

METHOD OF AND APPARATUS FOR TREATING OIL SHALE.

Patented June 18, 1918.

1,269,747.



Inventor:
Lebens H. Rogers
By Mauro, Cameron, Lewis & Massie,
Attorneys.

L. H. ROGERS.
METHOD OF AND APPARATUS FOR TREATING OIL SHALE.
APPLICATION FILED APR. 6, 1918.

1,269,747.

Patented June 18, 1918.

2 SHEETS—SHEET 2.

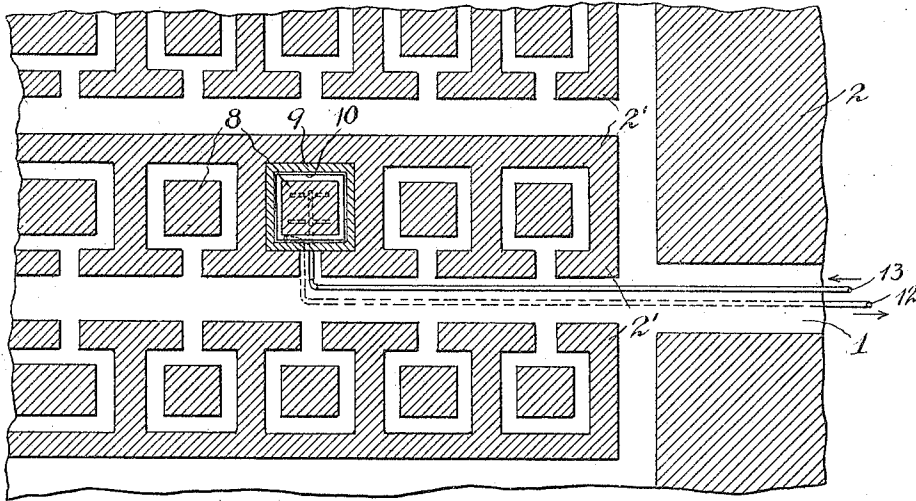


Fig. 4.

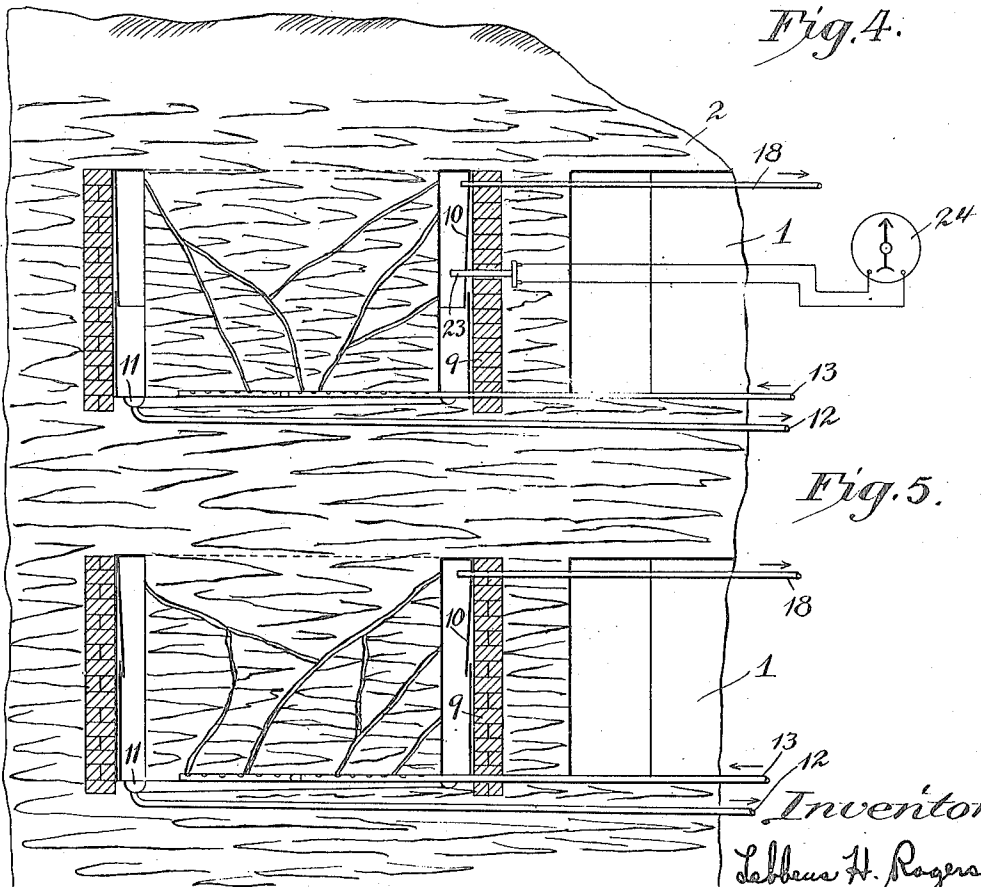


Fig. 5.

Inventor:

L. H. Rogers

By Mauro Cameron, Lewis Massie,
Attorneys.

UNITED STATES PATENT OFFICE.

LEBBEUS H. ROGERS, OF NEW YORK, N. Y.

METHOD OF AND APPARATUS FOR TREATING OIL-SHALE.

1,269,747.

Specification of Letters Patent. Patented June 18, 1918.

Application filed April 6, 1913. Serial No. 227,087.

To all whom it may concern:

Be it known that I, LEBBEUS H. ROGERS, a citizen of the United States of America, and a resident of New York city, N. Y., have invented a new and useful Improvement in Methods of and Apparatus for Treating Oil-Shale, which invention is fully set forth in the following specification.

The present invention relates to the production of mineral oil and other products from oil-bearing rocks or shale, and has for its object to recover the above products without removing the shale or rock from the formations in which they naturally occur.

Oil-bearing shales are widely distributed over the earth and usually occur in horizontal or nearly horizontal beds or layers varying greatly in thickness from a few inches to several hundred feet. These beds usually lie between other strata, such as sand-stone, differing therefrom in character and which are more or less impervious. As heretofore practised, oil-bearing shale has been mined either from the surface by sinking shafts and extending lateral galleries therefrom, as in coal mining, or by stripping the surface and excavating the shale where surface outcrops occur. This mined or excavated shale has been subjected to distillation in retorts for the recovery of the oils and other volatile products such as ammonia.

While vast quantities of oil are locked up in the oil-bearing shales, the cost of removing the shale to the retorts for distillation, except in peculiarly advantageous situations, has heretofore rendered this source of oil too expensive to work at a profit.

In certain formations, occurring particularly in the Tertiary and Cretaceous ages, the oil-bearing shale outcrops on the slopes and cliffs above the valleys or flood planes and appears between strata of impervious rock and extends in horizontal beds far back from the sides of the valleys.

My invention provides a method of treating oil-shale beds to distillation, particularly those lying above the level of valleys, without removing the shale or only a part of it from its natural position. With this end in view, I cut or tunnel through the shale-bed intersecting passages leaving columns of oil-shale of any desired cross-section covering

an acre, or more or less, and also preferably leaving supporting masses of rock between the columns. Where impervious rock strata occur at vertical intervals suitable to constitute ceiling and floor walls for the tunnels, I preferably operate between these levels. Into each column of shale I drill blast holes for the reception of explosive charges suitable for rending the mass without destroying the identity of the column.

Each charge is connected up to outside firing means such as a deflagrating battery or spark device. A brick or concrete wall is erected around each column at a distance therefrom sufficient for workmen to enter between the wall and column. This wall extends vertically the height of the column and preferably is built against the face of the supporting rock left between the columns. Where the oil-shale lies between impervious strata of suitable vertical interval, the brick wall extends between such strata. The space between the circumscribing wall and column also serves the purpose of giving room for the expansion of the shale during the process of distillation. A lining to the brick wall, such as cement or sheet-metal, is preferably provided and may and preferably is made in sections permitting of its removal and reuse with other columns after the operation of distillation is completed. Means are now provided for subjecting the mass of shale confined within the wall to the necessary temperature for destructive distillation. This means may assume various forms, such as the introduction of highly heated fluids under more or less pressure, including air, steam, highly heated products of combustion, or other gases either separate or mixed, or the heat may be applied by means of the electric current passed through electrodes or resistances located in the oil-shale. This latter manner of heating may be relied upon alone for distilling or be associated with the use of heated fluids. The temperatures within the column under treatment may be indicated to the attendant or stillman for his guidance by suitable temperature-sensitive means introduced into the heated space and adapted to indicate or record temperatures outside.

I preferably conduct the operation of dis-

tillation by locating perforated pipes in the body of the confined oil-shale and connect them with sources of highly heated air and steam under pressure. The air is first heated
 5 to a temperature sufficient to set up slow combustion in the oil-shale and is then introduced preferably at the base of the column and is continued until a body of shale has been raised to a temperature sufficient to
 10 start distillation of the shale above it. Superheated steam under pressure is then introduced through the same or different pipes to continue the distillation without combustion. This operation may be repeated until
 15 the oil-shale is exhausted.

The products resulting from the above treatment of the oil-shale are vapors and gases which are withdrawn and conducted to suitable condensers and apparatus for recovering the gasoline, oils, ammonia, and other products. The heavier oils separating from the shale and which do not distill are permitted to drain off to collecting receptacles. Their removal may be assisted, if necessary,
 25 by introducing air, steam, or water under pressure to force or flood them out.

The shale residue left after distillation contains alkali metal salts and is useful as a fertilizer. The shale which is removed
 30 from around the columns is subjected to distillation in ordinary retorts for the production of gasoline and other products. The gases produced in the operation of shale distillation are used to raise steam, heat
 35 the air used in treating the shale columns, and producing power for operating dynamos for supplying heating current and for other purposes.

In order that the invention may be more readily understood, reference is had to the accompanying drawings which show, by way of illustration, constructional forms of my invention, but such drawings are intended merely to assist the description and
 45 not to define the limits of the invention.

Figure 1 is a schematic plan view showing the manner of tunneling the oil-shale and arrangement of the inclosing wall;

Fig. 2 is a view partly in vertical section
 50 through a bed of oil-shale, and partly diagrammatic showing a column of oil-shale with its inclosing walls and accessory apparatus;

Fig. 3 is a vertical sectional detail view
 55 through a bed of shale provided with electric heating means;

Fig. 4 is an enlarged detail plan view showing the manner of reinforcing the inclosing walls by aid of native rock backing; and
 60

Fig. 5 is a plan view showing the manner of treating oil-shale when the shale is unaccompanied by impervious confining top and bottom strata.

In the drawings, Fig. 1 shows a main entrance tunnel 1 in a bed of oil-shale 2 lying between more or less impervious strata 3, 4. This tunnel is extended into the bed of shale and from it lateral corridors extend which are in turn cut by other corridors normal thereto, thereby leaving columns 8 of oil-shale between the ceiling and floor rock. Into each of these columns, blast holes are drilled and each hole is supplied with a light charge of explosive, as shown at 5 at the left of Fig. 2. These charges are connected by electric wires 6 to a source of current, such as deflagrating battery A, through a suitable switch 7. 9 is a brick wall built around the four sides of the oil-shale column 8 and spaced therefrom to permit a workman to enter and place a sheet-metal lining 10 against the wall. The lining and wall extend from the ceiling rock 3 to the floor rock 4 and make tight joints therewith. 11 is a gutter cut in the solid rock and given a fall to a central point from which an oil drain pipe 12, governed by cocks, leads to a suitable collecting tank or tanks not shown. 13 is a superheated steam supply pipe which is located at or near the base of the column of shale 8 and provided with one or more perforated branches for introducing steam which is superheated by means of a boiler 14. Connected with steam pipe 13 is a
 95 valved air supply pipe 16 passing through a heater 17 and designed to force highly heated air through pipe 13 into the oil-shale by aid of a pump. This pump can be used later for forcing water or air into the column to force or flood out the heavier products. 18 is an eduction pipe open near the top of the column in the walled space and connected with a condenser of conventional form and terminating in a separator from which the gaseous products are here shown conducted to a pump which supplies fuel to the furnace of the boiler. Gasoline and other products of condensation are drawn off through cock 19 and water containing ammonia through cock 20. A thermosensitive device 23 for indicating temperatures at a distance affords information to the stillman to guide him in conducting the operation.

The system thus far described operates in the following manner: Assume that a column of shale has been prepared as described above for distillation, and the entrance opening has been sealed up. The rending charge may be set off before the column is walled in or afterward. The force of the explosion is so regulated by the quantity of explosive as to form numerous crevices in the shale for penetration of heated fluid. By means of the pump, air is forced under pressure through furnace 17 where it is heated sufficiently to set up slow combustion in a localized portion of the shale column when in-

roduced through pipe 13. Steam at this time is cut off. After combustion in the lower part of the column is well started, air is cut off and superheated steam is introduced through pipe 13. As the shale yields to destructive distillation, vapors and gases pass off through pipe or pipes 18 to the condenser where the condensable portions, such as gasoline and light oils, are separated from the gas and water of condensation which latter contains the ammonia. The heavy oils which result from the treatment of the shale gravitate to the bottom of the column and may be driven out through pipe 12 by aid of air or steam under pressure or flushed out with water by aid of the force pump.

The blasting with air and steam are repeated and the temperatures are controlled to conform to the indications of the temperature-indicating device 24.

Instead of heating the oil-shale by heated fluid alone, an electric source of heating, such as shown in Fig. 3, may be used either alone or in connection with the heated fluids. In this case, electrodes 21 are provided and are located in the shale. Current is supplied for a dynamo 22 by power from fuel derived from the shale.

Fig. 4 is like Fig. 1, except that it shows a somewhat different manner of tunneling whereby each column of shale may be surrounded with supporting rock 2' thereby affording a retaining backing for the brick wall on the four sides.

Fig. 5 shows the system as applied to a thick bed of shale which is not associated with top and bottom rock strata. The shale itself constitutes the ceiling and floor closures of the inclosing wall.

While I have described the use of highly heated air and superheated steam as suitable for conducting the distilling operation of the oil-shale, I desire it to be understood that any highly heated fluid, either alone or mixed with other highly heated fluids, may be employed in distilling the shale, such as hot furnace gases or the like.

While I have described the use of impervious walls built, for example, of masonry for confining the oil-shale columns during distillation, I may, where the oil-shale itself is sufficiently impervious, omit such built-up walls and in lieu thereof seal up the entrances to the spaces surrounding the columns shown in Fig. 4. In other respects the operations are conducted in the manner described above.

What is claimed is:—

1. The method of treating oil-shale in its native position consisting in confining a body of said shale within an impervious wall and subjecting said shale to heat to destructively distil the same and withdrawing the resulting products.

2. The method of treating oil-shale in its native position consisting in confining a body of said shale within an impervious wall, opening up crevices in said body by exploding therein an explosive agent, and subjecting said shale to heat to destructively distil the same and withdrawing the resulting products.

3. The method of treating oil-shale in its native position consisting in confining a body of said shale within an impervious wall, introducing therein highly heated fluid to destructively distil the shale and withdrawing the resulting products.

4. The method of treating oil-shale in its native position consisting in confining a body of said shale within an impervious wall, opening up crevices in said body by exploding therein an explosive agent, and introducing therein highly heated fluid to destructively distil the shale and withdrawing the resulting products.

5. The method of treating oil-shale in its native position consisting in surrounding a body of said shale with an impervious wall, opening up crevices in said body by exploding therein an explosive agent, heating a portion of said body to the point of destructive distillation by introducing highly heated air, then introducing thereat superheated steam and then withdrawing the resulting products.

6. Apparatus for distilling oil-shale comprising an impervious wall adapted to surround a column of oil-shale in its native rock bed, means for supplying heat to said inclosed shale, and means for conducting away the products formed.

7. Apparatus for distilling oil-shale comprising a wall having a removable metal lining and adapted to inclose a column of shale in its native rock bed, means for supplying heat to the shale within said wall, and means for conducting away the products formed therein.

8. Apparatus for distilling oil-shale comprising an impervious wall adapted to inclose a column of oil-shale in its native rock bed and spaced away therefrom, means for supplying heat to said inclosed shale, and means for withdrawing the products formed therein.

9. A system for producing oil and other products from an oil-shale bed consisting in removing portions of shale from said bed leaving a column of shale undisturbed, surrounding said column with an impervious wall and subjecting the inclosed oil-shale column to destructive distillation.

10. A system for producing oil and other products from an oil-shale bed, consisting in removing portions of shale from said bed leaving columns of shale undisturbed and other portions of shale substantially sur-

rounding said columns, provideing each column with an impervious wall which is spaced therefrom and is reinforced by said surrounding rock, and subjecting said confined oil-shale to destructive distillation.

11. Apparatus for distilling oil-shale comprising an impervious wall adapted to in-

close a column of said oil-shale, electric heating means located within said inclosed shale, and means for removing the products formed therein.

In testimony whereof I have signed this specification.

LEBBEUS H. ROGERS.