Apr. 10, 1923 1,451,575

G. E. HOLMES

OIL SHALE RETORT

Filed Dec. 27, 1919 2 sheets-sheet 1

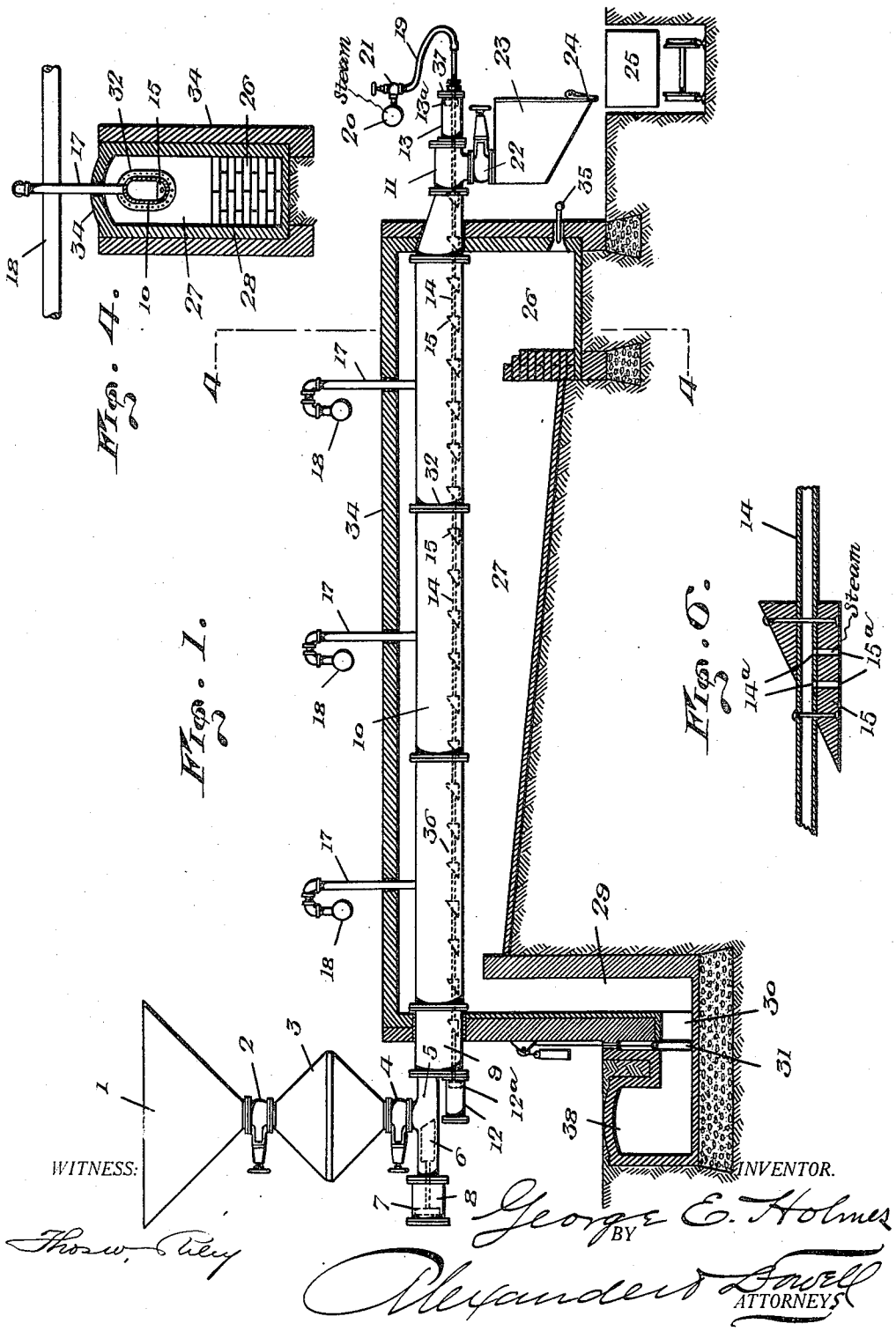


Fig. 4.

Fig. 1.

Fig. 6.

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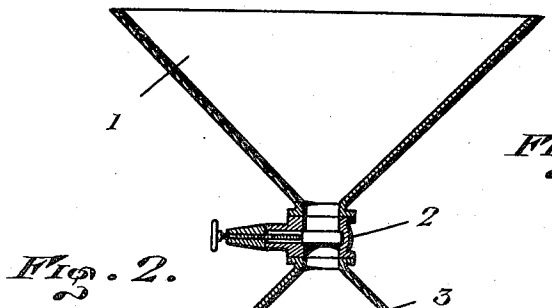


Fig. 2.

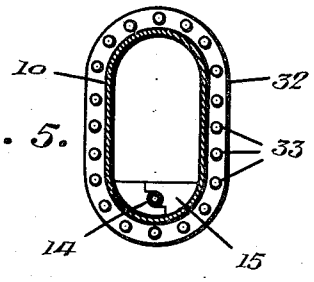
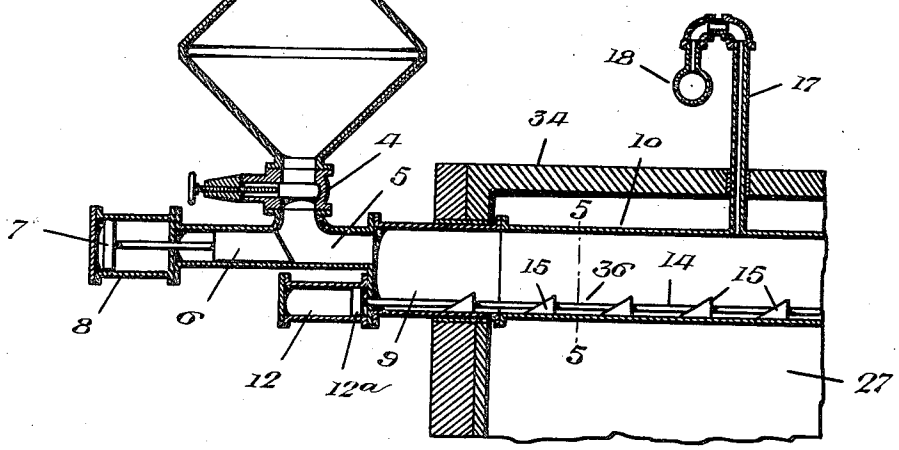


Fig. 5.



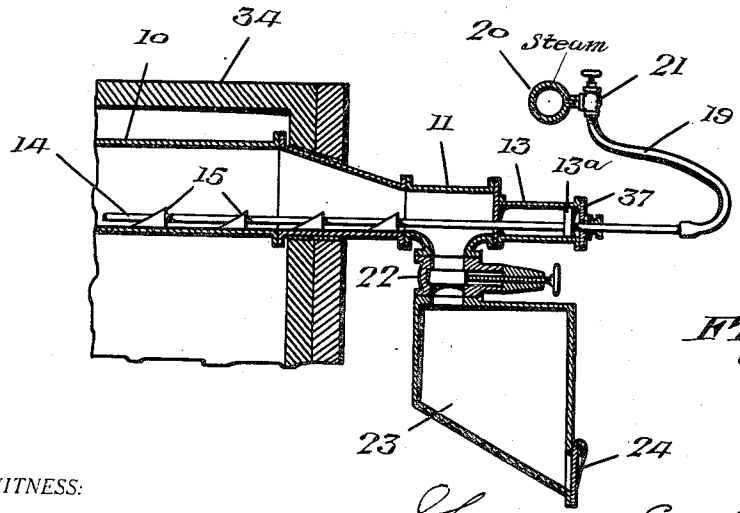


Fig. 3.

WITNESS:

Thos. W. Cley

INVENTOR.

George E. Holmes

BY

Alexander & Sawell

ATTORNEYS

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UNITED STATES PATENT OFFICE.

GEORGE EDWARD HOLMES, OF SALT LAKE CITY, UTAH.

OIL-SHALE RETORT.

Application filed December 27, 1919. Serial No. 347,665.

To all whom it may concern:

Be it known that I, GEORGE E. HOLMES, a citizen of the United States, residing at Salt Lake City, in the county of Salt Lake and State of Utah, have invented certain new and useful Improvements in Oil-Shale Retorts; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is an apparatus for and process of distilling or separating the oil contained in oil shale, asphalt or other oil bearing mineral, from the solid or residual matter thereof and is particularly designed for use in refining plants in which oil shale is treated for the purpose of extracting its oil contents.

The principal object of my invention is to provide a simple and efficient means for and method of distilling off the oil from the shale without scorching or burning the distillate by an apparatus and method adapted to be operated preferably in a continuous manner and with a maximum recovery of the products of distillation.

A further object of my invention is to provide means to fractionate or make an approximate separation of the distillate into portions according to their relative points of vaporization so that the final refining processes will be simplified.

To facilitate an understanding of the method and apparatus I will explain one practical form of apparatus embodying the invention and illustrated in the accompanying drawings, which will enable others skilled in the art to adapt and use the invention; but as it is capable of being utilized and embodied in various forms of apparatus; and as such apparatus would naturally be modified in accordance with the particular material to be treated, it is not restricted to the specific construction and arrangement of parts illustrated in the drawings; and therefore I refer to the claims following the description for summaries of the novel essentials of the invention and the various novel combinations of parts and novel specific features or elements embraced within the invention, for all of which protection is desired.

In said drawings:

Fig. 1 is a diagrammatic side elevation of the retort and longitudinal section of its setting.

Fig. 2 is an enlarged longitudinal section through the feed end of the apparatus.

Fig. 3 is an enlarged detail section through the discharge end of the apparatus.

Fig. 4 is a transverse section on line 4—4, Fig. 1.

Fig. 5 is an enlarged transverse section of the retort on line 5—5, Fig. 2.

Fig. 6 is a detail section of the conveyor.

In the accompanying drawings 10 designates a horizontal metal container or shell herein termed a retort which is made up of one or more sections which are fastened together by means of suitable flanges 32 and bolts 33. This retort 10 is suitably supported, so as to permit of expansion and contraction due to temperature changes, in a heating furnace 34.

Experiment showed that slow, low temperature, which would cause fractional, destructive distillation was necessary to secure the best results in the distillation of oil shade. Hence I preferably employ a long horizontal retort elliptic in shape; relatively narrow and higher than its width, for the reason that shale is to be conveyed along its floor; narrow to permit of the ready transference of heat; and higher than its width in that steam, with its tendency to rise in a straight line, is introduced in the bottom of the retort.

At the feed end of the retort is a hopper 1, communicating by a gate valve 2 with a secondary hopper 3 which connects by means of a gate-valve 4 with a feeding cylinder 5, in which is a plunger feeder 6 which is reciprocated forward and backwards by any suitable means. Preferably it is operated by means of a piston 7 in a cylinder 8 and by admitting steam first on one side and then on the other side of piston 7 the contents of hopper 3 are gradually fed into the receiving end 9 of the retort 10.

The material thus fed into the receiving end 9 of retort 10 by plunger feeder 6 is then alternately agitated and conveyed forward through the retort by any suitable means. As shown a reciprocating scraper conveyor 36 is employed. This conveyer 36, as shown,

comprises a longitudinally disposed pipe or rod 14 to which are attached—at suitable intervals—wedge-shaped shoes or blades 15, tapered oppositely to the desired direction of movement of the material.

The reciprocating conveyor 36 is preferably actuated by means of steam cylinders 12 and 13 and pistons 12^a, 13^a located at opposite ends of the retort as shown. Preferably the pistons 12^a, 13^a are of the single acting type, and are actuated in alternation so that the conveyor rod 14 is always moved under tension and never under compression. The conveyor rod 14 with its conveyor shoes 15 is thus alternately pulled forward by piston 13^a at the discharge end of the retort and then pulled backwards by means of piston 12^a at the feed end of the retort. The shoes 15 as they are moved forward and backward gradually work the shale or other oil bearing material forward through the retort which is thus subjected to the heat generated in the combustion chamber and furnace and its contained oils are thus vaporized and driven off.

The forward and backward, or reciprocating motion of the conveyor along the bottom of the retort, has a cleaning effect that keeps the shale constantly in motion, prevents fluxing along the sides of the retort, and expedites among the material the ready transference of heat.

At the discharge end of the retort is an outlet gate-valve 22 through which the material drops into a receiving hopper 23, from which it can be discharged as desired.

At different points along the retort, pipes 17 are tapped into the top wall of the retort 10. These pipes 17 connect to collector pipes 18 which may lead to separate suitable condensing apparatus where the collected oil vapors are condensed.

The furnace 34 may be of any suitable and preferred construction. In the drawings it is shown as comprised of a firebox 26, combustion chamber 27 and flue gas passageway 29, which connects with the usual stack flue 38 by means of tunnel 30, which is equipped with a damper 31. The firebox 26 may be equipped to burn gas or oil by means of any suitable burner, indicated at 35, or may be provided with grates or other suitable means to burn coal or other solid fuel.

As the oil shale or other oil bearing material is alternately agitating and moved forward through the retort the oil contained therein is vaporized and such temperatures should be maintained in the furnace and combustion chamber that all oil in the shale or other material being treated will be separated therefrom by the time the material reaches the discharge end of the retort 11. The spent or waste material is then dropped through gate valve 22 into receiving hopper 23 from which it can be removed from time to time through discharge gate 24 into cars 25.

I have found by experience that it is very desirable to thoroughly inject steam under the oil shale to prevent it fluxing or sticking to the bottom and sides of the retort, and also to reduce the temperature of the gases as they are distilled from the shale.

The introduction of steam into the retort in the manner hereinafter described, also increases the volume of hydrocarbon vapors produced from distillation of the shale, increasing the volume between two and three times. The action is chemical. The superheated steam in the presence of a fixed carbon readily disassociates; some of the hydrogen of the water (steam) will unite with the nitrogen in the shale forming ammonia NH_3. Other of the nitrogen will unite with the carbon forming the hydrocarbon series, thereby increasing the volume of the retorted vapors.

To so introduce or inject steam into the shale, the reciprocating conveyor shaft 14 is preferably made of a hollow rod or pipe and extended through the front head 37 of cylinder 13 and the extended end of this hollow shaft is connected to a steam main 20 by any suitable flexible means, a flexible steam-hose 19 being indicated. A regulating valve 21 is provided to control the amount of steam introduced through the conveyor shaft 14 into the retort. Suitable holes or slots 14^a may be provided at regular intervals in the bottom of conveyor shaft 14, or to connect with passageways 15^a in conveyor shoes 15 (as indicated in Fig. 6) so that the steam will thoroughly agitate and penetrate the shale or material as it is moved forward through the retort.

The introduction of low pressure steam through the piston at the hotter end of the retort serves to regulate the temperature of the piston operating in such hotter end, thereby preventing it from burning. The low pressure steam introduced through the piston becomes superheated from the heat applied to the retort and such superheated steam admitted through the length of the retort assists and hastens the transfer of heat inside the retort from outlet to the intake end. It thus hastens distillation, and as the steam is drawn off through the vents, it acts as a carrier for the volatilized hydrocarbons, and sweeps the entire retort.

The method of treating the shale or oil bearing minerals will be obvious from the foregoing description.

While I have shown and described my invention as embodied in an apparatus wherein the means employed to agitate and gradually move the material being treated forward through the retort consists of a drag or scraper conveyor comprised of wedge shaped shoes mounted on a hollow shaft

through which the steam is conveyed to the various points of use; it is obvious that the conveyor and agitating members may be otherwise located and arranged; and other suitable types of conveyor might be employed. It is also obvious that various other means could be used to feed the raw material to be treated into the retort, or to remove the spent material from the retort.

It will be obvious from the foregoing that the invention does not reside so much in the particular construction of the elemental parts of the apparatus, as in the general arrangement and method of operating same; and obviously the elemental features of the apparatus and specific arrangement thereof can be changed and varied to suit the designer while retaining the essential characteristics and substantial beneficial results of the invention.

What I claim is:

1. Apparatus for distilling oil shale, comprising a heating furnace, a closed horizontal retort, extending through such furnace and subjected to graduated external heat; means for admitting shale into the cooler end of said retort; reciprocating means for stirring the shale when said means moves in one direction and to move the shale along the bottom of the retort in the other direction; means for drawing off distilled products progressively along said retort; means to inject low pressure steam through the agitating means along the bottom of the retort while the shale is in process of distillation; and means for discharging the spent shale at the hottest end of the retort, substantially as described.

2. In an apparatus for distilling oil shale, a heating furnace, a closed tubular retort, extending through said furnace, a valved feeder connected with one end of said retort, means for forcibly ejecting shale from the said feeder into said retort, a valved discharger at the hotter end of said retort; reciprocating means adapted to stir the shale when moving in one direction and to forward the shale when moving in the other direction and also to inject steam along the bottom of the retort while the shale is in process of distillation to prevent scorching of the gaseous products as the shale is moved through the retort; and means for discharging the spent shale at the hottest end of the retort, substantially as described.

3. In an apparatus for distilling oil shale, a heating furnace, a closed tubular retort, extending through said furnace, a feeder connected with one end of said retort, a discharge at the other end of said retort, a pipe extending through said retort, a steam supply connected with said pipe, combined stirrers and pushers connected with said pipe within the retort and perforated for the escape of steam along the bottom of the retort, and means for reciprocating said pipe to agitate the material and propel it through the said retort.

4. In an apparatus for distilling oil shale, a heating furnace, a closed tubular retort extending through said furnace, a valved feeder connected with one end of said retort, means for forcibly ejecting shale from the said feeder into said retort, a valved discharger at the other end of said retort, with a pipe extending through said retort, a steam supply connected with said pipe, a series of stirrers or pushers connected with said pipe within the retort and perforated for directing steam against the bottom of the retort, and means for reciprocating said pipe in both directions under tension to alternately stir the material and propel it forward through the said retort.

5. In an apparatus for distilling oil shale, a heating furnace, a closed retort extending through said furnace, a feeder connected with one end of said retort, a discharger at the other end of said retort, a pipe extending through said retort, a steam supply connected with said pipe, combined stirring and pushing shoes connected with said pipe within the retort and perforated for the escape of steam; and means for positively pulling said pipe and the stirring and pushing shoes first in one direction and then in the other, thereby alternately stirring the material and intermittently propelling it through the retort; substantially as described.

6. In an apparatus for distilling oil shale, a heating furnace, a closed tubular retort extending through said furnace, a valved feeder connected with one end of said retort, means for forcibly ejecting shale from the said feeder into said retort, and a valved discharger at the other end of said retort, with a perforated pipe extending through said retort, a steam supply connected with said pipe, a series of stirring and pushing shoes connected with said pipe within the retort and perforated for the escape of steam along the bottom of the retort, and means for positively pulling said pipe and the stirring and pushing shoes first in one direction and then in the other to alternately stir the material and propel it forward through the said retort.

In testimony that I claim the foregoing as my own I affix my signature.

GEORGE EDWARD HOLMES.