W. L. RUSSELL

PROCESS OF AND APPARATUS FOR EXTRACTING OIL FROM OIL BEARING STRATA

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To all whom it may concern:

Be it known that I, WILLIAM LOW RUSSELL, a citizen of the United States, residing at New Haven, in the county of New Haven and State of Connecticut, have invented a new and useful Improvement in Processes of Apparatus for Extracting Oil from Oil-Bearing Strata; and I do hereby declare the following, when taken in connection with the accompanying drawings and the characters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this application and represent, in—

Fig. 1 a schematic, sectional view, showing one apparatus which may be employed for carrying out my invention.

Fig. 2 a similar view illustrating gas-bubbles depriving grains of oil-bearing sand of their films of oil.

My invention relates to an improved process of and apparatus for extracting oil from oil-bearing strata of various kinds and degrees of richness, whereby a considerable and paying percentage of the oil-content of oil-bearing sand, gravel, and the like, may be recovered, such, for instance, from oil fields in which the natural production, or pressure flow, has ceased; from such fields after they have been subjected to flooding; and from oil fields which have been invaded with salt water.

With these ends in view, my invention consists in a process of subjecting oil-bearing strata, whatever their character, to the infiltration under pressure of a liquid carrying a gas, producing bubbles, which by reason of their capillary attraction for the oil, detach the same from the oil-bearing material.

My invention further consists in an apparatus having certain details as will be further described and pointed out in the claims.

For the purpose of disclosing my improved process, I have, in the accompanying drawings, shown one form of apparatus which may be used for carrying it on, but wish to have it understood that my invention is not limited to such an apparatus, but comprehends the use of any apparatus by means of which oil-bearing strata may be subjected to the infiltration of a gas-bearing liquid under pressure.

As herein shown, I employ a water feed-pipe centrally located in the bore 6, the upper portion of which is provided with the usual casing 7. As shown, the upper end of the said pipe is provided with an indicating cup 8, which, however, will be omitted in case the weight of the column of water in the pipe is not sufficient to force it through the oil-bearing strata and artificial pressure must be supplied by a pump or equivalent means. The lower end of the said pipe is furnished with a cone 9, positioned in the bore 6 at a point just above the horizontal oil-bearing stratum 10, which may be oil-bearing sand, gravel, broken shale, or any other material bearing oil.

The said cone is sealed in the lower end of the bore by means of a body 11 of concrete or cement introduced through the top of the bore, after the cone has been positioned therein directly over the oil-bearing stratum 10, whereby the water introduced through the pipe 5 into the bore, upon the oil-bearing stratum 10, is prevented from rising in the bore and forced to find another way out by infiltration through the oil-bearing stratum 80 to a neighboring well or other outlet. I also introduce into the bore 6 a gas feed-pipe 12 enough longer than the water feed-pipe 5 to extend downward through and below the stratum 10, and through a cup-shaped, perforated gas-distributor 13, positioned in that portion of the bore 6 carried downward through the oil-bearing stratum 10.

For the protection of the gas-distributor 13, I preferably employ a cup 14 located within the cone 9 and carried by an arm 15 secured thereto, this cup being intended to catch any sediment which may find its way downward through the water feed-pipe 6, and which, if not intercepted, might clog the perforations in the distributor.

In carrying on my process, water is supplied to the pipe 6 and air, or some other suitable gas, to the tube 12. The gas must be supplied to the tube 12 at a sufficient pressure to force it into the bore 5 to a point below the distributor 13 and, therefore, under a pressure sufficient to overcome the water pressure, whatever that may be in any given situation. A portion of the air will, under these circumstances, be absorbed by the water and carried along therewith, through the oil-bearing stratum 10. As the water, thus saturated with air, moves away from the bore 6 in the direction of some neighboring well or outlet, the pressure upon it will gradually diminish and the absorbed
air will reappear in it in the form of bubbles 16 (Fig. 2), for which the thin films 17 of oil on the grains 18 of sand will have greater capillary attraction than the grains of sand themselves. The oil thus detached from the grains 18 reforms itself as films upon the bubbles 16, and will be carried along by them in the current of water flowing to a neighboring well or outlet.

In this manner, a paying percentage of the residual oil in non-flowing wells may be recovered. Even after such non-flowing wells have been flooded with water for the recovery of the residual oil, my process may be effectively used for the recovery of the oil still remaining in the oil-bearing sand. When such non-flowing wells are flooded for the removal of oil remaining in them, the tendency of the water is to flow or percolate through the looser portions of the stratum, the more impervious portions thereof not being penetrated. However, under my process, the air bubbles will tend to block the interstices in the pervious stratum with the effect of forcing the water through the more impervious portions thereof. My improved process may also be applied to advantage to extracting oil from oil-bearing wells which have been flooded with salt water.

I wish it clearly understood that I do not limit myself to the particular means herein shown and described for carrying on my process, my invention broadly comprehending the subjection of oil-bearing strata, of whatever description, to the searching action of a gas-bearing current of liquid under pressure. On account of its availability, water will be employed as the liquid, but, under some circumstances, other gas than air may be found more efficacious, such as carbon dioxide. I also conceive that the gas, whatever its character, might be dissolved in the liquid prior to the introduction of either into the earth.

In case the pressure secured by the column of water in the pipe 5 in any given situation provides sufficient water-pressure or head for the infiltration of the oil-bearing stratum and the cup 8 is used, the bubbles rising therein will serve to advise the operator when the amount of air supplied through the pipe 12 is sufficient in amount to effect the saturation of the water being injected into the oil-bearing stratum. When, as already stated, means must be resorted to to artificially increase the water-pressure, the use of a cup in the indicated position must be dispensed with. The cement seal 11 may, of course, be replaced by a packer of the kind commonly used in oil-well installations.

I claim:

1. A process of extracting residual oil from oil-bearing strata consisting in subjecting the same to the searching action of a liquid under pressure containing a dissolved substance appearing as bubbles of gas as the pressure is relieved from the liquid whereby the oil is extracted from the oil-bearing strata by the reciprocal attraction between the bubbles and the oil, causing the latter to become attached in the form of a film to the exterior surface of the bubbles.

2. An apparatus for extracting residual oil from oil-bearing strata, comprising a water feed-pipe, a seal near the lower end thereof, a gas feed-pipe, and a gas-distributor located below the seal at the lower end of the water pipe, and having the gas pipe carried downward through it.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

WILLIAM LOW RUSSELL.

Witnesses:

GEORGE DUDLEY SEYMOUR,
M. E. HUNTINGTON.