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RECOVERY OF OIL FROM OIL SANDS.

APPLICATION FILED JAN. 26, 1918.

1,263,618. Patented Apr. 23, 1918.

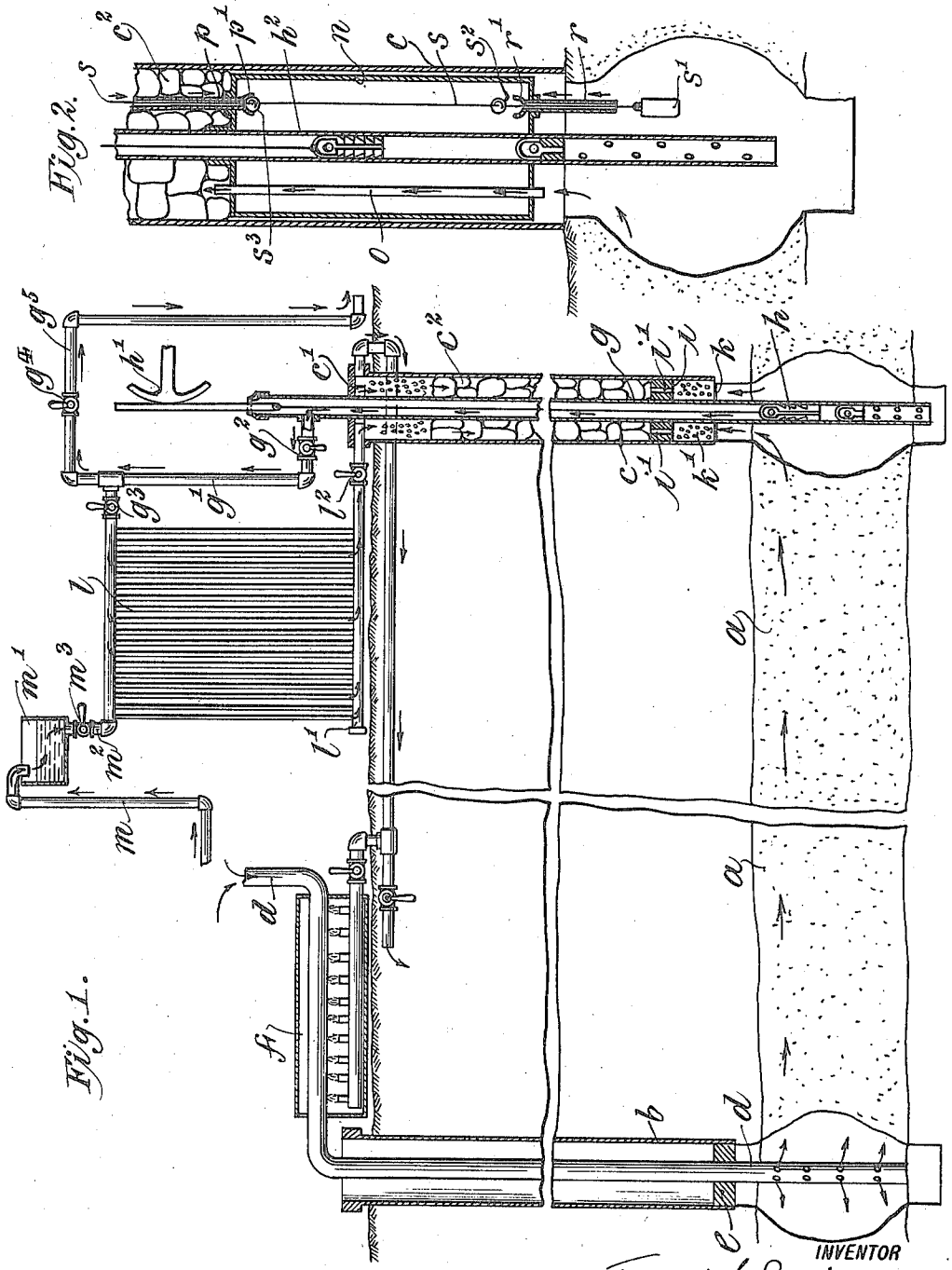


Fig. 2.

Fig. 1.

WITNESS:

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RECOVERY OF OIL FROM OIL-SANDS.

1,263,618. Specification of Letters Patent. Patented Apr. 23, 1918.

Application filed January 26, 1918. Serial No. 213,864.

To all whom it may concern:

Be it known that I, FREDERICK SQUIRES, a citizen of the United States, residing in Marietta, in the State of Ohio, have invented certain new and useful Improvements in the Recovery of Oil from Oil-Sands, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

The object of this invention is to increase the production of oil from oil sands when the natural flow has ceased and to increase the gravity of the recoverable oil. The mechanical increase of the flow of oil from the sands of a given area through certain wells, called venting or pumping wells, of a given group of wells, by supplying to other wells of the group, known as pressure wells, a pressure medium, such as air or natural gas, has long been practised. In this old method it has been sought only to drive out from the oil sands, by the mechanical action of the pressure medium, such oil in liquid form, held in the sands by capillary attraction or otherwise, as will not flow to the pumping well by natural seepage. Of necessity there is in the sands a quantity of oil, large in the aggregate, which, for one reason and another, is not driven out in liquid form by pressure. The particular object in view in this invention is to increase the production of oil from oil bearing sands by accomplishing the recovery not only of the oil which heretofore has been moved in liquid form by pressure but also that which heretofore has not been driven out in liquid form by pressure and, if moved at all, has been vented as a waste gas. In accordance with the invention, the pressure medium, supplied as heretofore to one or more pressure wells of the group, is made to act not only mechanically, by pressure, to increase the flow of oil toward the venting or pumping well or wells, but to take up by evaporation a part of the oil over which it passes and to carry it on, in a gaseous or vapor form, toward the venting or pumping well, where or in the vicinity of which it is liquefied again and is eventually pumped from the venting or pumping well. Not all of the oil vapor which is taken up by the pressure medium is liquefied in the vicinity of the bottom of the pumping well and a further object of the invention is to bring about the liquefaction and recovery of such oil by treatment of the oil vapor which rises in the venting well. The invention will be more fully described hereinafter with reference to the accompanying drawings in which it is illustrated and in which—

Figure 1 is a view representing in a somewhat diagrammatic and conventional way earth strata, including the oil sands, a pressure well and a venting well and apparatus in connection therewith adapted for the practice of the invention.

Fig. 2 is a detail view on a larger scale through the lower end of the venting well showing means whereby static pressure may be utilized to aid absorption.

In the practical application of the invention the stratum *a* of oil sand is penetrated by a pressure well *b* and a venting well *c*. The pressure medium, whether air or gas, is supplied under pressure from a compressor or other suitable source, not necessary to be shown, through a pipe *d* which is carried to the bottom of the well, through a packing *e*, so as to prevent the escape of pressure from the well, and is perforated at its lower end as indicated. In its passage from the compressor or other source of supply the pressure medium is carried through a preheater *f*, so that the temperature of the pressure medium shall be raised somewhat above the normal temperature of the oil sand *a*, which is usually about 70° F. The heating of the pressure medium may be effected by any suitable means, preferably by the combustion of the waste gas supplied from the venting well as hereinafter explained. It will also be heated as a result of compression.

The mechanical action of the pressure medium will drive oil from the oil sand toward the venting well, as usual, but it is not alone relied upon in the present case. On the contrary, so far as this invention is concerned, the pressure medium is depended upon to act as a vaporizer or solvent of the oil with which it comes in contact in its passage through the oil sand, thereby itself becoming charged with the oil vapor to the point of saturation for the temperature and pressure under which the pressure medium comes in contact with the oil. In this manner a great portion of the oil which is held

in capillary spaces or in pockets and is not driven out by pressure alone, is taken up by the pressure medium and is carried on toward the venting well in a gaseous form. The vaporization of the oil is assisted by the higher temperature of the pressure medium secured by the preheating and until the temperature of the pressure medium is reduced through expansion as it approaches the venting well, practically all of the oil which has been vaporized will be carried in a gaseous form near to the venting well, but as the temperature falls through expansion as the pressure medium approaches and enters the venting well, more or less of the oil vapor will be liquefied and will enter the venting well in a liquid form to be mixed therein with whatever oil has been driven by pressure into the well without vaporization. The oil in liquid form which enters the venting well is pumped up through the usual casing g by the usual pump indicated at h, h', while the pressure medium which enters the well c in gaseous form, still more or less charged with oil vapor, passes up through the venting well, the usual packing i being perforated, at at i', to permit the passage of the gas. Below the usual packing i may be formed by a perforated diaphragm k a coke chamber k', to be filled with coke or similar material for the purpose of promoting the absorption of the desirable constituents of the gas by the descending oil as hereinafter explained.

The oil pumped from the well c, already of higher gravity than that recovered by methods heretofore practised, is further raised in gravity by the recovery from the gas which passes off through the well c of some of its oil vapor. For this purpose the oil which is raised to the surface has its temperature further reduced and is then permitted to descend through the well against the counter-current of rising gas, its capacity for absorption of such oil vapor having been increased by the cooling. As shown, the oil may be delivered through a conductor g', provided with suitable valves, as at g^2, g^3, to a cooler l which may be of any suitable construction. The oil passes through thin tubes which may be surrounded in winter by cold air and in summer by some other cooling medium. From the cooler l the now cooled oil passes through a conductor l', which may be provided with a suitable valve l^2, to the top of the well c which is closed, as by a cap c'. The well c, around the casing g, is filled with coke, or some other suitable material, so that a great surface for absorption shall be provided. The depth of such a well is rarely less than five hundred feet, so that the well furnishes an absorption tower of great height and great efficiency. As the cold oil descends in the well and meets the rising gas it absorbs from the gas a great part of the oil vapor which it still retains after expansion into the bottom of the well from the oil sand. As the oil is coldest at the top and its absorption capacity is then greatest while the gas near the top of the well has lost the greatest part of its oil vapor, the arrangement is well adapted to extract from the gas, by absorption into the oil, the maximum possible quantity of oil vapor. The oil which is thus used therefore is of greatly increased gravity as compared with oil recovered by other methods and when eventually delivered from the pump, as through the valve g^4 and conductor g^5, will be found not only to have been increased in quantity, as compared with that recovered by a method of procedure which does not embody the invention, but to have had its gravity increased also, thereby commanding a higher price. The oil which is thus enriched and delivered from the well may be conducted to a refinery or otherwise disposed of.

The oil which is thus made to absorb the oil vapor of the gas itself may be derived directly from the well or it may be supplied from a different source. Thus, if a refinery be located in proximity to the well, the topped or heavy oil from the refinery may be introduced, being delivered to the cooler through a conductor m. Low gravity oil from another field might be added, as at the tank m', from which the oil is conducted to the cooler through a pipe m^2 provided with a suitable valve m^3. On the local oil, the refinery oil and the foreign, low gravity oil may be mixed and introduced. In any case the lower gravity of the oil as well as its lower temperature will increase its absorptive capacity.

It will be obvious that although the preheater and the provisions for the introduction of low gravity oil are desirable in most cases, nevertheless without them the practice of the invention may be carried on with a high degree of efficiency.

If desired, static pressure may be utilized in the well to assist in the absorption of the oil vapor. A form of apparatus, suitable for this purpose, is shown in Fig. 2. As there shown there is provided at the lower end of the casing of the venting well c below the coke filling c^2, a compression chamber n. The pump tube h^2 is carried through this compression chamber into the shot hole at the bottom of the well without perforation of any sort within the compression chamber. A tube o is also extended through the compression chamber, with its extremities respectively above and below the upper and lower ends thereof, so as to permit the passage of gas from the bottom of the well upward through the absorption tower. In the upper end of the compression chamber is secured the lower end of a pipe

p which is extended upward through the well to the top, where it may be connected to the oil delivery pipe l' so that it may be filled with oil wholly or partially. The lower end of the pipe p, within the compression chamber, is formed with a valve seat, as at p'. In the lower end of the compression chamber is secured a short section of pipe r which is formed with a valve seat, as at r'. A wire s, having at its lower end a weight s', carries a valve s^2 for coöperation with the valve seat r' and a valve s^3 for coöperation with the valve seat p', and is carried to the top of the well where it is connected to any suitable operating mechanism whereby the valves may be raised and lowered either at the will of the attendant or automatically at fixed periods. When the wire is raised, as indicated in Fig. 2, the valve s^3 closes the lower end of the tube p and the valve s^2 is lifted from the valve seat r'. Under these conditions, gas from the shot hole may enter the compression chamber n. Meanwhile the tube p, above the valve s^3, is filled with oil to a greater or less extent. When the wire s is lowered and the valves are lifted, the oil in the tube p, under a great head, falls into the compression chamber and compresses the gas therein under great pressure, the escape of gas back into the well being then prevented by the seating of the valve s^2 on the valve seat r'. As the oil descends through the pipe p, the gas under compression passes up through the pipe p and is brought into intimate contact with the descending oil, whereby the absorption of the oil vapor in the gas by the oil is greatly facilitated. It will be obvious that this high pressure absorption may take place at intervals while the low pressure absorption goes on continuously.

It will be understood that although certain specific forms of apparatus have been shown and described herein as adapted for the practice of the invention, various other forms of mechanical devices may be substituted therefor.

It will also be understood that if there is a difference in density of the oil sands in different parts of the field, the best results will be produced when the pressure medium is introduced in the wells which penetrate the relatively dense sands and made to flow thence toward the less dense sands. Moreover, it will be obvious that if a high pressure be maintained in the main line it can be reduced through proper reducing valves at the several wells so as to suit the varying conditions and secure the best results.

I claim as my invention:

1. The method of increasing the production of oil wells which consists in causing a gaseous medium to become charged with oil vapor by evaporation of the oil in the oil sand and causing it to carry the oil vapor in gaseous form toward the pumping well, producing condensation of the oil vapor in and near the pumping well, pumping from the well the oil therein, permitting the gaseous medium with its uncondensed vapors to escape upward through the well, and supplying oil to the top of the well to descend therein counter-current to the rising gaseous medium to absorb from the gaseous medium the oil vapor carried thereby.

2. The method as recited in claim 1 in which the gaseous medium is forced into one of the wells of a group to be caused to carry the oil vapor toward the pumping well of the same group.

3. The method as recited in claims 1 and 2 in which the gaseous medium is heated to a relatively high temperature.

4. The method as recited in claim 1 in which the oil supplied to the top of the well is relatively cool, being cooled at the top of the well.

This specification signed this 16th day of January, A. D. 1918.

FREDERICK SQUIRES.