving the sloping drifts and then driving the horizontal drifts.

12. A method of the kind described in claim 10 in which the recovery of the oil sand by mining operations includes the step of exploiting the deposit from the roof to the floor of the working.

13. A method of the kind described in claim 10 in which the recovery of the oil sand by mining operations includes the step of introducing into the exploited deposit a mixture of sand from which the oil has been extracted and a loosening material such as sawdust, slag, or the like.

14. A method of the kind described in claim 10 in which the recovery of the oil sand by mining operations includes the step of tamping the old workings with cleaned oil sand.

15. A method of the kind described in claim 10 in which the recovery of the oil sand by mining operations includes the step of tamping the old workings with a filling material.

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