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K. GROSSE ET AL

TREATMENT OF OIL-SAND AND LIKE MIXTURES

Filed Oct. 29, 1938

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4 Sheets-Sheet 1

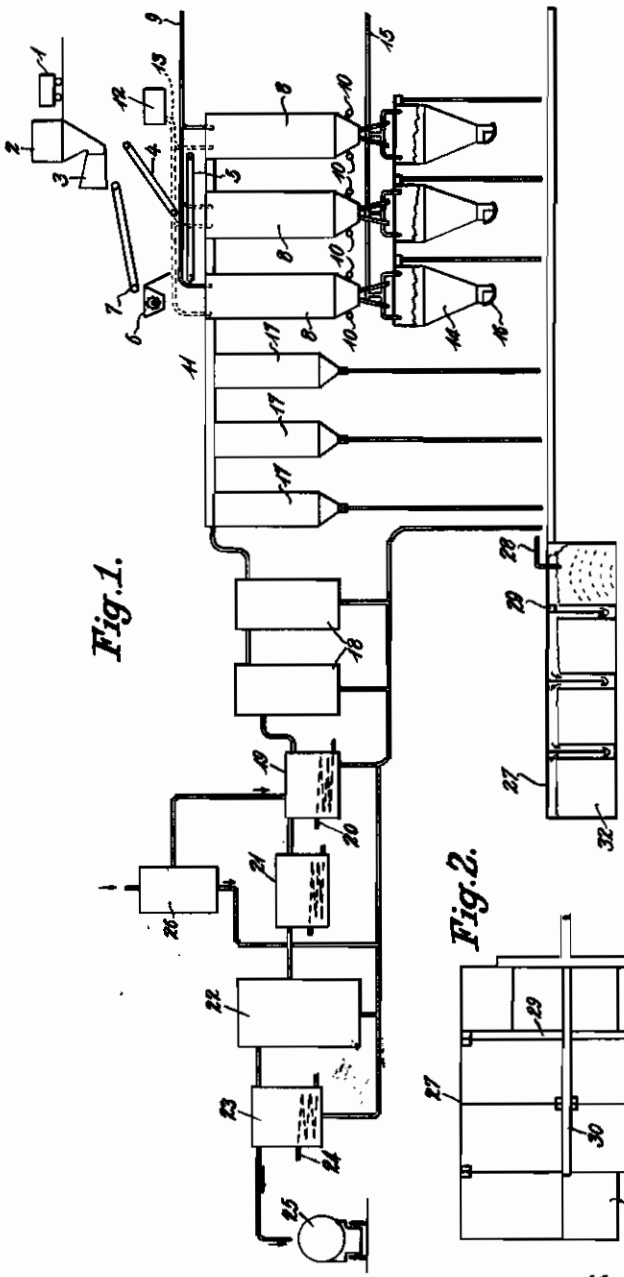

Fig. 1.

Fig. 2.

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Fig. 3.

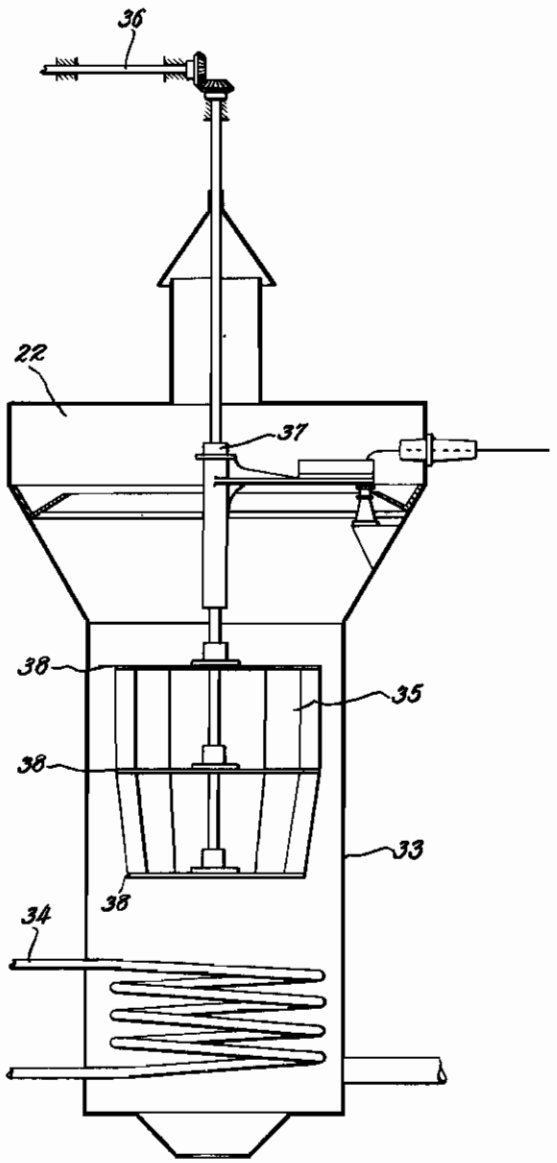

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Fig. 4.

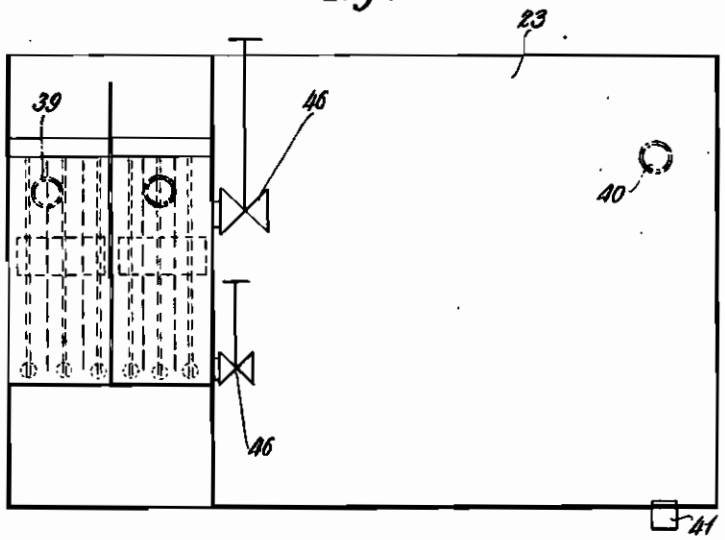

Fig. 5.

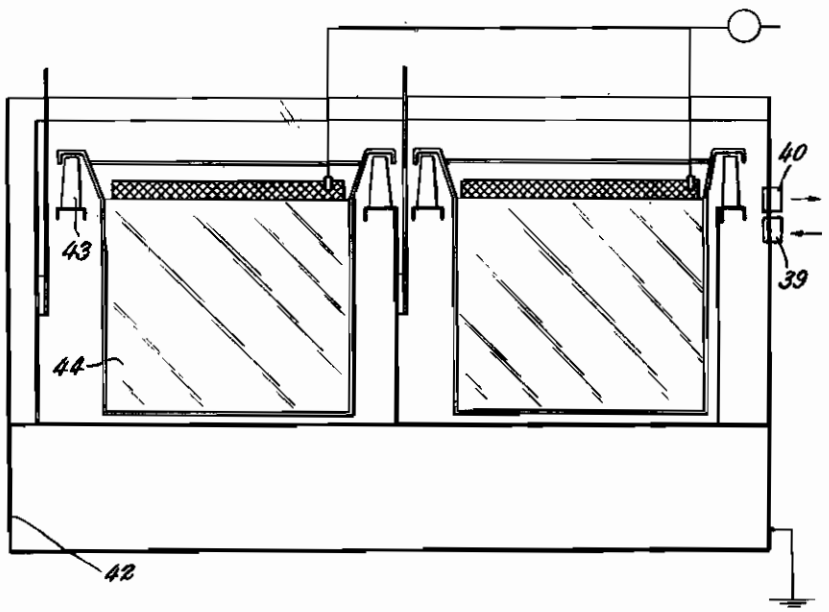

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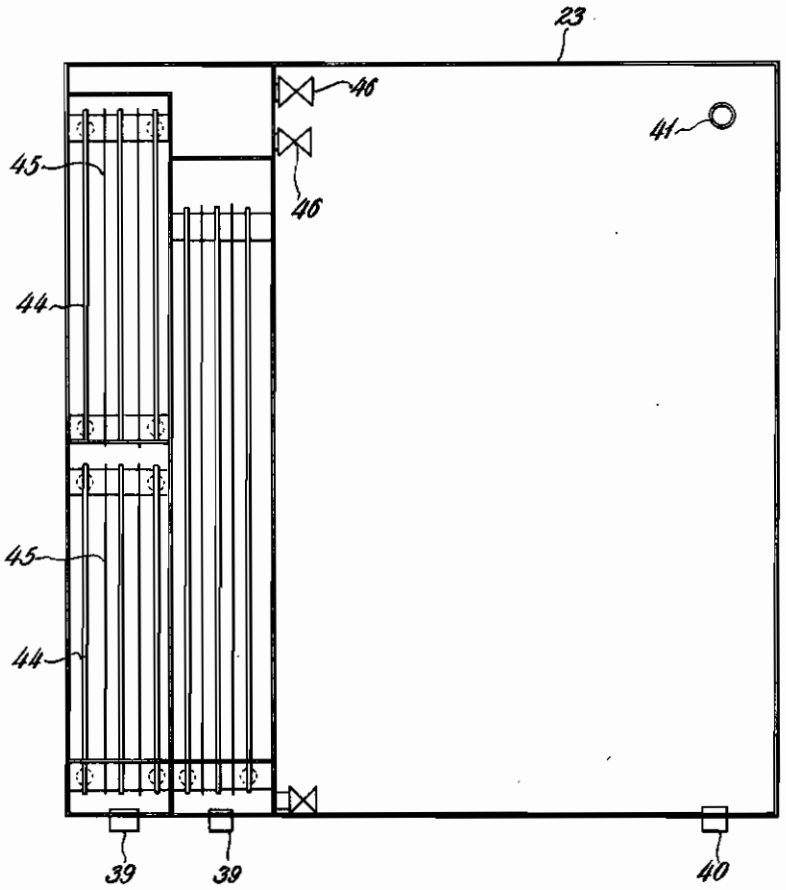
Fig. 6.



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ALIEN PROPERTY CUSTODIAN

TREATMENT OF OIL-SAND AND LIKE MIXTURES

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Application filed October 29, 1938

Various processes have been proposed hitherto for the liberation of oil and the preparation of stones containing oil, wherein the liberation of oil could be carried out in individual apparatus, partly by the addition of chemicals, partly by means of extraction, and partly by mechanical means. It has also been known to carry out the preparation of oil-sand in washing apparatus by the employment of heat and movement, whereby the oil-sand has been mechanically whirled by means of steam and washed out by the employment of hot water. However, none of these known processes has been satisfactory for continuous working or for working on a large scale.

The applicants have for the first time carried out the process of the so-called direct earth oil mining, in which the oil containing granary stones are obtained in great quantity in mining drifts and working and which required a really effective preparatory process with the highest possible effect of oil liberation. After many years it has been possible to develop the treating process which constitutes the subject matter of the present invention and which has been found satisfactory in the working of large plants.

The applicants have found, as a result of their experience, that in the treatment of oil-sands two main problems have to be solved: on the one hand the oil has to be separated from the stones containing oil by washing with water, or if necessary by the addition of chemicals; and then on the other hand has to be obtained as a pure product from the washing water. The invention relates to a process for the preparation of oil-sands or similar oil-carrying stones in washing apparatus and in applying heat and movement, both these problems being practically solved with complete satisfaction. The invention consists essentially in that, during the entire treatment the materials to be treated are maintained approximately at a constant temperature by the repeated admission of heat. In the process in accordance with the present invention, it has been found possible not only to obtain a sufficient separation of oil from the oil-containing stones, but also a satisfactory separation from oil and washing water. The process in accordance with the invention is preferably carried out in sueh a manner that the overflow from the washing apparatus is subjected in settling containers or similar apparatus to a single or repeated admission of heat. The temperature at which the treatment in aecordance with the invention is carried out depends on the type of oil. For example, in practice a temperature from 40° C. to 60° C. has been proved sufficient for light oils; whilst for heavy oils—for example of a specific gravity of approximately 0.94—a temperature up to 100° C. is necessary.

In accordance with a further feature of thc invention the efficacy of the process in freeing from oil by the maintenance of an approximately constant temperature can be yet further improved by subjecting the product falling from the washing procedure to an electric treatment, either directly or during the passage through the heated settling containers. This electric treatment can, for example, be carried out, in accordance with the present invention, in such a way that the product obtained from the washing process constitutes a conductor between current carrying electrodes. This kind of procedure in accordance with the present invention is carried out preferably in such a way that the content of water of the washing product is maintained at not more than 20%, by suitable measuring of the draw-off from the settling receptacles. On the other hand, it is also possible to carry out the electrical treatment of the product in the process in accordance with the present invention, so that the washing product is exposed to the effect of an electrical field. It is thus possible to obtain a satisfactory yielding of oil with a water content up to 80%.

For the separation of earth oil and oil-sand on the one hand and washing water and oil on the other hand, sought by the method in accordance with the present invention, it may be essential in accordance with existing conditions to subject the article to be prepared, before entrance in the washing process, to a special selection in regard to the contents of clay or salt containing substances, as these promote extraordinary coagulation in the washing process and aggravate very strongly the oil separation in consequence. It is therefore advantageous to have the washing artiele freed before the washing process, for example by hand-picking a substantial part of the clay substance. In addition, or instead of this preparation of the washing article, the treatment can further be carried out by reducing the clay substances as much as possible, whereby the content of clay and salt in the washing water can be maintained at or below 1% by freeing from salt or freeing from clay, or by constant supplying of fresh water. The minimum percentage of clay and salt content which is still admissible for the economical carrying out of the preparation process depends substantially on the kind of earth oil obtained.

Further advantageous details of the invention can be seen from the drawings in which the invention is explained by some examples. In the drawings:

Figure 1 shows diagrammatically an oil-sand dressing plant working in accordance with the method of the invention;

Figure 2 shows in plan a settling plant;

Figure 3 shows one embodiment of an electrical treating apparatus, and

Figures 4 to 6 a further embodiment of an electrical treating apparatus.

In the present procedure illustrated in Figures 1 and 2, the oil-sand coming out of the mine is passed from the conveyor 1 first through the centrifuge 2 and then onto a revolving screen 3; the sand falling through the revolving screen 3 drops onto the transport belt 4 and is thence passed to the distributing belt 5. The coarser pieces pass from the revolving screen 3 onto a collecting belt 7 where the clay admixtures are picked out by hand. The oil-sand pieces are carried onto the breaking roller 6 where they are reduced to small pieces, passing thence to the distributing belt 5. The distributing belt 5 distributes the material to be dressed to the washing-apparatus 8 working discontinuously. The washing goods are introduced to the several washers 8 in determined quantities which are proportional to their sizes and to the quantity of washing liquid contained therein; and are whirled for a time fixed as the result of experiments, by means of steam, air or other gaseous medium, examples of the last mentioned being mainly inert gases and particularly gases of combustion from the boiler house. The oil-sand thus falls into the washing container filled with hot water and is whirled up during the downward lowering at one or several points.

In the illustrated embodiment of the invention suitably preheated fresh water is admitted through the pipes 9 and the steam and compressed air through the annular pipe 10 to the washers 8. The oil-carrier is freed as a result of the whirling action and by the heat from the adhesive oil film, the oil rises to the surface of the washers 8 and is here passed through the stream of the superfluous liquid into the overflow channel 11. From a reservoir 12 chemical coagulating agents can be admitted through the pipe 13. The oil-sand subjected to the washing process passes from the washer 8 into the rinsing container 14, where it is subjected to a rinsing by the admission of fresh water through the pipe line 15, and is finally extracted by a suitable drawing-off device 16 as dumping sand or mixing material.

The overflow of the washers 8 is deposited in deposit receptacles 17 and afterwards is brought into special separating containers 18, where a part of the washing water and mud or sand particles carried along are separated from the oil. It arrives finally at the oil collecting reservoir 19. According to the progress and considering the specific structure of the preparing plant, the oil-washing-water mixture is subjected in the deposit vessels 17 and 18 to a renewed heating which can be carried out in every case in the oil collecting reservoir 1 by feeding the coiled tubes 20 or the like with steam or any other heat carrier. In the oil collecting reservoir 19 a part of the washing water is again separated out. The overflow of the oil collecting reservoir 19 is conveyed to a preheater 21 preferably also steam-heated, and from there into the electrical manipulator 22, the design of which will be further described in detail. In the manipulator 22 a substantial part of the washing water is divided from the oil, which passes to the decomposition container 23, which is also steam-heated through a coiled tube 24. In the container 23 is obtained the oil ready for shipping which is delivered to an oil-truck 25 or to a large tank reservoir.

In accordance with the illustrated example the ground oil which is obtained from the mine by draining or other means, or earth oil obtained by boring, can also be subjected to the dressing process whereby this oil is firstly admitted to a deposit container 26 and afterwards to the oil collecting reservoir 19, in order to carry on this process simultaneously or parallel with the washing of oil from the oil-sand.

The overflow of the rinsing containers 14 and the discharge from the deposit receptacles 17, the separating container 18, the oil accumulating reservoir 19, and the apparatus 22, 23 and if necessary 26, are delivered through suitable pipe lines in the settling or clearing plant 27, which are separately illustrated in Figure 2 in elevation. This discharge consists substantially of mud coagulation and oil water mixtures and still possesses mostly a temperature required for the separation. This discharge is subjected to a renewed whirling in the clearing or settling plant 27, by means of compressed air whirling nozzles 28, whereby the oil rises as froth up to the surface of the individual container of the clearing or settling plant 27, and is drawn out by means of rakes in the oil overflow channels 29. From there the discharge is conveyed through the oil discharge channel 30 (Fig. 2) into an oil collecting reservoir 31, from which this product is subjected to a similar treatment to that described with reference to the main product from the oil collecting container 19. The used washing water is pumped from the last container 32 of the clearing plant 27 into a mud tank where it is allowed to drain.

In the example illustrated in Figure 3 the electrical device 22 consists substantially in a cylindrical vessel 33 in which the washed product is interposed directly as a conductor between current leading electrodes. The vessel 33 is earthed and is heated by a steam coil 34. Within it is rotatably suspended an electrode 35 which consists of a vertical axle 37 provided with three spaced sheet-metal discs 38 and driven by a rotating mechanism 36. The sheet-metal discs 38 are of a diameter approximately say 20 cm. smaller than that of the cylindrical external vessel 33. The rotating electrode 35 receives a voltage of approximately 9,000 to 12,000 volts. As in this example of the invention the current passes directly through the oil-water coagulation, this current is dependent on the water content. In consequence the success of this form of the invention depends essentially on water content, which should not surpass substantially 20% for carrying out the aforesaid stages of the process. This upper limit of the water content varies with various kinds of oil: for example, heavy oils of a slightly higher water content may still be purified; whilst light oils may only be treated with a water percentage of under 20% in the illustrated plant. The separation of the water from oil is substantially accelerated when the temperature of the oil in the aforesaid preheater 21 is brought up to 60° C. and is maintained then by the heating of the steam coil 34 approximately at

this level. The same temperature limit is maintained in the adjacent decomposition container **23**. The invention has proved that with a heat of approximately 60° C., the viscosity of practically all earth oils is so small that the water in finely distributed form can be comparatively quickly expelled. With sufficiently large measuring of the decomposition container **23**, the electrical treatment in the container **22** can also be carried out continuously.

Should earth oils with a water content higher than 20% be clarified, electrical manipulators with insulated electrodes are preferably employed, in accordance with the invention as illustrated in the examples of Figures 4 to 6. The purifying of the oil is then achieved by the creation of a strong electrical field. This effect can be further heightened by suitable shaping of the electrodes. In the illustrated example, the oil admission is indicated at **39**, the oil discharge at **40**, and the water outlet at **41**. The device consists substantially of an earth container **42**, in one compartment of which glass plates **44** are suspended on insulators **43**. As a conducting coating a fine wire cloth is employed, which is arranged in an oil-tight manner between the glass plates **44** and which creates on the one hand a large laminar field effect and on the other hand produces in the direction of the wires a large accumulation of field lines, so that these reinforced field lines have for a consequence an additional directing strength for the water particles finely distributed in the oil. As the electrodes are insulated by this manner of treatment, the current consumption is comparatively independent of water content of the earth oil, and oils with a water content up to 80% may thus by this manner be treated. The voltage here can be raised up to approximately 15,000 volts. Between the electrodes insulated by the glass plates **44**, sheet metal plates are appropriately placed at a distance of 3–5 cm., which are in direct connection with the sheet metal housing **42** and are therefore earthed. The plant can be considered in a certain degree as a condenser, the capacity of which varies with the type of dielectric, consisting in an insulating plate and earth oil coagulation. The change of capacity takes place proportionably with the changing rate of current. In the illustrated example the oil, controlled by the slide valve **46**, passes firstly through the various compartments of the appropriate treating device and reaches then the decomposition container **23** built unitarily with the device, as illustrated in this example; from which container the purified oil discharges through the outlet **40** and the water through the outlet **41**. The heating of the oil so that it may have only a small viscosity is carried out in the same or a similar manner to what is illustrated in Figures 3 or 1.

The invention, however, is not exhausted in any way by the illustrated embodiments, but can be carried out constructively in various other manners. For example, the oil may also be centrifuged as an intermediary or final treatment, where again the essential feature of the maintenance of a defined constant temperature may be borne in mind. Further the invention is not particularly bound up with the illustrated example of intermittent washing, but can also be carried out in a continuous manner without departing from its scope. Whilst in the intermittent process the introduction of the washing goods is effected in a dry manner, that is to say by the aid of suitable mechanical conveyor means; in the continuous form of the invention the admission of the oil-sand to the washers is carried out advantageously by hydraulic means, although it is obviously possible here to apply mechanical delivery also. The continuity of the process is mainly achieved by the fact that the rinsed oil carrier is distributed in a suitable manner in accordance with the delivery of fresh wash material. In vertical or obliquely arranged wash containers, a conical outlet is appropriately provided, from which the distribution is carried out by the aid of endless screws or worms, stop slide valves and suitable scratching devices or the like. Particular attention should be drawn here to the fact that the respective manner of distribution can be widely adjusted and especially excludes, for safety reasons, a sudden breaking of hot washing slimes in the washing container and also of the washed oil carrier. Should horizontal or obliquely-placed wash containers be used, the forward movement of the oil carrier from the entrance end to the delivery end takes place either by means of a worm or endless screw, or by stirring apparatus with stirring arms disposed upon the conveyor, or by the fact that with a closed cylindrical vessel the envelope is in rotation, whereby the transportation is effected with the aid of suitably arranged rotating ribs or sheets.

The preheating of the fresh water used for the washing process and also the high temperature which is achieved in the washing process depends on the contents of the oil in easily boiling substances; in order to prevent losses as much as possible, the washing apparatus and also the entire containers in which the oil is subjected to high temperatures for purifying or additional clearing, is equipped with drawing-off devices for the escaping of the foul air (vapour) from which the easily vapouring hydro-carbons are obtained in suitable condensing column.

The washing process may be improved in regard to the extraction of oil in the continuous and also in the intermittent process, by the addition of appropriate chemicals which act disturbingly upon the surface tension and boundary surface tension of the oil film surrounding the rock particles, or act as expelling means.

Finally, the electrical treatment illustrated in Figures 3 and 6 of the oil-sand is not absolutely bound up with the entire process, but possesses also for itself independent significance. In resume, the method in accordance with the invention can be employed in any of its several stages or in its entirety wherever the same or similar conditions exist, such as in the treatment and separation of oil-sand and other oil-containing minerals, as for example in treating earth oil obtained by boring.

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