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MIST REMOVAL

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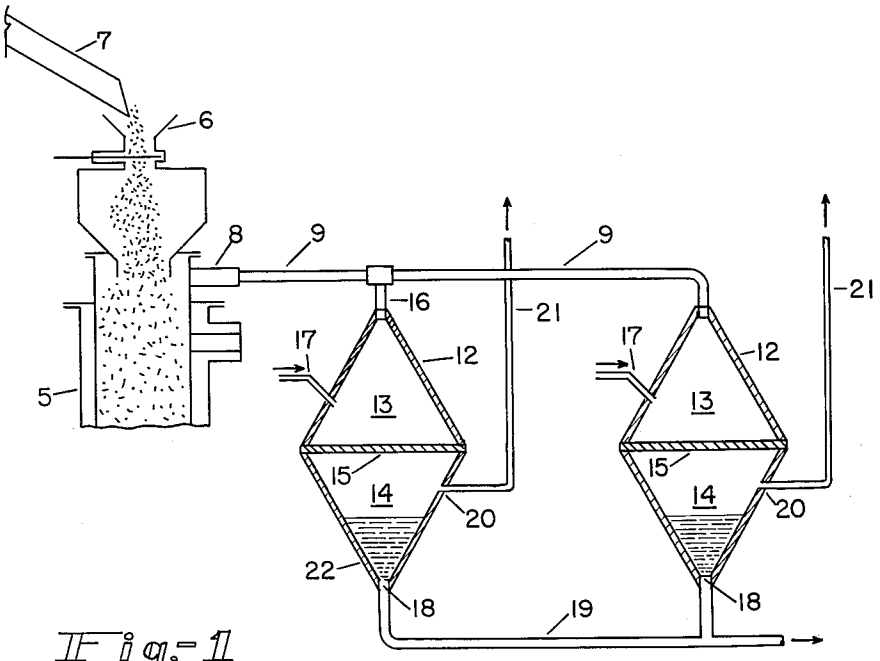


Fig. 1

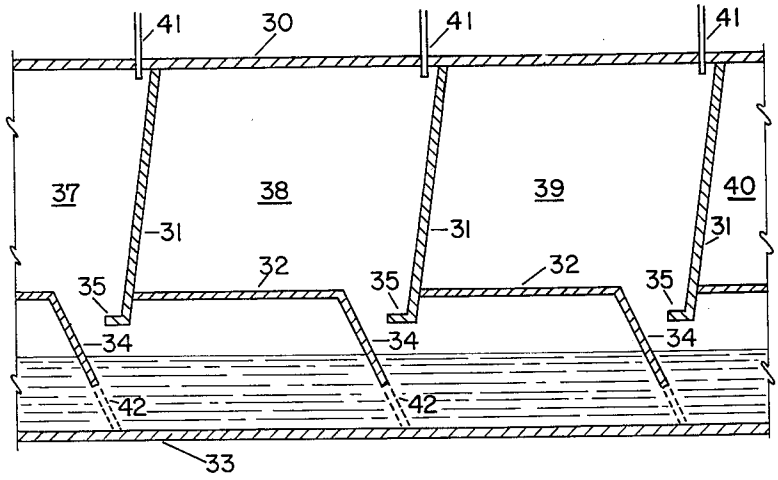


Fig. 2

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MIST REMOVAL

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This invention relates to methods and apparatus for recovering the oil content of oil mists or aerosols produced in conventional oil shale retorting operations and other oil shale processing.

In such operations, it has been customary to produce a stable mist in the retort to facilitate the removal of evolved oil from such retort, after which the oil is separated from the gaseous carrier vehicle in one or more subsequent treatment stages. However, due to the stable character of the mist produced in the retort, or otherwise, the subsequent extraction procedure frequently is rather involved and quite expensive.

The present invention involves a departure from prior practice in providing a simplified method and arrangement of apparatus for oil extraction from the oil mist discharge of the retort or other source. The present extraction is based on the discovery that by using a porous medium disposed as a barricade in the path of aerosol flow, which medium has pores of relatively fine size, particularly within the 10–40 micron size range, the passage of the mist through such porous medium provides a good separation. In most operations it will be beneficial to subject the contact surface of such medium to a regular or continuous scrubbing action by a suitable material so as to prevent blinding and thereby establish an efficient and economical operation.

It is an object of my invention to provide a simple, efficient and economical method for the extraction and recovery of the oil content of oil mists or aerosols of oil shale processing.

Another object of my invention is to provide simple, durable and efficient apparatus for the extraction and recovery of the oil content of oil mists or aerosols of oil shale retort operations.

A further object of my invention is the provision of simple, economical and efficient scrubbing operations for maintaining a porous medium used in the oil extraction in a highly permeable condition over relatively long periods of operation.

Other objects reside in novel details of construction and novel combinations and arrangements of parts, all of which will be fully described in the course of the following description.

The inventive concept of the present invention is based on the discovery that an aerosol mist of oil shale retorting can be directed against and through a porous barricade or media, such as sintered glass or sintered metal, in continuous operation with or without scrubbing of the contact surface of such media with a light oil solvent, with resulting recovery of the oil content of such aerosol, separate from its gaseous content.

The practice of my invention will be best understood by reference to the accompanying drawings illustrating typical operations and apparatus utilized in such practice. In the drawings like parts bear similar reference numerals and,

FIG. 1 is a vertical section through one form of apparatus embodying features of the invention, and

FIG. 2 is a vertical section through another form of apparatus utilized in the practice of the invention.

Referring first to the form of the invention depicted in FIG. 1, a shale oil retort 5 having an intake 6 supplied by a chute 7 connected with a suitable source of oil shale supply (not shown) discharges retort gas containing an aerosol mist through an outlet 8 into a line

9 supplying one or a plurality of separators 12; a system using two or more parallel lines of separation each containing a plurality of units in series being the preferable method of operation.

Each separator 12 comprises an upper chamber 13, a lower chamber 14 and a porous partition member or barricade 15 dividing the interior of the separator into said chambers. A branch 16 delivers retort gas from line 9 into the chamber 13, and a line 17 supplies a light oil solvent to chamber 13 for scrubbing the contact surface of partition 15. The lower chamber 14 has a lower outlet 18 discharging into a line 19, and an upper outlet 20 discharging demisted retort gas into a conduit 21 which may discharge said gas as exhaust or conduct it into the next separator in the series.

Due to the fact that the porous material used in forming partition 15 is able to withstand temperatures in excess of the range of temperatures of the retort gas as it passes from outlet 8, temperature is no problem in the separator equipment and the gases can be conducted from the retort directly to the separator without passing through a cooling device. When solids deposit in the pores tends to occur the continuous scrubbing of the barricade surface with the light oil solvent keeps the barricade functioning efficiently over long periods of operation and only occasional replacement is required. In many treatments, such blinding does not occur because the oil carries its own solvent, and scrubbing with solvent is not required.

In the operation shown in FIG. 1 the retort gas entering line 9 is passed into a plurality of separators 12. The light oil solvent introduced into the plurality of upper chambers 13 assists in maintaining the flow through the pores of partitions 15 and also may be utilized in temperature exchange with the retort gas to initiate condensation. The flow into partition 15 permits gaseous components to travel through the succession of interstices in less time than the droplets of heavy shale oil with the result that such droplets are no longer airborne when they emerge at the under surface of the barricade and due to the pressure of following material, they fall by gravity to the sump portion 22 at the bottom of chamber 14.

The light oil solvent introduced at 17 may be obtained from any suitable source of supply (not shown) and preferably is a light oil fraction obtained in the processing of the oil discharge of line 19. When this solvent is introduced at a temperature substantially below that of the entering retort gas, a heat exchange results which promotes condensation and the mixing of the light recycle oil with the heavier shale oil causes an increase in size of the droplets at the downstream side of the barrier which reduces the likelihood of any oil becoming airborne again. Where solvent introduction is not required, lines 17 may be closed.

If desired the separators 12 of FIG. 1 may be included in a condensation and collection system of the type described in the co-pending application of Poettmann et al., Serial No. 753,043 filed August 4, 1958, for "In Situ Retorting of Oil Shale" and owned by the assignee of this application. Such a system may be employed to process the retort discharge of in situ retorting operations as described in said co-pending application, or such system may be arranged to process retort gas of a surface retort installation as indicated in FIG. 1.

FIG. 2 illustrates another arrangement of separator apparatus using features of my invention. In this form, stage separation is employed with the vapor discharge of one stage constituting the feed to a next stage until a desired extraction or separation has been obtained. Such apparatus may be arranged to receive the exhaust gas discharge of other separators such as the conduits 21 of FIG.

1, or may be fed directly from a retort outlet 8, or other supply of retort gas.

As shown, the apparatus comprises an elongated hollow structure 30 having a plurality of depending barricades or porous partitions 31 of sintered glass or sintered metal which form an enclosure with the top and sides of structure. The lower end of each partition 31 is connected with a baffle member 32 supported in spaced relation to the bottom 33 of structure 30 to permit a flow of separated oil along said bottom to a final point of discharge (not shown). Each said baffle has an inclined surface 34 positioned in close proximity to the lower end of the associated partition 31, here shown as a flange 35, providing a narrow gap for passage of separated oil into the flow along bottom 33. The ends of baffles 34 are substantially submerged in said stream, and this sealing arrangement causes the gaseous content to pass along the succession of chambers 37, 38 and 39 by penetrating the successive partitions 31 for final discharge as exhaust gas from another chamber or conduit 40.

Each of the partitions 31 has its upstream surface scrubbed by a light oil solvent introduced through a header or distributor 41. Some of the light oil so introduced will be entrained in the moving gas stream and mixed with the heavier shale oil in the passage through the porous structure, while the remainder flows by gravity into the oil flow along the bottom 33. The oil droplets emerging from the downstream surface of partitions 31 flow by gravity to and along the top surface of baffle 32 and portion 34 to reach the oil flow along bottom 33. In this form, distributor 41 may be shut off when solvent introduction is not required.

In most instances the mixing of different fractions of the separated oil, such as the discharges from chambers 37, 38 and 39, will not be objectionable. However, if it is desired to collect such fractions separately, the baffle 34 may be extended as indicated by the dash line representation 42 in which case a separate outlet would be provided for the collected oil discharge of each of said chambers.

The arrangement shown in FIG. 2 may be utilized to carry the separation or extraction to any desired degree by the provision of enough chambers to extract substantially all of the oil content of the aerosol mist. In addition, this arrangement permits utilization of heat exchange to substantially lower the temperature of the gas between the chamber 37 and outlet chamber 40 for example.

In the practice of the present invention the retort gas or other oil mist may be taken directly into the apparatus at prevailing temperatures and after the separation has been completed, in the manner described hereinbefore, the exhaust gases comprising the final gaseous discharge may be wasted but preferably are utilized in other stages of the processing. For example, when the separator apparatus receives retort gas directly from the surface retort, the exhaust gas discharge may be recycled into the retort air supply. The preheated effect of such gas will improve the combustion in the retort and any volatile content that otherwise would be wasted is available for recovery by such procedure.

Also, when the separation apparatus of the present invention is utilized in the treatment of the discharge of a production well of an in situ shale retorting operation, the exhaust gases may be recycled through the injection wells where the preheated effect would also be useful in the passage of such gases through the heat front.

The oil discharge of the present separation is in suitable condition for pipeline transportation particularly where there has been enough mixing of the extracted oil with the light oil solvent to render the mixture fluent. If desired the heavy oil separated by this treatment may be conducted on to further processing practices when this invention is utilized as an adjunct to existing installations. Where the oil is processed at or near the site of the separator installation, a light oil fraction can be separated by well-known methods and utilized as the light oil solvent of the present treatment.

I claim:

1. The method of extracting the oil content of oil mists of oil shale retorting or the like, which comprises directing a flow of oil mist directly from an oil shale retort through a confined zone, interrupting said flow intermediate the ends of said zone with a rigid barricade of porous media having openings predominantly in the 10–40 micron size range and capable of withstanding the retort temperature of the mist, scrubbing the contact surface of said media with a slight oil solvent so as to maintain permeability of such media substantially uniform throughout the operation, removing mixed solvent and extracted oil from said zone on the downstream side of said barricade, and discharging exhaust gases from said zone separately from the oil discharge.

2. The method of extracting the oil content of oil mists of oil shale retorting or the like, which comprises directing a flow of oil mist directly from an oil shale retort through a confined zone, interrupting said flow intermediate the ends of said zone with a rigid barricade of porous media having openings predominantly in the 10–40 micron size range and capable of withstanding the retort temperature of the mist, scrubbing the contact surface of said media with a light oil solvent so as to maintain permeability of such media substantially uniform throughout the operation, removing mixed solvent and extracted oil from said zone on the downstream side of said barricade, and discharging exhaust gases from said zone on the downstream side of said barricade at a higher elevation than the oil discharge.

3. The method of extracting the oil content of oil mists of oil shale retorting or the like, which comprises directing a substantially horizontal flow of oil mist directly from an oil shale retort through a confined zone, interrupting said flow intermediate the ends of said zone with an inclined rigid barricade of porous media having openings predominantly in the 10–40 micron size range and capable of withstanding the retort temperature of the mist, scrubbing the upstream inclined surface of said media with a light oil solvent so as to maintain permeability of such media substantially uniform throughout the operation, removing mixed solvent and extracted oil from said zone on the downstream side of said barricade, and discharging exhaust gases from said zone separately from the oil discharge.

4. The method of extracting the oil content of oil mists of oil shale retorting or the like, which comprises directing a flow of oil mist directly from an oil shale retort into and through a confined zone, forcing said flow through a rigid porous media in said zone having openings predominantly in the 10–40 micron size range and capable of withstanding the retort temperature of the mist, scrubbing the contact surface of said media with a light oil solvent so as to maintain permeability of such media substantially uniform throughout the operation and for mixing with the shale oil to increase droplet size, collecting settled oil at the downstream side of said media for discharge from said zone, and discharging exhaust gases from said zone separately from the oil discharge.

5. A method as defined in claim 4 in which the scrubbing oil is light recycle oil.

6. The method of extracting the oil content of oil mists of oil shale retorting or the like, which comprises directing a flow of oil mist directly from an oil shale retort into and through a confined zone, forcing said flow through a rigid porous media in said zone having openings predominantly in the 10–40 micron size range and capable of withstanding the retort temperature of the mist, collecting settled oil at the downstream side of said media for discharge from said zone, and discharging exhaust gases from said zone separately from the oil discharge.

7. The method of extracting the oil content of oil mists of oil shale retorting or the like, which comprises directing a flow of oil mist directly from an oil shale retort into and through a confined zone, forcing said flow through rigid porous media positioned at intervals along said zone having openings predominantly in the 10–40 micron size range and capable of withstanding the retort temperature of the mist, collecting settled oil at the downstream side of said media for discharge from said zone, and discharging exhaust gases from said zone separately from the oil discharge.

8. The method of extracting the oil content of oil mists of oil shale retorting or the like, which comprises directing a flow of retort gases carrying an oil mist directly from a retort into and through a confined zone, forcing said flow through a rigid sintered glass barricade in said zone, said barricade having openings predominantly in the 10–40 micron size range and capable of withstanding the retort temperatures of the mist, collecting settled oil at the downstream side of said barricade for discharge from said zone, and discharging exhaust gases from said zone separately from the oil discharge.

9. The method of extracting the oil content of oil mists of oil shale retorting or the like, which comprises directing a flow of retort gases carrying an oil mist directly from a retort into and through a confined zone, forcing said flow through a rigid sintered metal barricade in said zone, said barricade having openings predominantly in the 10–40 micron size range and capable of withstanding the retort temperatures of the mist, collecting settled oil at the downstream side of said barricade for discharge from said zone, and discharging exhaust gases from said zone separately from the oil discharge.

10. Apparatus for treating oil mists of oil shale retorting operations, comprising structure defining at least one elongated, pressure-confining chamber having an inlet through which such oil mists are directly conducted from an oil shale retort and having separate outlets for oil and exhaust gases distant from said inlet, a rigid porous barricade disposed interiorly of the chamber for interrupting the flow of oil mist through said chamber and capable of withstanding the retort temperature of the mist, and the pores of said barricade being predominantly in the 10–40 micron size range to thereby separate the oil and gaseous constituents prior to their passage to the respective outlets, and means for collecting settled oil at the downstream side of said barricade for discharge from said chamber.

11. Apparatus as defined in claim 10, in which said barricade is sintered glass.

12. Apparatus as defined in claim 10, in which said barricade is sintered metal.

13. Apparatus for treating oil mists of oil shale retorting operations, comprising structure defining at least one elongated, pressure-confining chamber having an inlet through which such oil mists are directly conducted from an oil shale retort and having separate outlets for oil and exhaust gases distant from said inlet, a rigid porous barricade disposed interiorly of the chamber for interrupting the flow of oil mist through said chamber and capable of withstanding the retort temperature of the mist, and the pores of said barricade being predominantly in the 10–40 micron size range to thereby separate the oil and gaseous constituents prior to their passage to the respective outlets, means at the upstream side of the barricade for scrubbing the porous surface so as to maintain uniform permeability and prevent pressure drop, and means for collecting settled oil at the downstream side of said barricade for discharge from said chamber.

14. Apparatus for treating oil mists of oil shale retorting operations, comprising structure defining at least one vertically disposed, pressure-confining chamber having an inlet through which such oil mists are directly conducted from an oil shale retort and having separate outlets for oil and exhaust gases distant from said inlet, a rigid porous barricade disposed interiorly of the chamber for interrupting the flow of oil mist through said chamber and capable of withstanding the retort temperature of the mist, and the pores of said barricade being predominantly in the 10–40 micron size range to thereby separate the oil and gaseous constituents prior to their passage to the respective outlets, and means for collecting settled oil at the downstream side of said barricade for discharge from said chamber.

15. Apparatus for treating oil mists of oil shale retorting operations, comprising structure defining at least one horizontally disposed, pressure-confining chamber having an inlet through which such oil mists are directly conducted from an oil shale retort and having separate outlets for oil and exhaust gases distant from said inlet, a rigid porous barricade disposed interiorly of the chamber for interrupting the flow of oil mist through said chamber and capable of withstanding the retort temperature of the mist, and the pores of said barricade being predominantly in the 10–40 micron size range to thereby separate the oil and gaseous constituents prior to their passage to the respective outlets, and means for collecting settled oil at the downstream side of said barricade for discharge from said chamber.

16. Apparatus for treating oil mists of oil shale retorting operations, comprising structure defining at least one elongated, pressure-confining chamber having an inlet through which such oil mists are directly conducted from an oil shale retort and having separate outlets for oil and exhaust gases distant from said inlet, a rigid porous barricade disposed interiorly of the chamber for interrupting the flow of oil mist through said chamber and capable of withstanding the retort temperature of the mist, and the pores of said barricade being predominantly in the 10–40 micron size range to thereby separate the oil and gaseous constituents prior to their passage to the respective outlets, means at the upstream side of the barricade for discharging a light oil solvent thereon so as to scrub the porous surface and thereby maintain uniform permeability and prevent pressure drop, and means for collecting settled oil at the downstream side of said barricade for discharge from said chamber.

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