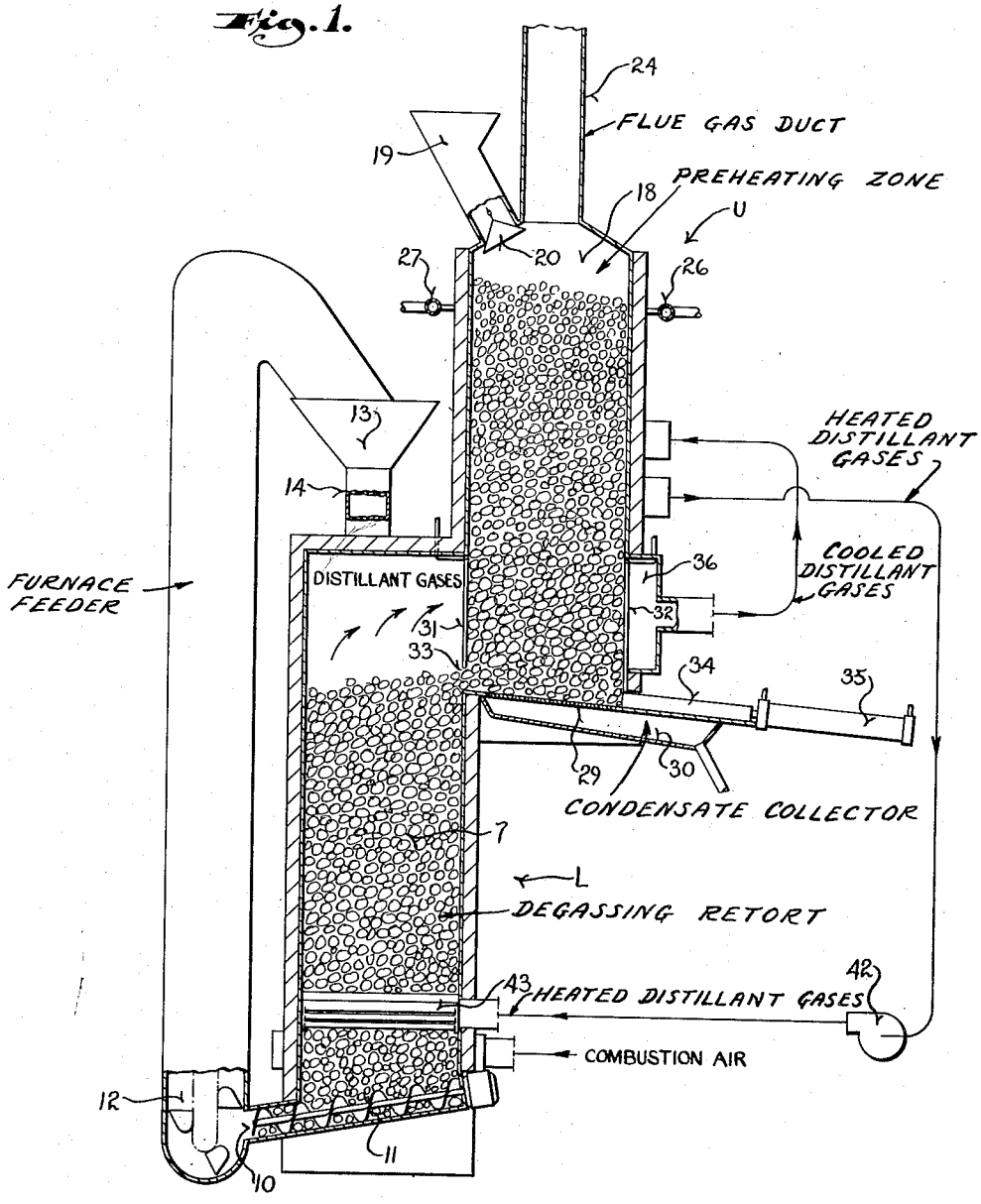
Dec. 1, 1953 D. DALIN 2,661,327

APPARATUS FOR THE DESTRUCTIVE DISTILLATION OF OIL SHALE

Filed Dec. 4, 1950

3 Sheets-Sheet 1

Fig. 1.



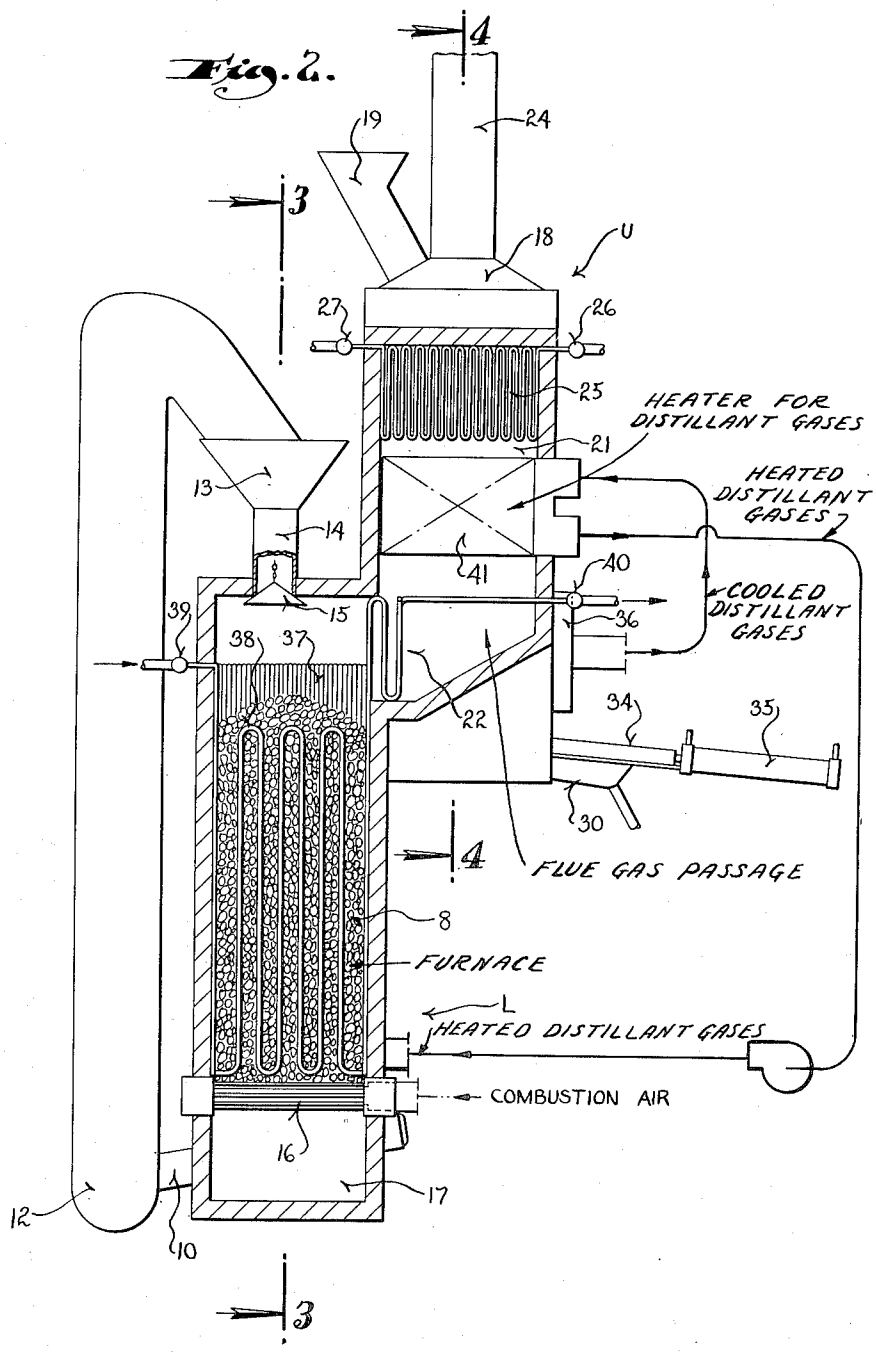
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APPARATUS FOR THE DESTRUCTIVE DISTILLATION OF OIL SHALE

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Fig. 2.



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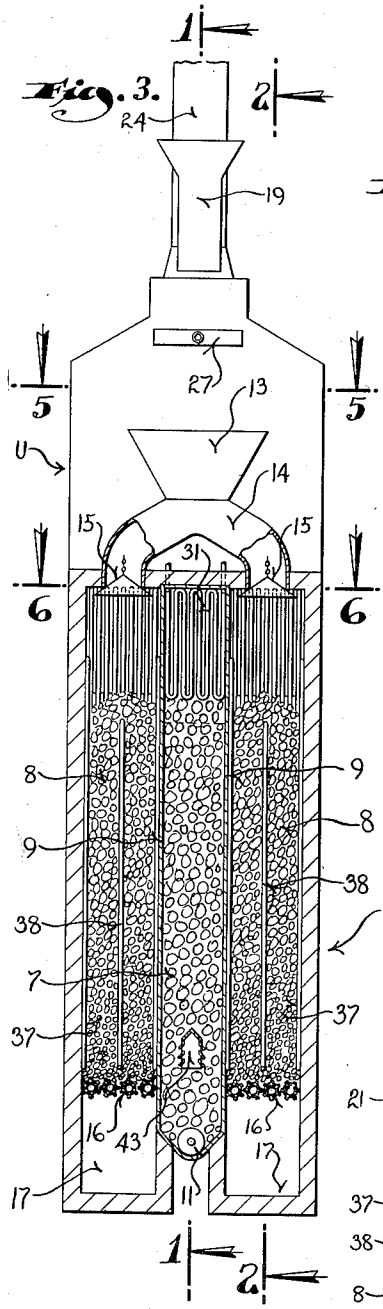


Fig. 3.

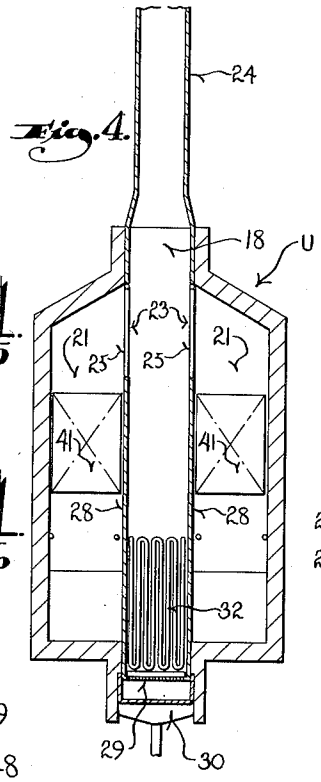


Fig. 4.

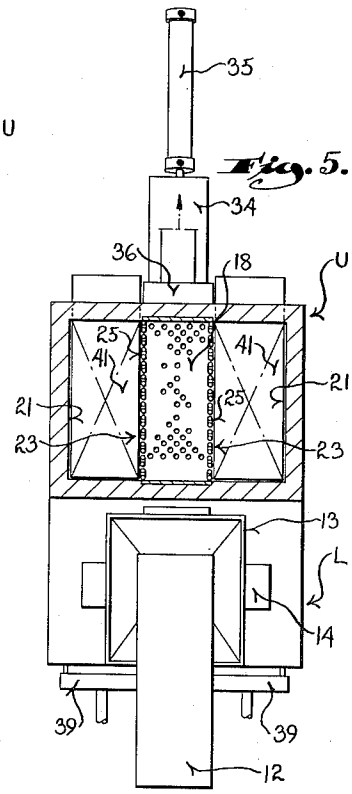


Fig. 5.

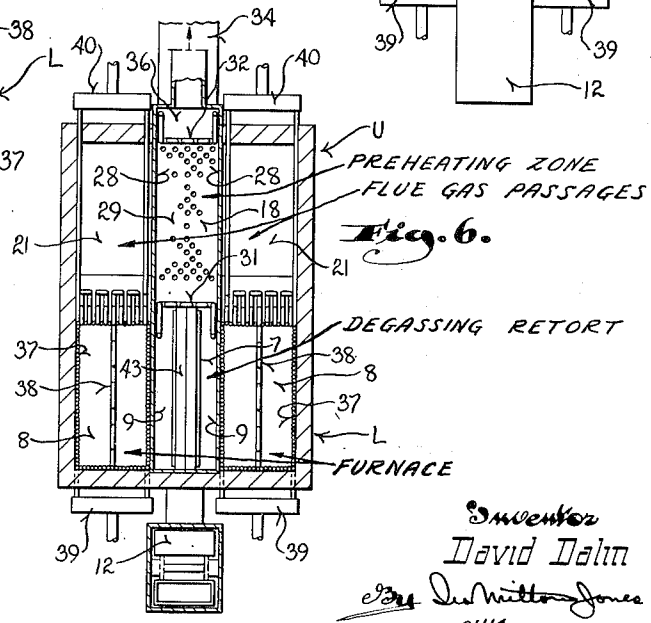


Fig. 6.

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Patented Dec. 1, 1953

2,661,327

UNITED STATES PATENT OFFICE

2,661,327

APPARATUS FOR THE DESTRUCTIVE DISTILLATION OF OIL SHALE

David Dalin, Stenkullen, Ronninge, Sweden

Application December 4, 1950, Serial No. 198,993

8 Claims. (Cl. 202—106)

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This invention relates to the destructive distillation of oil-shale and similar carbonaceous materials and has as its purpose to improve the processing of such material with a view toward speeding up the process and at the same time increasing the yield of the oil recovered.

With the above and other objects in view which will appear as this description proceeds, the present invention contemplates among other things preheating the raw material prior to feeding it to the coking or degassing retort, passing the distillant gases through the relatively cooler, though preheated, material about to enter the retort as these gases are withdrawn from the retort to thereby effect condensation of a part of the gases, and force-feeding the uncondensed distillant gases through a heater which is heated by the combustion gases emanating from the combustion zone of the apparatus, and then back into the degassing zone to thus effect a more positive flow of the distillant gases from the material undergoing treatment in the retort.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a vertical sectional view through an apparatus embodying this invention, said view showing the material descending through the preheating chamber or zone to be transferred into the top of the retort, from the bottom of which the degassed material, after being discharged from the retort, is conveyed upwardly for feeding into the furnace shaft or combustion zone, said view being taken on the plane of the line 1—1 in Figure 3;

Figure 2 is a vertical sectional view through the apparatus on a plane parallel to that of Figure 1 but forwardly therefrom as indicated by the line 2—2 in Figure 3, said view being through one of the two compartments or sections of the furnace shaft or combustion zone and its respective flue gas passage;

Figure 3 is a vertical sectional view through the apparatus taken on the plane of the line 3—3 in Figure 2 which passes through the degassing or coking retort and the two compartments of the furnace shaft or combustion chamber;

Figure 4 is a vertical sectional view through the upper portion of the apparatus looking in the same direction as Figure 3 but on the plane of the line 4—4 in Figure 2;

Figure 5 is a horizontal cross sectional view

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through Figure 3 on the plane of the line 5—5; and

Figure 6 is a horizontal cross sectional view through Figure 3 on the plane of the line 6—6.

The apparatus

Referring now more particularly to the accompanying drawings in which like numerals indicate like parts, it will be seen that the apparatus generally comprises an upper section U and a lower section L connected but offset from one another. The lower section L consists of an upright retort 7 and a furnace shaft 8. The retort 7 is substantially rectangular in cross section and is defined from the combustion zone or furnace shaft by opposite side walls 9 so that the interior of the retort is in heat exchange relation but not connected with the interior of the combustion zone. Since the retort is centrally located within the furnace shaft it divides this shaft into two similar compartments.

The bottom of the retort is entirely closed except for a discharge port 10 through which the degassed material leaves the retort, a screw 11 or other suitable material moving device being provided to advance the degassed material to and through the discharge port. The degassed material issuing from the discharge port is carried upwardly by a bucket conveyor 12 or the like and charged into a feed hopper 13 above the lower section L and from which a bifurcated feed chute 14 leads to the top of the two compartments of the furnace shaft. Suitable dampers 15 are preferably provided on the discharge ends of the feed chute branches 14 to prevent the escape of combustion gases from the top of the furnace shaft.

The columns of degassed residue coke thus charged into the top of the two compartments of the furnace shaft rest upon grates 16 of any suitable construction, and here shown as comprising a plurality of hollow ported rollers through which the air for combustion enters the bottom of the furnace shaft. The ash accumulates in ashpits 17 from which it is removed in any suitable manner.

The upper section of the apparatus provides a preheating chamber or zone 18 through which the raw material to be treated descends, a feed chute 19 being provided in the top of this chamber to facilitate charging the material thereinto, and as is customary a damper 20 is arranged in the discharge end of the feed chute to close the same when material is not actually entering the preheating chamber.

The preheating chamber is disposed between

two flue gas passages 21 which are connected with the upper portion of the furnace shaft compartments as at 22, and open to the upper portion of the preheating chamber as at 23. Thus the combustion gases emanating from the two compartments of the furnace shaft flow upwardly along the opposite sides of the preheating chamber to supply heat to the material therein and finally enter the extreme upper portion of the preheating chamber from which they are exhausted to a flue gas duct 24 which leads to the smoke stack (not shown).

Attention is directed to the fact that where the flue gas ducts join, the walls of the preheating chamber, which are necessary to confine the material to be treated therein, consist of banks of closely spaced tubes 25 containing a fluid heat absorbing medium, preferably boiler fluid such as water or a steam-water emulsion. These banks of tubes, as best shown in Figure 2, are connected at their opposite ends to inlet and outlet headers 26 and 27 which in turn are connected in the circulatory system of a boiler plant or the like (not shown) from which the boiler fluid is derived.

The two banks of coils 25 define the upper portions of the sides of the preheating chamber being in line with and forming substantially continuations of the imperforate side walls 28 which extend down to the bottom of the preheating chamber and connect with the bottom wall 29 thereof. The bottom wall, however, is perforated to enable the condensate resulting from condensation of the distillant gases in the lower portion of the preheating chamber in a manner to be hereinafter described, to flow from the preheating chamber into a collecting trough 30.

While the side walls of the preheating chamber are imperforate at their lower portions, the end walls thereof are not, being defined by banks of coils 31 and 32 similar to the banks of coils 25. The bank of coils 31 separates the preheating chamber from the upper portion of the retort except for an inlet port 33 through which the preheated material is transferred from the preheating chamber into the retort by a reciprocating pusher 34, driven by a fluid pressure motor 35 or the like.

As the pusher 34 is advanced it shoves the lowermost layer of preheated material through the inlet port 33 into the retort and in so doing scrapes across the perforations in the bottom wall 29 to keep them open.

The bank of coils 32 terminates short of the extreme bottom of the preheating chamber a distance sufficient to permit passage of the pusher 34 and separates the lower portion of the preheating chamber from a carrier gas collecting manifold 36.

The banks of coils or tubes 31 and 32 are individually connected in a boiler fluid circulating system in any suitable manner; and as will be readily apparent the fluid circulating through these banks of coils will have a tempering effect upon the material between them, abstracting excess heat therefrom if the temperature is too high and supplying heat thereto if the temperature is below a predetermined value.

Another set of tubes or coils is arranged within the two compartments of the furnace shaft or combustion chamber. This set of coils comprises a bank 37 along each wall of each compartment of the combustion chamber and a row of serpentine coils 38 extending lengthwise of the combustion chamber and substantially equispaced from

the opposite side walls thereof so as to be imbedded in the body of the fuel being burnt. All of these coils are connected with a supply header or manifold 39 and with an exhaust or outlet header or manifold 40 and the headers are in turn connected in any suitable manner with the circulating system of a steam boiler or the like so that boiler fluid flows through the coils. This flow is so controlled that sufficient heat is abstracted from the burning fuel and the material within the retort to preclude sintering thereof.

This feature of the present invention, as well as the isolation of the retort from the combustion chamber and the feeding of the degassed residue coke discharged from the bottom of the retort into the top of the furnace shaft, are disclosed and claimed in the copending application of David Dalin and Tore Johannes Hedbäck, Serial No. 192,082, filed October 25, 1950.

The method

The method of this invention, the practice of which is facilitated by the apparatus just described, comprises feeding the raw oil shale or other carbonaceous material to be treated into a preheating zone (provided by the chamber 18) to raise the temperature of the material and thereby speed up the degassing process. From the preheating zone, the material is transferred into the top of a vertical retort or degassing zone (7 in the illustrated apparatus) and because of its having been preheated the degassing or coking process which takes place in the retort is more rapid than otherwise.

While in the degassing or coking retort the material is, of course, heated to drive off the distillant gases, but the heating is controlled by the abstraction of excess heat by means of a fluid heat absorbing medium circulating over the walls of the retort and through but not in contact with the fuel bed, to preclude sintering.

The degassed material is discharged from the bottom of the retort (through port 10 in the disclosed apparatus) and conveyed upwardly to the top of a furnace shaft or combustion zone into which it is charged and where it burns to provide the heat for the process.

The combustion gases rising from the burning fuel are conducted upwardly alongside and in heat exchange relation with the preheating zone to supply heat to the material therein and eventually are discharged to the smoke stack.

The distillant gases driven from the material undergoing treatment in the degassing zone are drawn off and passed through the much cooler material in the adjacent portion of the preheating zone to thereby effect condensation of a substantial portion of these gases.

The liquid condensate is, of course, collected for subsequent refinement.

The uncondensed distillant gases which have been cooled to some extent by their passage through the material in the lower portion of the preheating zone are then reheated by passage thereof in indirect heat exchange relation with the flue gases flowing in the passages 21. Upon being thus heated the distillant gases are force fed back into the degassing zone. While these method steps may be performed in any suitable manner, the apparatus shown is well adapted thereto. Thus each of the two flue gas passages 21 has a heat exchanger 41 mounted therein. The inlet of each heat exchanger is connected with the carrier gas collecting manifold 36 and its outlet is connected with the inlet of a blower

42. The uncondensed distillant gases, therefore, flow through the heat exchangers 41 where they are heated, and then back to the degassing zone or retort through a louvered inlet 43 which extends across the full width of the retort in the lower portion thereof. By such forced circulating a more positive flow of the distillant gases is obtained and in general the processing of the material is speeded up.

From the foregoing description taken in connection with the accompanying drawings it will be readily apparent to those skilled in this art that this invention provides a method and apparatus for the destructive distillation of oil shale and similar carbonaceous material which will reduce the time required for the complete process and at the same time assure a higher yield of extracted oil.

What I claim as my invention is:

1. Apparatus for the dry distillation of oil from oil bearing shale and similar carbonaceous material, comprising: an upright retort closed except for an inlet in the upper portion thereof through which the material to be degassed enters and an outlet at the bottom through which the degassed residue coke is discharged; means defining a furnace shaft along side the retort but isolated therefrom; means for conveying degassed residue coke from the bottom of the retort into the top of the furnace shaft; means defining an upright preheating chamber having its lower portion laterally adjacent to and in open communication with the upper portion of the retort; a perforate wall separating the laterally adjacent portions of the preheating chamber and the retort, said wall having a feed opening therein adjacent to the bottom of the preheating chamber and through which preheated material may be fed from the bottom of the preheating chamber into the retort, and the perforate character of said wall allowing distillant gases to flow from the retort into the preheating chamber; a sump under the preheating chamber; an apertured wall defining the bottom of the preheating chamber and dividing the same from the sump so that distillant gases condensed in the preheating chamber may collect in the sump; means for moving preheated material from the bottom of the preheating chamber into the retort through the feed opening in said perforate wall; and means for conducting the hot combustion gases from the furnace shaft in indirect heat exchange relation with the contents of the preheating chamber.

2. The apparatus of claim 1 further characterized by the provision of means defining a gas collecting manifold adjacent to the lower portion of the preheating chamber; and a perforate wall separating the gas collecting manifold from the preheating chamber and defining a wall of the preheating chamber spaced from the perforate wall which separates the preheating chamber from the retort so that distillant gases from the retort must pass through a portion of the preheating chamber to reach the gas collecting manifold.

3. The apparatus of claim 2 wherein said two perforate walls are banks of closely spaced coils; and means for circulating boiler fluid through said banks of coils.

4. The apparatus of claim 2 further characterized by the provision of: a heat exchanger positioned in the path of the hot combustion gases leaving the furnace shaft; duct means connecting the gas collecting manifold with the heat exchanger; duct means connecting the heat exchanger with the retort; and a gas circulating means connected in one of said duct means to effect positive flow of uncondensed distillant gases from the top of the retort, through the preheating chamber, the heat exchanger and back into the retort.

5. The apparatus of claim 4 further characterized by the provision of a gas inlet in the lower portion of the retort and with which said second named duct means connects so that the distillant gases enter the lower portion of the retort.

6. The apparatus of claim 1 wherein the means for moving the preheated material from the preheating chamber into the retort comprises a pusher reciprocable across the apertured wall defining the bottom of the preheating chamber toward and from the feed opening in the perforate wall separating the preheating chamber from the retort; and power means for reciprocating the pusher.

7. The apparatus of claim 1 wherein the furnace shaft comprises two compartments one on each side of the retort; and wherein the means for conducting the hot furnace gases from the shaft comprises a pair of flue gas passages each connected with one of said compartments at the upper portion of the furnace shaft, said flue gas passages extending along opposite sides of the preheating chamber.

8. Apparatus for the dry distillation of oil from oil bearing shale and similar carbonaceous material, comprising: an upright retort providing a degassing zone in which the material to be treated is heated to drive distillant gases therefrom, said retort having a side inlet adjacent to its top; means defining a combustion zone in juxtaposition to but isolated from the degassing zone provided by the retort so that the combustion gases resulting from fuel burning in said combustion zone cannot commingle with the distillant gases driven from the material in the retort; means defining a feeding hopper directly alongside the upper portion of the retort, said feeding hopper having its discharge mouth in the lower portion thereof and adjacent to but communicated with the inlet of the retort; means for transferring the material from the hopper to the inlet of the retort; a drawoff duct connected with the upper portion of the feeding hopper for drawing distillant gases from the retort through the feeding hopper so that the distillant gases have direct contact with the material in the feeding hopper, whereby a fraction of said distillant gases is condensed by contact with the relatively colder material in the feeding hopper; and a sump beneath the feeding hopper in which the condensate accumulates.

DAVID DALIN.

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