P. DANCKWARDT.
METHOD FOR DISTILLING OIL SHALES.
APPLICATION FILED MAR. 8, 1920.

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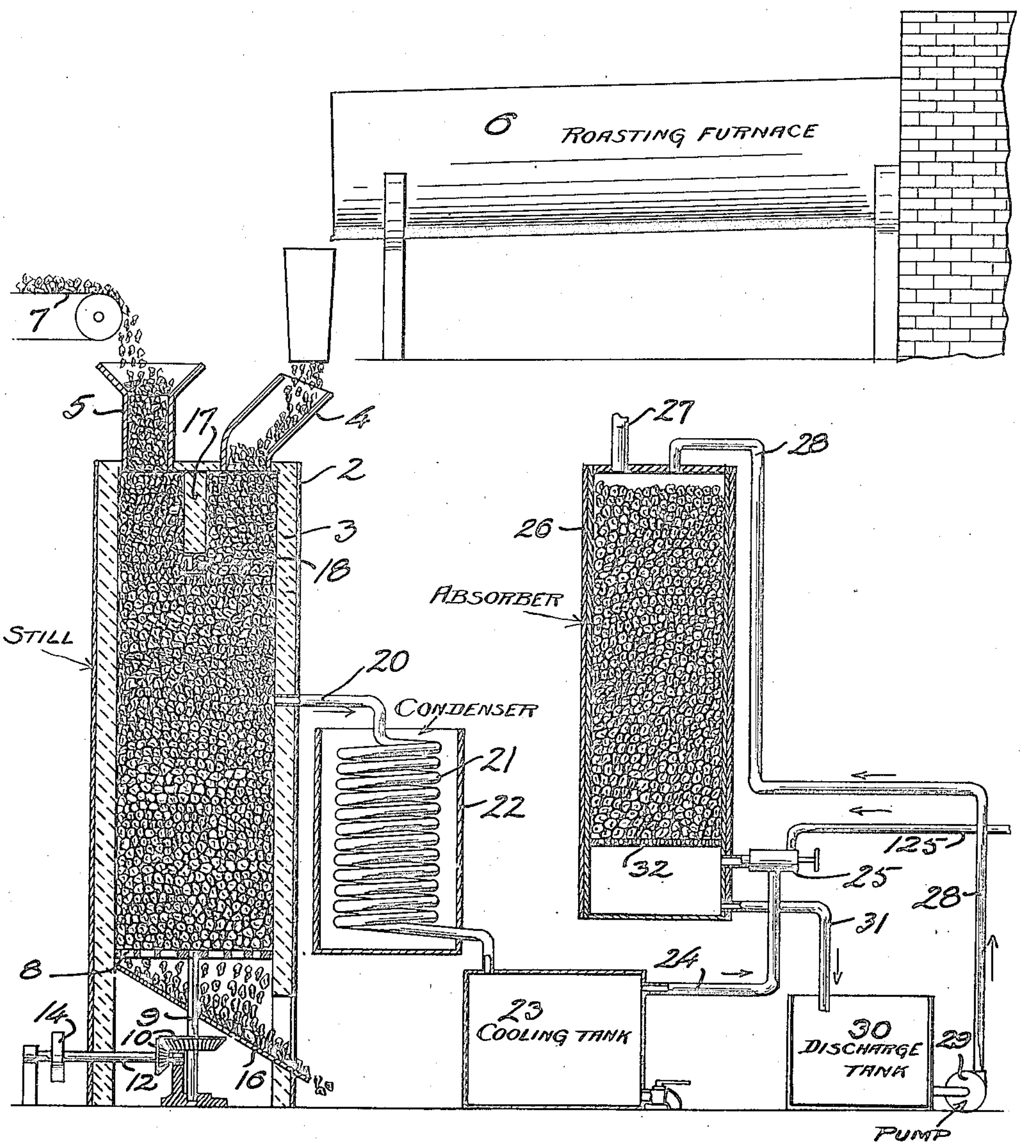

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By [signature] Attorney

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PAUL DANCKWARDT, OF DENVER, COLORADO.

METHOD FOR DISTILLING OIL SHALES.

Application filed March 8, 1920. Serial No. 363,997.

To all whom it may concern:

Be it known that I, PAUL DANCKWARDT, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Methods for Distilling Oil Shales; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

The object of this invention is to obtain certain constituents contained in oil shales, chiefly oils and ammonia, in a more economical way than has heretofore been known.

In processes of this character it is necessary to handle a large amount of shale to obtain a given quantity of the products, due to the fact that the percentage of the latter is usually quite small. Apparatus which has been used with more or less success in other countries is not valuable in this country because of the high cost of labor and apparatus, and the high cost of repairs and upkeep. In order to overcome these difficulties, the process and apparatus herein disclosed have been designed in order that the labor element may be largely eliminated, while the initial cost of the apparatus and the cost of its repair and upkeep will be very small.

Briefly stated, this process consists in heating a solid material which may be a part of the shale from which preferably the valuable ingredients have already been extracted, to a very much higher temperature than that required for the distillation of the shale. This heating can be most economically acomplished by direct fire in a roasting furnace of the continuous type. This heated shale serves as a heat-carrier and is brought into contact with a quantity of untreated shale, whereby said untreated shale is heated up to a temperature sufficient to drive out the volatile matter. This volatile matter consists chiefly of oil and ammonia, the gases of which are conducted to condensers and absorbers, and obtained therefrom in a fluid state. The process is made continuous by charging continuously into a specially constructed still both the raw shale to be treated, and the heated shale, which serves as a heat-carrier, and withdrawing the same continuously after the oil and ammonia have been expelled.

Part of the discharged shale is returned continuously to the roaster, and part is dumped. The still is never heated from the outside, and as it has a fire-proof lining, will last longer than that type of still which is heated externally.

The roasting furnace also is heated on the inside, and in this manner the cost of repairs is always low. At the same time the process in the still is rapid, due to the intimate contact of the heat-carrier with the raw shale. No cleaning-out of the still is required, thereby eliminating cooling, and recharging and reheating of the apparatus are also avoided.

An understanding of the details of the process will be facilitated by reference to the accompanying drawings, which show an apparatus in which the process may be carried on. It is understood, however, that this is only one of several devices which may be used successfully.

The still comprises an upright iron shell 2, lined with firebrick 3. The still is closed at the top and said top is provided with two ducts or spouts 4 and 5. The duct 4 is arranged to receive heated shale or other heat-carrier from a continuous roasting furnace 6. The duct 5 is arranged to receive raw shale from a belt-conveyor 7.

The material charged into the still is supported on rotating grates 8, operated by a shaft 9, driven by means of bevel gears 10, one of which is carried on a shaft 12, provided with a drive pulley 14. The treated material drops continually through the grates 8 and falls upon an inclined discharge chute 16. The top of the still may be supported by means of a firebrick part 17, resting upon an I-beam 18. A pipe 20 leads from the interior of the still at a point about half-way up, and connects with a condensing coil 21, positioned in a condensing tank 22, adapted to be filled with a cooling medium, such as water. The coil 21 leads into a cooling tank 23, from which the condensed fluids may be drawn. A conduit 24 leads from the top of the tank 23 by way of an injector 25, into an absorber 26. Steam may be supplied to the injector 25 through a pipe 125. The absorber 26 may be built of lead-lined steel, or of wood. At its upper end it is provided with an outlet pipe 27, for the passage of waste gases. A pipe 28 also leads from the upper end downward to a circulating pump 29, which takes an absorbing fluid from a tank 30, which receives liquid by way of a discharge pipe 31, leading from the bottom of the absorber 26. The absorber is provided at a point slightly above the injector 25 with a perforated plate 32, which supports large pieces of coke or rock, over which the absorbing fluid trickles as it is discharged from the pipe 28 by the circulating pump 29.

In carrying on the process in the apparatus above described, waste shale or rock, crushed to about one inch or less in size, is heated to a bright redness in the roasting furnace 6, and is discharged in a continuous stream into the spout 4. This material, which generally contains some carbon, may be mixed with a small percentage of coal or coke, which facilitates its heating and also prevents loss of heat as it passes from the roaster to the still. This also protects the vapors and gases produced in the still from being burned by any air leaking in. This heat-carrier is discharged into the still until the latter is full. Machinery is then started which drives the grates 8, the conveyors 7 and the pump 29. At the same time steam is turned into the exhauster 25. The speed of the parts is so regulated that the amount of material discharged from the still is equal to that charged into it; in other words, the still always remains full. The proper proportion of heat-carrier to raw shale must be watched, this being such that the heat introduced through the medium of the heat-carrier is slightly in excess of that required to drive off all the volatile matter from the raw shale. The exhauster is adjusted so that all, or nearly all, of the gas and vapor generated in the still is withdrawn through the pipe 20. At the same time it is necessary to take care that no air gets into the still through any of the openings, either at the top or bottom, since the economic recovery of the valuable vapors depends upon this precaution.

The cooling-medium in tank 22 must be replaced continuously, so that all of the oil vapors, and most of the water vapors are condensed in the coil 21 and flow into the collecting tank 23. The gases and uncondensed vapors are continually drawn off by the injector 25, and forced through the mass of coke or rock in the absorber 26. The pump 29 circulates dilute sulfuric acid, or other suitable absorbing fluid, and ammonia, taking it from the tank 30 and discharging it into the upper end of the absorber 26. As the condensed vapors contain all the ammonia not condensed in the tank 23, the ammonia is absorbed by the downwardly moving dilute acid as it passes through the coke. The resulting solution of ammonium sulfate is withdrawn from the tank 30 as it becomes saturated, and fresh acid is supplied from time to time.

The water and oil in the tank 23 are withdrawn and separated as required.

From the foregoing, it will be seen that there are no separate operations in carrying on the process, so that interruption or interference in the various steps is avoided. The result is that the whole process may be carried on continuously for a great length of time without necessity for shutting down.

I claim:

1. The process of distilling oil shale which consists in continually charging highly heated waste shale and raw shale into a still, allowing the two portions to mix, whereby heat is transferred to the raw shale sufficient to drive off all the volatile matter, condensing the latter, and withdrawing the waste shale continually from the still.

2. The process of distilling oil shale which consists in uninterruptedly charging raw shale into a still, introducing a continuous stream of heated waste shale, thereby causing the volatile oil and ammonia to distil off, discharging the shale deprived of its oil and ammonia, withdrawing the volatile constituents from the center of the still, and condensing them.

3. The process of distilling oil shale, which consists in passing previously-heated waste shale and raw shale by gravity, continuously through an upright still open at top and bottom, the material entering at the top and passing out at the bottom, allowing the volatile vapors to escape through an opening centrally between inlet and outlet, and condensing them.

4. The process of distilling oil shale, which consists in heating waste shale and carbon, transferring the red-hot product in a continuous stream into a still, introducing a continuous stream of raw shale into the still to mix with said heated shale, withdrawing the mixed material from the still and the volatile constituents from a point near the center of the still, and condensing the latter.

5. The process of distilling oil shale which consists in causing preheated waste shale to mix with raw shale while both are passing through a still, removing by suction all vapors formed by the heat interchange of the two materials at a rate sufficient to prevent air from passing into the apparatus from outside the still and also to prevent vapors or gases formed inside the still from passing out of it into the air, and condensing the vapors.

In testimony whereof I affix my signature.

PAUL DANCKWARDT.