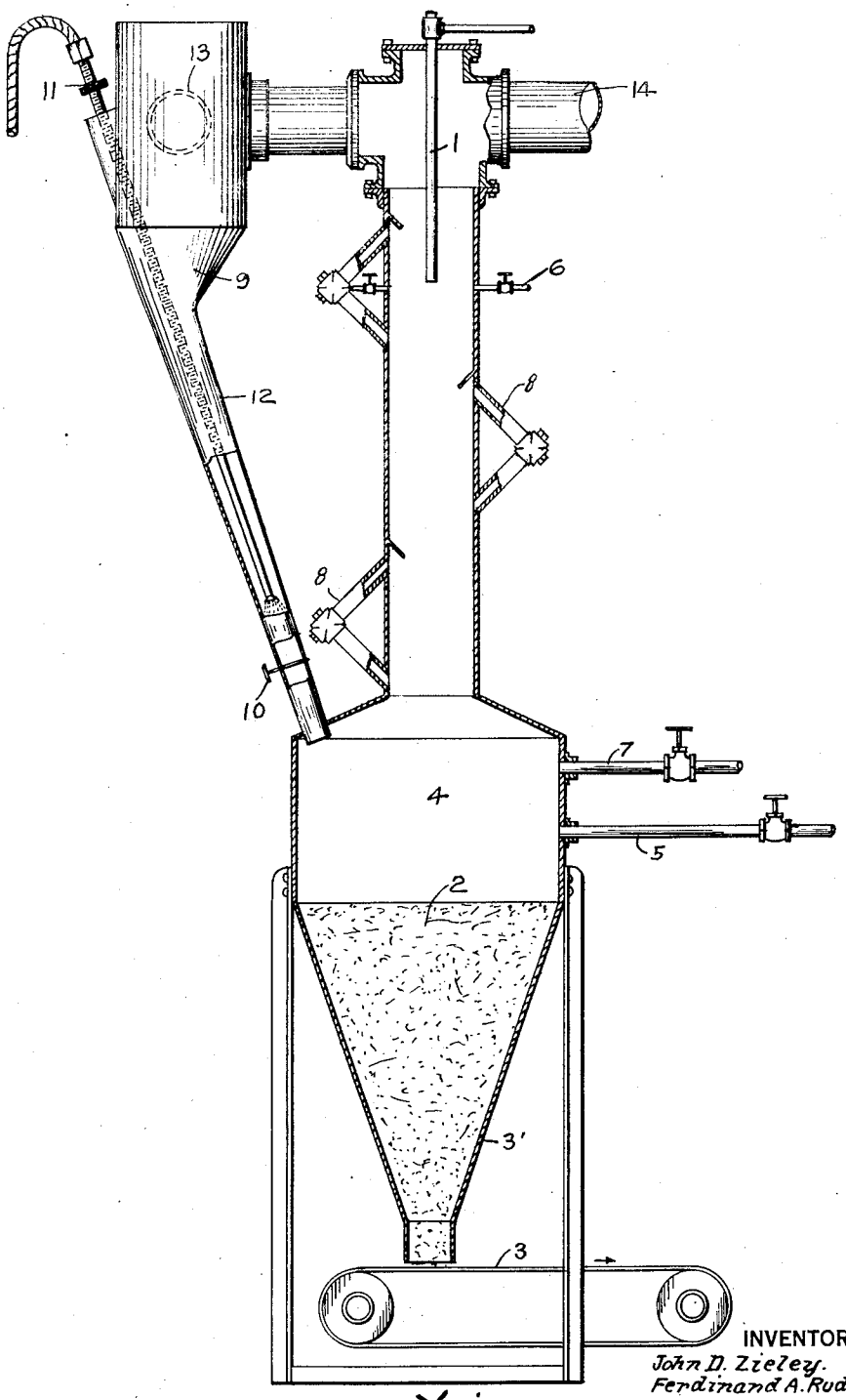
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TREATMENT OF SHALE

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UNITED STATES PATENT OFFICE

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TREATMENT OF SHALE

Application filed October 15, 1920. Serial No. 417,084.

Our invention relates to certain new and useful improvements in the treatment of so-called oil-shale for the recovery of hydrocarbon values and conversion of said hydrocarbons to hydrocarbons of lighter specific gravity and containing a different ratio of hydrogen to carbon than is present in the original hydrocarbon in said shale.

The present method of recovering hydrocarbons is an improvement over the old distillation or retorting process wherein by means of heat and variations of pressures the hydrocarbon is removed from the shale residuum. The product is an oil or tar of varying composition. In general, such old process is not an economic one and is not commercially successful.

One of the objects of our invention is to increase the yield of hydrocarbon from the shale and to improve the nature of such yield by producing a more volatile product which has a higher commercial value. This is done by treatment of the shales preferably in powder form under conditions of heat with superheated steam and a chemical, preferably sodium chloride, whereby the molecular structure of the hydrocarbon is altered and a product is formed wherein the ratio of hydrogen and carbon in the molecule is different from that in the hydrocarbon in the original shale.

In the accompanying drawing, we have illustrated in vertical cross-section a suitable form of apparatus which may be employed for practicing the invention.

Referring to said drawing, 1 indicates an aspirator for injecting pulverized shale into the apparatus. This shale may be injected by the use of dry steam in which case it shall be of advantage to slightly pre-heat the shale to avoid excessive condensation in said shale at the entrance to the aspirator as well as throughout the same. If desired, however, the shale may be injected in dry condition, being forced in by some inert gas, or if the operator desires to treat a heavy oil in the same apparatus (it being understood that the apparatus is adapted for the treatment of either oil or crude shale), the oil and shale may be mixed and sprayed into the treating chamber and the whole mixture treated simultaneously.

2 indicates a reservoir or ash pit for receiving the residue from the shale and this is preferably deep enough to store sufficient of the residue to act as an air seal at the discharge end. It is likewise deep enough to carry sufficient of the residue so that it will have sufficient opportunity to give up a large quantity of its heat by radiation to the reaction chamber above, thus cutting down the fuel requirement.

3 is an endless belt or conveyor beneath the chamber 2 and preferably has a variable speed so that the residue in the hopper 3′ may be automatically removed and the supply in the hopper at the same time maintained at a predetermined elevation. 4 indicates the combustion chamber wherein combustion is maintained by any suitable solid, liquid, or gaseous fuel, which may be supplied by the pipe 5 and sufficient air is supplied to as nearly as possible establish perfect combustion. The upper part of this chamber is likewise a reaction chamber and the shale falling from its source passes finally through this chamber, any carbon, or hydrocarbon not already distilled off, being acted upon here. 6 indicates suitable injector pipes for steam which retard the fall of the shale and afford temperature control. 7 indicates suitable inlet for steam or the chemical solution, or both, and 8 indicates the heavy hydrocarbon condensate return pipes for returning said hydrocarbons to the zone of reaction for further regeneration and re-formation. 9 indicates a suitable dust collector and heavy condensate return and is suitably formed and heat insulated to avoid condensation of the lighter hydrocarbons and is preferably controlled by a damper 10. 11 indicates a steam injector which may be raised and lowered through the delivery pipe 12 of the dust collector to the retort, the object of this being to clean away obstructions due to clogging. Hermetical connections are preferable as it is important that no excessive amount of air get into the apparatus while shifting the steam pipe 11 to different positions. 13 indicates the pipe leading to the condenser which may be of any standard

form, and the outlet 14 may be provided with any suitable form of relief valve for exhausting automatically into the atmosphere any time that undue pressure develops.

In operation, the shale is preferably first ground by any suitable means to such a size as will permit spraying or blowing and still not cause excessive dust. This ground shale is now sprayed or blown downward into the apparatus from the inlet 1, the same being retarded in its fall by steam baffles such as 6 and slowly descending through the successive zones of increasing temperature, the lighter hydrocarbons during the descent being distilled off. Such heavier hydrocarbons as are evolved, are condensed in the condensate returns such as 8 and falling back into the zone of reaction are again re-formed into more volatile products. The heavier hydrocarbons and carbon remaining after the more volatile products have escaped continue their passage downward and finally reach the reaction and combustion chamber 4 where they come in contact with the highly superheated steam and sodium chloride which are being introduced through the pipe 7.

It has been indicated that the oxygen from the decomposed steam and also any in the products of combustion reacting with the carbon, forms carbon monoxide. Reactions also take place between carbon dioxide in the combustion products and carbon forming more carbon monoxide. The exit gases issuing after the hydrocarbons are condensed will be a mixture of carbon monoxide and nitrogen which may be used for other desirable purposes.

Of course it will be readily understood that modifications may be made in the apparatus and in the several steps pursued therein without departing from the spirit of the invention. For instance, instead of spraying the powder shale into the apparatus any type of gas retort may be charged with lump shale which has previously been impregnated with a solution of salt and superheated steam may be injected and the heat of reaction may be maintained externally or internally. The latter may be maintained by either liquid or gaseous fuel or the charge may have been previously mixed with solid fuel which is easily burnt as in a blast furnace.

We claim:

1. Process of distilling oil shale comprising continuously blowing finely divided oil shale with sodium chloride into an elongated chamber, cooling portions of the vapors evolved during the destructive distillation of the shale by withdrawing said vapors from the chamber at various levels and returning the vapors with condensate to the chamber, retarding the flow of the shale through the chamber by injecting a stream of super-heated steam in a direction opposing the flow of the shale, and injecting into the chamber near the bottom thereof a gaseous fuel mixture of air and fuel proportioned to produce a flame sufficiently hot to destructively distill the oil shale.

2. Process of distilling oil shale comprising introducing oil shale and sodium chloride into a chamber, heating the mixture of oil shale and sodium chloride to a temperature sufficient to destructively distill the oil shale, and cooling portions of the vapors evolved during the destructive distillation of the shale by withdrawing said vapors from the chamber and returning the vapors with condensate to the chamber.

3. Process of distilling oil shale comprising continuously blowing finely divided oil shale with sodium chloride into a chamber, cooling portions of the vapors evolved during the destructive distillation of the shale by withdrawing said vapors from the chamber and returning the vapors with condensate to the chamber, and injecting into the chamber a gaseous fuel mixture of air and fuel proportioned to produce a flame sufficiently hot to destructively distill the oil shale.

4. Process of distilling oil shale comprising continuously blowing finely divided oil shale with sodium chloride into a chamber, cooling portions of the vapors evolved during the destructive distillation of the shale by withdrawing said vapors from the chamber and returning the vapors with condensate to the chamber, and heating said chamber to a temperature sufficient to destructively distill the oil shale.

5. Process of distilling oil shale comprising continuously blowing finely divided oil shale with sodium chloride into an elongated chamber, cooling portions of the vapors evolved during the destructive distillation of the shale by withdrawing said vapors from the chamber and returning the vapors with condensate to the chamber, retarding the flow of shale through the chamber by injecting a stream of super-heated steam in a direction opposing the flow of the shale, and heating said chamber to a temperature sufficient to destructively distill the oil shale.

6. Process of distilling shale comprising introducing oil shale and sodium chloride into an elongated chamber, retarding the flow of shale through the chamber by injecting a stream of superheated steam in a direction opposing the flow of the shale and injecting into the chamber near the bottom thereof a gaseous fuel mixture of air and fuel proportioned to produce a flame sufficiently hot to destructively distill the oil shale.

In testimony whereof we hereunto affix our signatures.

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