

Nov. 20, 1951

C. DAVIES, JR
CARBONIZATION APPARATUS

2,575,587

Original Filed Jan. 5, 1946

3 Sheets-Sheet 1

Fig. 4

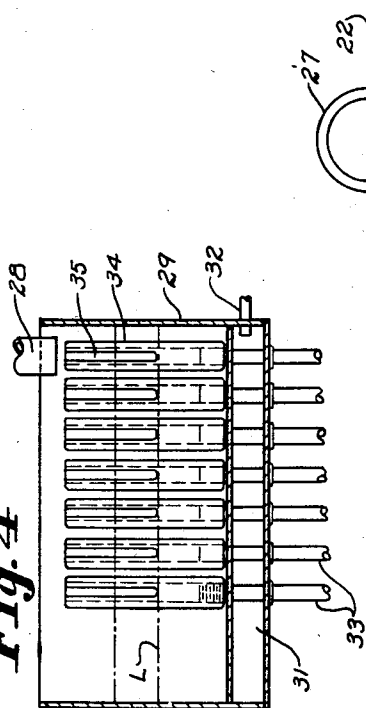
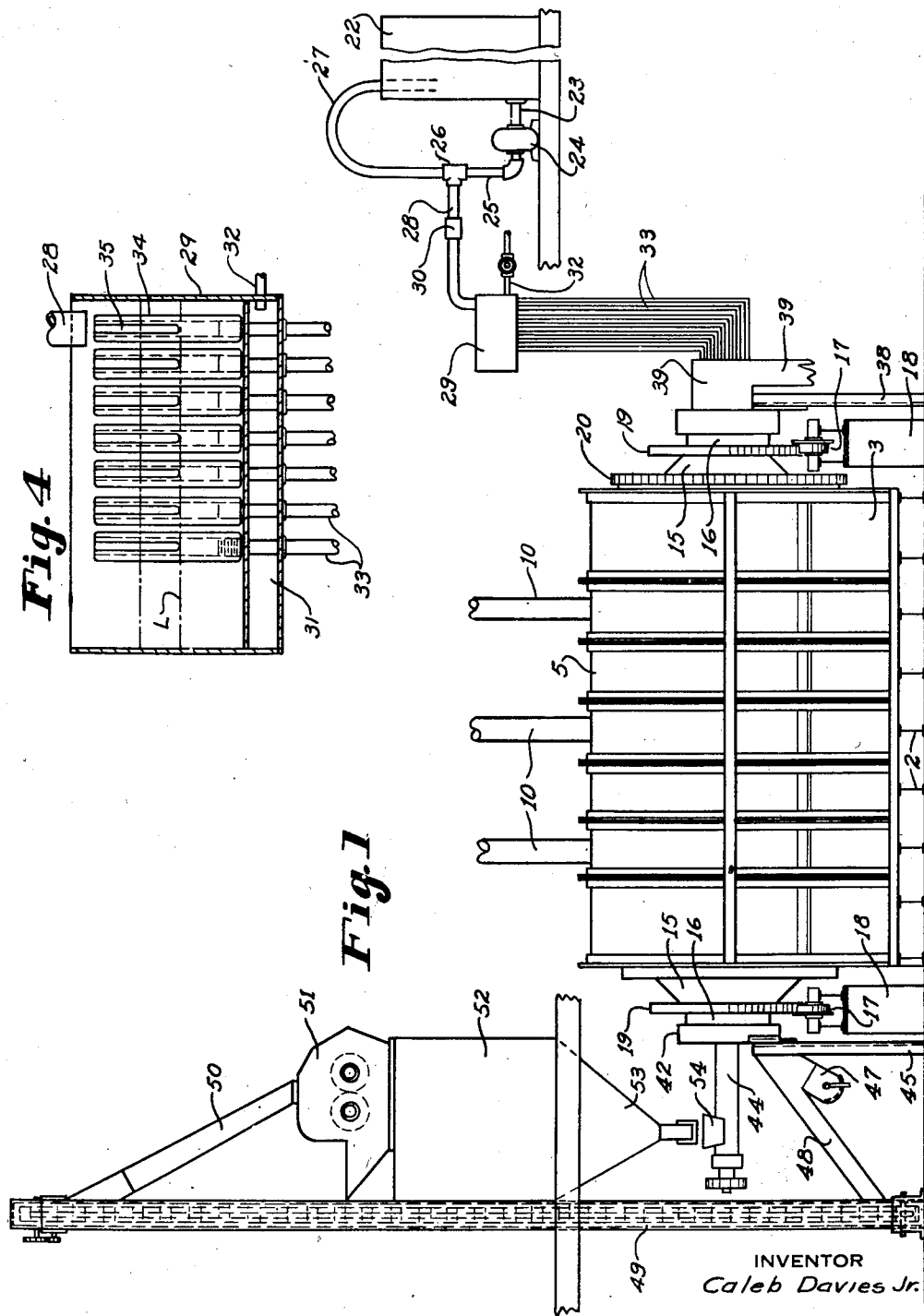


Fig. 1



INVENTOR
Caleb Davies Jr.
BY *D. Leigh Fowler Jr.*
ATTORNEY

Nov. 20, 1951

C. DAVIES, JR

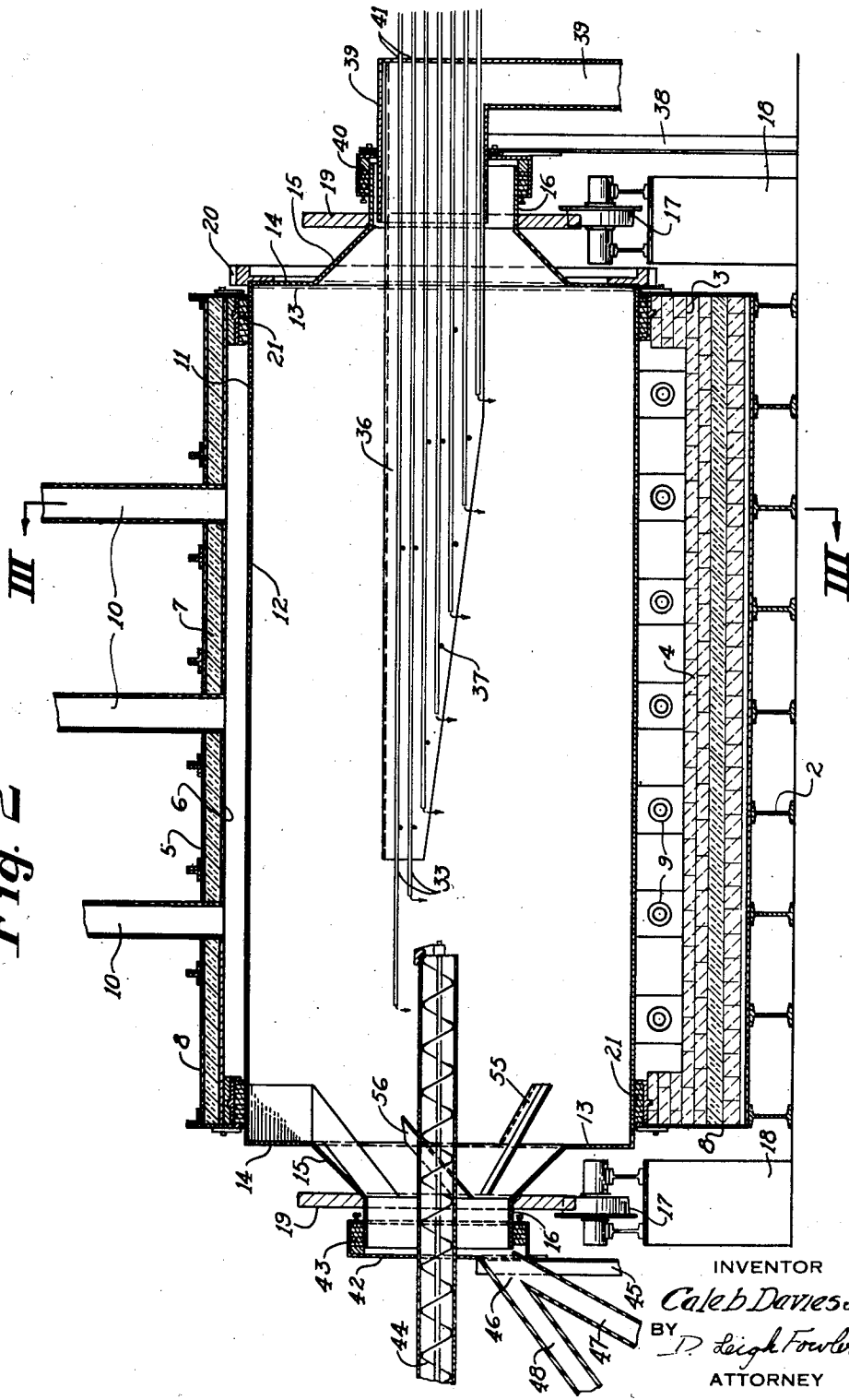
2,575,587

CARBONIZATION APPARATUS

Original Filed Jan. 5, 1946

3 Sheets-Sheet 2

Fig. 2



INVENTOR
Caleb Davies Jr.
BY D. Leigh Fowler, Jr.
ATTORNEY

Nov. 20, 1951

C. DAVIES, JR

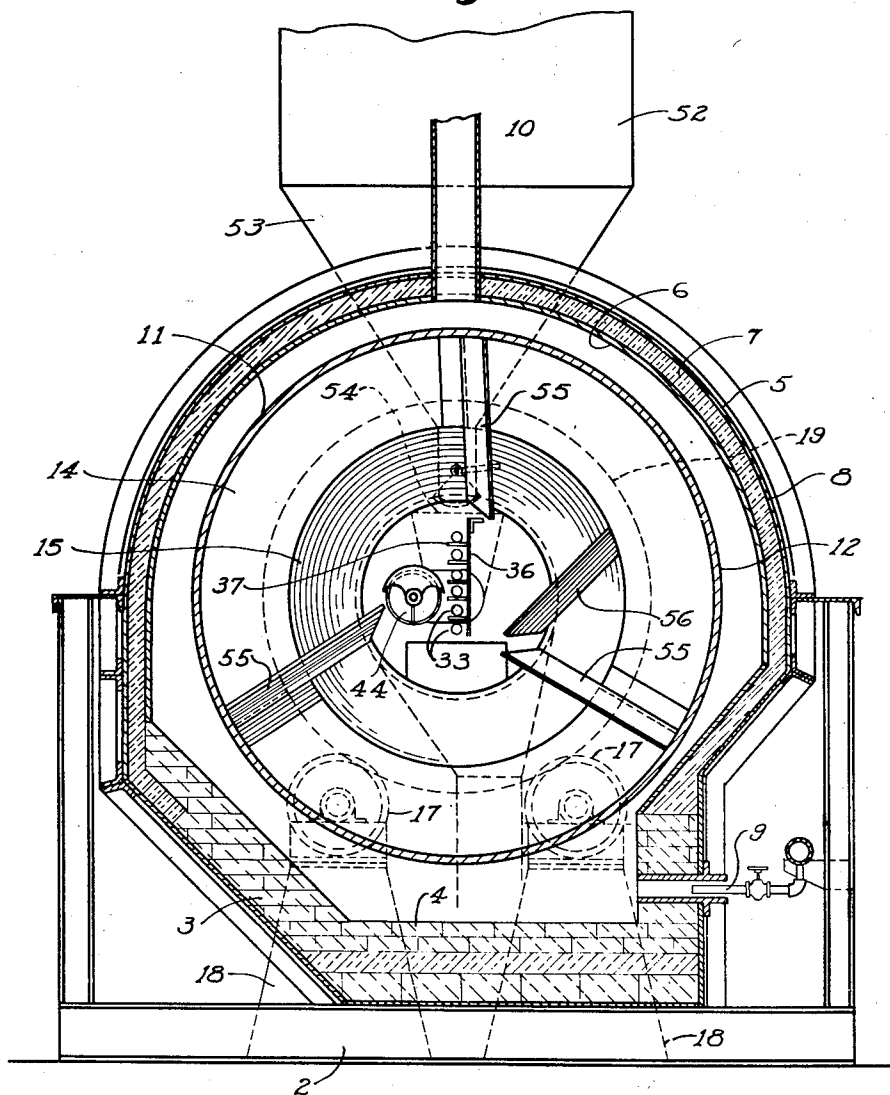
2,575,587

CARBONIZATION APPARATUS

Original Filed Jan. 5, 1946

3 Sheets-Sheet 3

Fig. 3



INVENTOR

Caleb Davies Jr.

BY

D. Leigh Foulke, Jr.

ATTORNEY

UNITED STATES PATENT OFFICE

2,575,587

CARBONIZATION APPARATUS

Caleb Davies, Jr., Ben Avon, Pa., assignor, by
mesne assignments, to Pittsburgh Consolidation
Coal Company, Pittsburgh, Pa., a corporation of
Pennsylvania

Original application January 5, 1946, Serial No.
639,376. Divided and this application April 14,
1948, Serial No. 20,891

1 Claim. (Cl. 202—136)

1

This invention relates to a distillation process and particularly to a process for distilling or coking bituminous material in finely divided form (i. e., liquid or finely divided solid form) to make a coke-like product. The bituminous material being distilled is so treated while in contact with hot finely divided solid base material which assists in bringing about proper distribution of the bituminous material whereby to insure formation of the desired product. The base material is incorporated in and itself becomes a part of the product. Additional functions of the hot finely divided solid base material are to retard the flow of feed material toward the surface of the retort, and to heat the feed material so rapidly that the distillation of any portion of it is sufficiently completed before its resultant distillation residue reaches the surface of the retort so that substantially no adherent masses of residual material are formed on the inner surface of the retort, but substantially all the distillation residue is produced in discrete form. This application is a division of my co-pending application Serial No. 639,376, the latter being a continuation-in-part of application Serial No. 450,945. Both of these applications are now abandoned.

While the invention may be otherwise employed, as for example, in the destructive distillation of coking coal, I have found that it has great utility in the manufacture of pitch coke, that is, the distillation of pitch supplied in either liquid or finely divided solid form to remove volatiles and form coke which has well known uses. For the purpose of explanation and illustration I shall describe the invention in connection with the distillation of liquid pitch to form pitch coke.

I preferably liquefy pitch and introduce it into a heating chamber in intimate contact with a finely divided solid base material, which material assists in dispersion of the pitch and itself forms part of the product as above mentioned. In the heating chamber the pitch is distilled and the products of distillation are conducted away. The pitch and base material are agitated during distillation. Preferably the heating chamber is in the form of a rotatable retort in which the material being treated is tumbled during treatment. The material is heated either internally of the retort or by heat applied externally of the retort and passing through the wall of the retort to the material within. The heat is preferably applied at least principally from without. The coke produced is removed from the retort and

2

I find it desirable to crush and return pitch coke formed in the retort to serve as the base material for further operation. The returned pitch coke is crushed to reduce it to the proper state of subdivision to serve as the base material.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred process employing the same proceeds.

In the accompanying drawings I have shown apparatus by the use of which the invention may be practiced and have illustrated a present preferred method of practicing the invention, in which:

Figure 1 is a side elevational view of distillation apparatus which we term a "pitch coker;"

Figure 2 is a central longitudinal cross-sectional view to enlarged scale through a portion of the apparatus shown in Figure 1;

Figure 3 is a vertical transverse cross-sectional view taken on the line III—III of Figure 2; and

Figure 4 is a vertical longitudinal cross-sectional view through the pitch distributing box.

I shall describe the apparatus shown in the drawings. There is provided a foundation comprising I-beams 2 upon which is built a furnace designated generally by reference numeral 3 and comprising a bottom 4 of firebrick and an upper generally cylindrical portion 5 having an inner metal lining 6 covered externally with insulating material 7. The entire furnace is encased in a metal cover 8. The furnace is of generally cylindrical shape. Fuel is admitted through burners 9 and is burned within the furnace. The products of combustion are conducted away through stacks 10.

Mounted so as to extend longitudinally through the furnace is a retort 11. The retort comprises a cylindrical metal body 12 and opposed ends 13 each having a generally vertical outer flange 14, an inclined intermediate portion 15 and a generally cylindrical open end 16. The retort is rotatably carried upon rollers 17 mounted on pedestals 18. Heavy flanges 19 are connected with the end portions 16 of the retort and ride upon the rollers 17. A ring gear 20 is connected with the retort and is adapted to be driven by a suitable driving pinion whereby to cause the retort to turn within the furnace 3. The rotary retort is sealed to the stationary furnace by packing 21, which is carried in the furnace end walls which fit close to the protruding cylindrical portion of the retort.

Pitch is liquefied in any suitable apparatus and is made available in a pitch tank 22. A pipe 23

3

leads from the tank 22 to a pump 24 and a pipe 25 leads from the pump to a T 26. Leading from the T 26 is a return pipe 27 through which liquid pitch may be recirculated. Also leading from the T 26 is a pipe 28 for delivering liquid pitch to the pitch distributing box 29 (Figure 4). A valve 30 controls the flow of pitch through the pipe 28.

The pitch distributing box 29 is open at the top and has a steam jacket 31 at the bottom into which steam is admitted through a pipe 32. Pitch delivery pipes 33 enter the box 29 through the steam jacket 31 at the bottom and extend upwardly where they are provided with enlarged heads 34. Each head has a vertical slot 35 extending downwardly from its top to a predetermined level designated by the line L in Figure 4. The respective pitch delivery pipes 33 extend downwardly from the box 29 and each of such pipes then turns through a right angle and extends horizontally into the retort 11 through the right-hand end thereof viewing Figures 1 and 2. The pipes are supported within the rotating retort by a plate 36 provided with pins 37 on which the pipes rest. The plate 36 is carried by a support 38 at one end of the retort, which support also carries an offtake 39 for the gaseous products of distillation. The offtake 39 is sealed to the right-hand end 16 of the retort by packing 40. The respective pipes 33 pass through the wall of the offtake at 41. The pipes 33 extend to different points longitudinally of the retort as shown in Figure 2 so as to deliver liquid pitch at a plurality of places within the retort. In an alternate design, the pitch feed pipes are supported from stationary structural members at both ends of the retort without being in the gas offtake proper—also, the junction between rotating and stationary portions of the apparatus is in a pair of close-fitting radial flanges, the stationary flange being fastened to a slip-joint, and held against the rotating flange by means of springs.

At the left-hand end of the retort viewing Figures 1 and 2 there is a sealing device 42 sealed to the left-hand end 16 by packing 43. A screw conveyor 44 extends through the sealing device 42 and into the interior of the retort. The sealing device 42 is carried by a support 45. Also leading from the sealing device 42 is a discharge chute 46 having a lower branch 47 and an upper branch 48 is for discharging material to the base of the apparatus while the upper branch 48 is for discharging material to the base of an elevator 49 which raises it and in turn discharges it through a downwardly inclined conduit 50 into a roll crusher 51 whence it falls into a bin 52 having at its bottom a hopper 53 for feeding the crushed material through a receiving opening 54 into the screw conveyor 44. Provision is made for by-passing the crusher and for discharging material from the bin to a truck for transportation to stock or to point of use.

Within the left-hand end of the retort viewing Figure 2 are four discharge devices or lifters (see Figure 3) three of which designated 55 extend to the periphery of the cylindrical body 12 of the retort and the fourth of which designated 56 extends only part way to the periphery of the cylindrical retort body. The lifters 55 are inclined in one direction and the lifter 56 is inclined in the opposite direction. When the retort is rotated in the clockwise direction viewing Figure 3 the three lifters 55 are effective for

4

delivering the contents of the retort through the discharge chute 46. Since these lifters extend to the periphery of the retort body they will substantially entirely remove the contents of the retort. When the retort is rotated in the counterclockwise direction viewing Figure 3 the lifter 56 is operative to remove contents thereof, but since such lifter extends only part way to the periphery of the retort body it will not substantially entirely remove the contents of the retort but will simply skim off the same above the point at which it terminates in the outward direction. In an alternate design, lifter 56 is omitted and discharge is intermittent and partial instead of continuous. Of course complete discharge is also made when convenient.

Having described the apparatus shown in the drawings, I shall now explain how my improved process may be practiced using such apparatus. The unit may be operated either by batch operation or by continuous operation. In either event a quantity of finely divided solid material, preferably ground pitch coke, is first introduced into the retort through the screw conveyor 44. This material lies in the bottom of the retort and upon rotation of the retort will be distributed along the length thereof. Also the retort is heated so that the finely divided solid material therein is maintained at a temperature above the end point of distillation of the pitch to be introduced. When coal is being coked the finely divided solid material in the retort is maintained at a temperature at least as high as the coking temperature of the coal. The finely divided solid material in the retort is preferably supplied with heat principally through the wall of the retort; indeed, I find it desirable to maintain the finely divided solid material at the desired temperature solely by heat supplied through the wall of the retort.

With the retort supplied with ground pitch coke acting as the base material and brought up to the desired temperature liquid pitch is pumped by the pump 24 through the pipes 25 and 28 into the box 29 whence it rises above the level L and is fed by gravity through the pipes 33 and into the interior of the retort. The structure of the distributing box 29 is such that each of the pipes 33 receives at any given time the same amount of pitch as each of the other pipes so that the pitch is delivered internally of the retort fairly evenly along its length. While seven pipes 33 are shown, any desired number may be employed.

The pitch delivered by the pipes 33 drops onto the finely divided base material which is continually being agitated in the rotating retort with the result that the liquid pitch is finely dispersed and coats individual particles of the base material and is otherwise prevented from forming large masses of coke. Since the base material is maintained at a temperature above the end point of distillation of the pitch the result is the formation of a large number of small balls or pellets in the retort, many such balls individually having base material as a nucleus and being covered with a coating of pitch which is distilled as the process proceeds. Thus the pitch is coked substantially without forming adhering masses on the interior of the retort.

The expression "end point of distillation" as used herein means either the distillation temperature at which substantially no residue is left or the distillation temperature at which the residue becomes solid.

In normal operation the retort turns in the

5

counter-clockwise direction viewing Figure 2. If it is to be batch operated the lifter 56 may be dispensed with, although batch operation may be carried out with such lifter in place if the level of the material in the retort does not rise above the outer end of the lifter 56. If the apparatus is batch operated the direction of rotation is reversed after the material in the retort has been completely distilled, or preferably when the quantity of material in the retort has increased to the desired amount as shown by increased ammeter readings for the retort drive motor circuit, and the lifters 55 feed the contents out through the chute 46. Preferably in batch operation only a portion of the contents of the retort are thus removed periodically although the entire contents may be removed if desired. Preferably, the feed of pitch into the retort is maintained unchanged during the partial discharge of the contents of the retort. Thus the quantity and quality of gas and oil production is unchanged. At each removal period when the apparatus is being batch operated at least a portion of the coke removed through the chute 46 is delivered through the upper branch 48 into the elevator 49 whence it is lifted and discharged through the conduit 50 into the crusher 51 and returned through the bin 52 and the screw conveyor 54 into the retort to serve as base material for the succeeding batch. When the apparatus is continuously operated it is rotated in the counter-clockwise direction viewing Figure 3 and when the product rises above the outer end of the lifter 56 it is continuously discharged by such lifter into the chute 46. Preferably a portion of the coke thus discharged is delivered through the lower branch 47 and the remainder through the upper branch 48 whence it is crushed and returned either continuously or periodically as desired. It has been found, however, that with certain operating temperatures and feed rates it is not necessary to crush or return any of the coke.

When the retort is rotated in the clockwise direction viewing Figure 3 the lifter 56 does not act to discharge material therefrom but simply tends to stir any material which rises above the outer end thereof and push it back toward the center of the retort. When the retort is rotated in the counter-clockwise direction viewing Figure 3 the lifters 55 do not act to discharge material therefrom but simply tend to stir the material in the retort and push it back toward the center of the retort. However, to all intents and purposes the lifter 56 may be deemed inoperative when the retort turns in the clockwise direction viewing Figure 3 and the lifters 55 may be deemed inoperative when the retort turns in the counter-clockwise direction viewing Figure 3.

The gaseous products of distillation are conducted away from the retort through the offtake 39. Such products may be condensed and are themselves of value. Pitch oil and creosote oil may thus be recovered.

Preferably the pipes 23, 25, 27, 28 and 33 and the T 26 are insulated to promote efficiency and to prevent pitch from freezing therein. Insulation of pipes 33 decreases tendency to coke shut at low feed rates. When the apparatus is first being heated up the pipes 33 are cooled with steam.

To give an example of batch operation which has been found quite satisfactory, a quantity of granular pitch coke amounting to about 60% of the quantity which would fill the retort to the bottoms of the ends 16 is introduced through the con-

6

veyor 44 and the retort is heated up to a shell temperature of about 1100° F., which is maintained throughout the operation. During the entire heating and operating period during batch operation the retort is rotated in the counter-clockwise direction viewing Figure 3 except when it is desired to discharge its contents. When the desired operating temperature has been reached the steam is shut off from the pipes 33 and liquid pitch is immediately fed through the distributing box 29 and through the pipes 33 to the bed of moving granular coke. I have found that the liquid pitch may be desirably introduced at the rate of 400 gallons per hour. I find it desirable to rotate the retort in the counter-clockwise direction viewing Figure 3 for one hour or until 400 gallons of liquid pitch have been fed in. At the end of one hour the elevator 49 and the crusher 51 are started, the direction of rotation of the retort is reversed and the pitch coke formed during the preceding hour is discharged through the chute 46 and the upper branch 48. The retort is rotated in the clockwise direction for about ten minutes, thus feeding some of the coke through the crusher into the bin 52. The direction of rotation of the retort is then again reversed so that it will be rotating in the counter-clockwise or operating direction and the freshly crushed coke in the bin 52 is fed back at once through the screw conveyor 44 into the retort. The liquid pitch is again fed in as previously described, or preferably it is fed in without interruption regardless of direction of rotation of the retort, and the cycle is repeated. When the liquid pitch is fed in without interruption the discharge of coke is accomplished without depleting the quantity of coke in the retort sufficiently to impair its effectiveness. The discharge of coke is repeated after each hour of coking operation, each discharge period lasting ten minutes. Preferably alternate discharge batches are crushed and returned to the retort as above described, alternate batches being delivered through the lower branch 47 and removed from the apparatus entirely. The product may, for example, be used as boiler fuel or it may be mixed with coal for carbonization.

According to the procedure above described the coke in the retort gradually builds up during two hours from about 60% of the volumetric capacity of the retort below the bottoms of the ends 16 to about 80% of such volumetric capacity and is then reduced by ten minutes of discharging back to about 60% of such capacity. In the middle of each such build-up period about 30% of the coke in the system (20% of effective volumetric capacity) is taken out, crushed and returned. If desired part of each discharge batch of coke may be crushed and returned and the remainder of it may be delivered for other uses.

Another satisfactory procedure in the same retort differs from the foregoing as follows: (1) the feed is 250 gallons pitch per hour, (2) the intermittent coke discharge maintains coke level in the retort between rather high limits, the coke level being judged by power consumption of the retort drive motor; and (3) no coke is crushed nor returned to the retort. Thus, not long after starting the operation, the mass of finely divided solid material in the retort consists principally of solid distillation residue from previously fed bituminous material, such distillation residue not having been removed from the retort.

When the apparatus is operated continuously the material in the retort rises to the level of the

outer end of the lifter 56 and is continuously but relatively slowly discharged thereby. The pitch feed and the rate and manner of introduction of the base material may be varied both in batch operation and in continuous operation.

In the claim the words "finely divided form" as applied to the material being distilled mean either liquid form or finely divided solid form.

While I have described a present preferred method of practicing the invention and have shown one form of apparatus in which it may be practiced, it is to be distinctly understood that the invention is not limited to the particular method described and may be carried out on other apparatus within the scope of the following claim.

I claim:

Apparatus for the distillation of liquid carbonaceous material which comprises, in combination, a cylindrical retort mounted for rotation about its horizontal central axis, said retort having end walls adapted to confine a bed of solids therein, means for heating the bed of solids to a temperature above the distillation temperature of the liquid carbonaceous material, a plurality of conduits extending longitudinally through an end wall of said retort and having discharge openings located respectively at different distances from said end wall, said conduits being supported independently of said retort in spaced relationship to the side walls of the retort and so disposed with respect to said bed of solids that the contents of said conduits are discharged directly onto the

surface of said bed, a container for the liquid carbonaceous material arranged at a level above the retort into which said conduits upwardly extend, said conduits terminating within said container in vertically disposed end sections having vertical slots therein which extend downwardly to the same horizontal plane, means for maintaining liquid carbonaceous material in said container at a level between the bottom and the top of said slots, said conduits being arranged to convey liquid from said container to said retort solely by gravity, and means for withdrawing vaporous and solid products of distillation from said retort.

CALEB DAVIES, Jr.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,602,819	Jakowsky	Oct. 12, 1926
1,945,530	Karrick	Feb. 6, 1934
2,080,046	Leshner	May 18, 1937
2,114,416	Donnelly	Apr. 19, 1938
2,151,849	Hardy et al.	Mar. 28, 1939
2,287,437	Leshner et al.	June 23, 1942

FOREIGN PATENTS

Number	Country	Date
585,273	Germany	Sept. 30, 1933