

July 14, 1931.

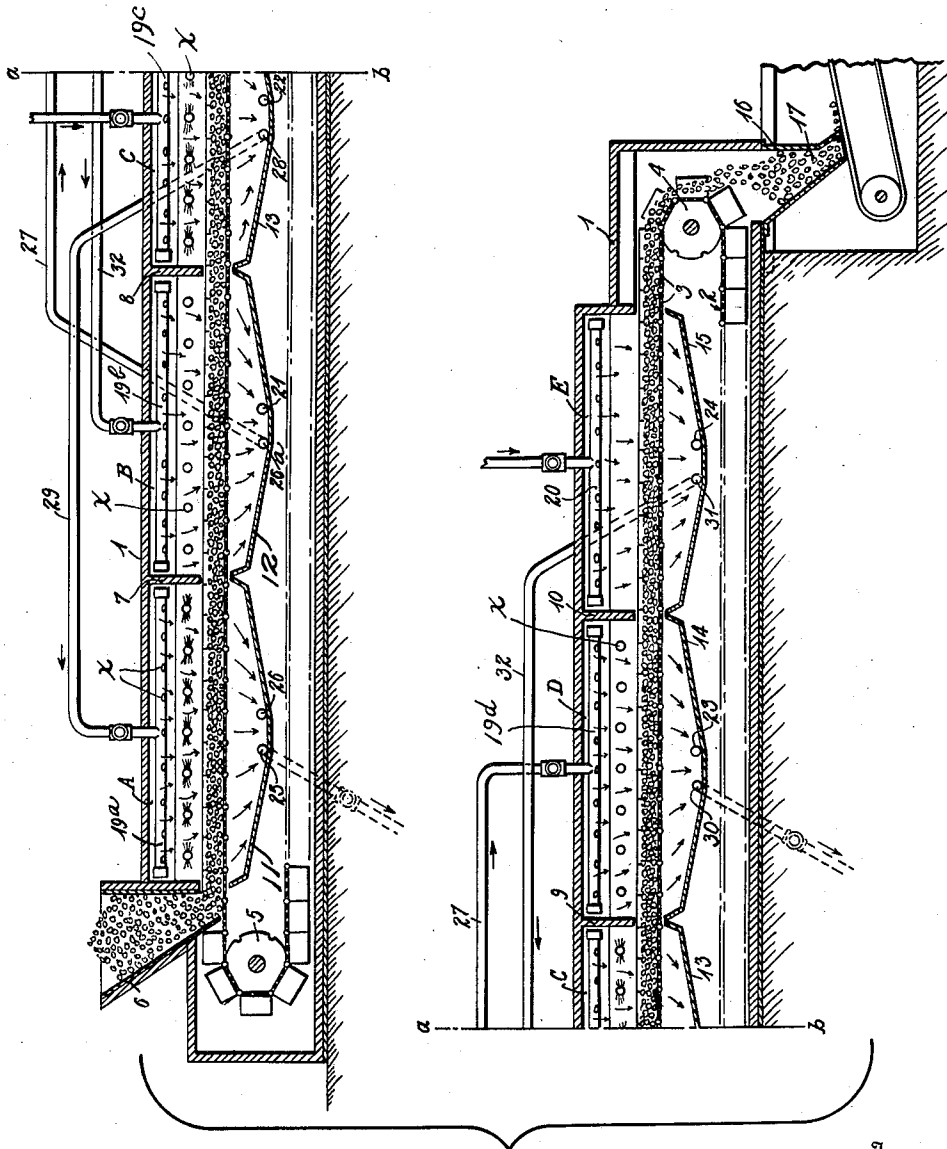
W. E. TRENT

1,814,463

PROCESS FOR CARBONIZING MATERIALS

Filed May 18, 1925

2 Sheets-Sheet 1



Inventor
Walter E. Trent

By Charles M. Thomas.

Attorney

July 14, 1931.

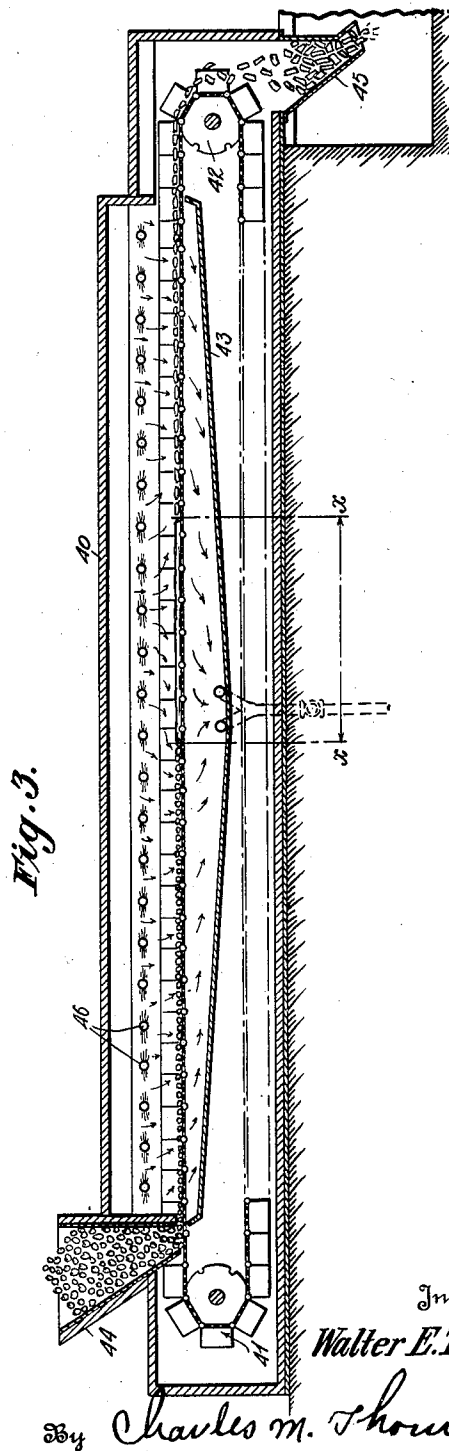
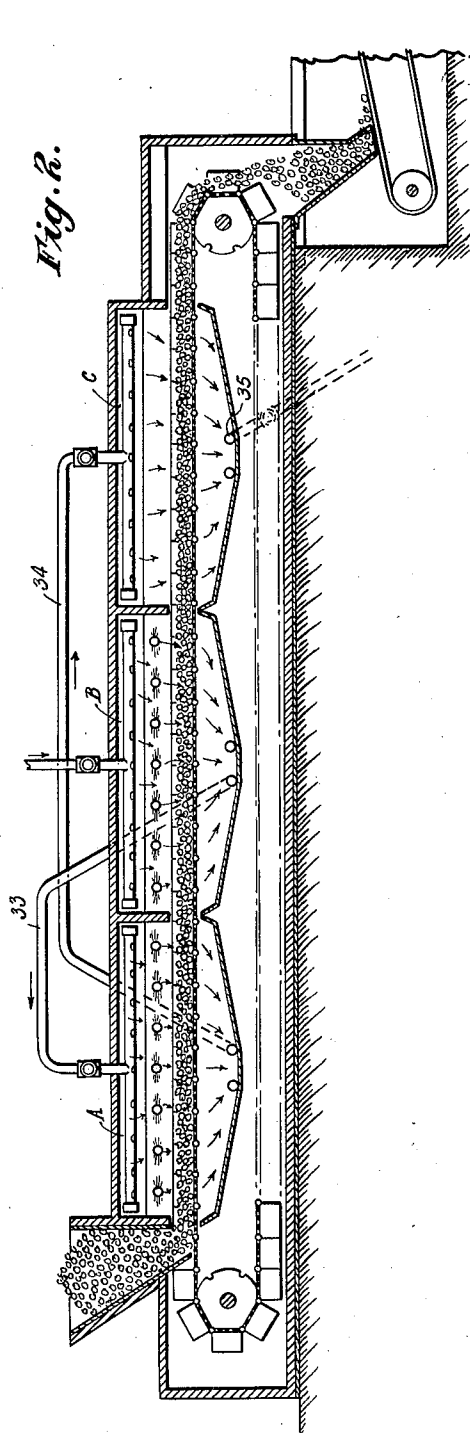
W. E. TRENT

1,814,463

PROCESS FOR CARBONIZING MATERIALS

Filed May 18, 1925

2 Sheets-Sheet 2



Inventor
Walter E. Trent
By *Charles M. Thomas*
Attorney

UNITED STATES PATENT OFFICE

WALTER EDWIN TRENT, OF NEW YORK, N. Y., ASSIGNOR TO TRENT PROCESS CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

PROCESS FOR CARBONIZING MATERIALS

Application filed May 18, 1925. Serial No. 31,221.

This invention relates to a process for carbonizing or otherwise treating materials having a volatile content, such for instance, as coals, lignites, or mixtures of oil and coal.

5 In the treatment of coals it is recognized that different products will vaporize from the coal at progressively increasing temperatures. The primary products of distillation usually will be removed when the coal is sub-
10 jected to a temperature of say 500° centigrade. The secondary products leave the coal when its temperature is raised from 500 to 1200° centigrade, it being fully recognized that different reactions occur at different tem-
15 peratures.

The present invention relates primarily to a process in which a body of coal or like material is continuously moved through a retort and during its passage through said retort
20 passes through successive independent heating zones maintained at different temperatures whereby the volatiles removed from the coal by reason of said different temperatures may be separately collected, if desired.
25 In the process I find it desirable at times to pass gases and vapors taken from one zone, or certain fractions thereof, to a succeeding zone which may be maintained at a higher or lower temperature than the zone where
30 these products were produced.

A further object of the invention is to provide a process in which the material traveling through the retort is subjected to the direct action of heating gases when passing
35 through the different independent zones in the retort. In this process the heated gases are compelled to pass through the fuel bed before they are permitted to escape and the vapors and gases discharging from each compartment may be separately collected, or they
40 may be further treated by returning them to either a hotter or cooler compartment or zone in the retort. As a last step of treatment, it is generally preferable to return the hottest vapors and gases back to the first compart-
45 ment for the purpose of utilizing their excess heat in the green fuel, and to also reduce the work placed on the condensers. The invention in a modified form also comprises a process wherein coal or like material is passed

through an elongated retort quite rapidly, the retort being so heated that when the material is traveling through a certain zone therein, it becomes fused and impervious, but the heating gases directed on the material at
55 this time will continue to add heat thereto as they travel along the bed of material to a point where the fuel still remains green and is porous, or they will travel with the fused material toward the discharge end of the
60 retort at which point the fused material becomes hard and porous to permit the penetration of the gases.

In the accompanying drawings, I have merely shown the preferable embodiment of
65 my invention. The apparatus herein shown is disclosed for the purpose of illustrating a highly successful mechanism for carrying out my process.

In the drawings, Fig. 1 represents a longitudinal sectional view through the apparatus.

Fig. 2 is a modified form with two of the treating zones shown in Fig. 1 eliminated, and Fig. 3 is another modified form of an
75 apparatus for supporting a modified process.

Referring now more particularly to Fig. 1, the numeral 1 designates an elongated retort having disposed therein an endless conveyor 2 consisting of pivotally connected per-
80 forated pans 3, the conveyor traveling around the sprockets 4 and 5. Either one of these sprockets may be operated by power means to impart to the conveyor a continuous movement through the retort. At one end of the
85 conveyor there is provided a hopper 6 by means of which raw material such as pulverized coal or mixtures of coal and oil are fed to the conveyor.

The retort intermediate its ends is provided with a series of partition walls 7, 8, 9 and 10 which divide the retort into compartments A, B, C, D, and E. Underlying each compartment I also provide independent vapor and condensate collecting pans 11 to 15
95 inclusive. The end of the retort is provided with a discharge hopper 16 for discharging the treated fuel 17 onto a belt or the like where it is conveyed to a point of storage.

In the treatment of coal products, various

volatiles contained in the coal distil off at different temperatures, for instance, the primary products may come off at a temperature not exceeding 500° centigrade. The other products come off at progressively increased temperatures.

The object of this invention is to provide a process in which the coal is subjected to successively rising temperatures in the different zones of the retort by means of which the various products removed from the coal can be separately collected. As an illustration, the gases and vapors of primary distillation are formed at a temperature of say 500° centigrade. At a temperature of from 500° to 700° centigrade fixed gases and tars appear, and within this range of temperature the products if passed through the fuel bed, will be largely converted to motor fuel stock. At 600° centigrade or higher, when steam is brought into contact with the heated fuel, it is decomposed, liberating hydrogen, and the oxygen forms carbon monoxide gas with the carbon. Then part of the hydrogen combines with the nitrogen that is released by the decomposition of the coal and forms ammonia. If the gases carrying the ammonia vapors are at once conducted to lower temperatures, the ammonia does not suffer severe decomposition. It therefore follows, that in accordance with this invention I maintain the various zones of the retort at different and preferably at progressively increasing temperatures so that the different products derived from the coal at various temperatures may be so collected and treated as to not be severely decomposed when such a decomposition is not preferable, and which objection would otherwise be present if the coal were permitted to pass through a continuous retort where all the gases are permitted to commingle.

In the apparatus shown in Fig. 1, the coal when passing through zone A, is heated to a temperature of say 500° centigrade. This occurs by reason of heating gases generated by the burners X, a row of parallel burners being arranged in this zone A. These burners direct their gases downwardly on the bed of fuel passing through this retort on the conveyor, vaporizing certain products therein which pass downwardly into the pan 11. The zone B is heated to a higher temperature than the zone A. This zone may be heated to a temperature of 600° centigrade by means of the burners X which are of the same construction as the burners described in the zone A. Similar burners are used in the zones C and D, and in accordance with this invention the zone C may be heated to say 700° centigrade and the zone D to 800° centigrade. These temperatures are only given for the purpose of illustration and can of course vary depending upon the materials being treated and the products desired. In

each instance, however, the products of distillation drop into the pans 11, 12, 13, 14 and 15 respectively, and these products are either withdrawn for passage through the condenser or other apparatus. The products may furthermore be withdrawn from one pan, and returned to a succeeding retort of a higher temperature, or any portion of the products produced in any treating zone may be introduced to one of the succeeding zones in a manner which will be hereinafter described. It is well recognized that steam decomposes when brought into the presence of heated carbon at a temperature in excess of 600° centigrade. In the compartment E I preferably provide a water or steam discharging jet 20 by means of which steam or water is introduced to this compartment for the purpose of contacting with the bed of heated or carbonized fuel which is at this time at a very high temperature. This contact causes a decomposition of the steam forming the gases to which I have heretofore alluded. The formation of this gas is well known to those skilled in the art and need not be repeated in this specification. As the fuel passes from the zone E, it becomes porous and broken and discharges into the hopper 17 in the form of a solid carbonized fuel.

The products of decomposition produced in the zone B may be withdrawn from this zone through the line 21 to a condenser, collector or the like, or in fact any plant suitable for the recovery of these products. The same also applies in connection with the zones C, D and E, as each zone has a drawoff line 22, 23 and 24 respectively for this purpose. The zone A furthermore has a drawoff line 25 which may lead to a producer gas recovery plant, and a second drawoff line 26 which may also lead to a condenser or the like, it being understood that all of these drawoff lines are provided with suitable valves. It will be seen however, that a second drawoff line 26^a from the pan 12 of the zone B leads by means of the line 27 to the upper end of the compartment D, into which it discharges through tube 19^a. Gases carrying ammonia are transferred through this line to this compartment. The pan 13 of the compartment C is also provided with a second drawoff line 28 leading through line 29 to the compartment or zone A, into which it discharges through tube 19^a so that the intensely hot gases apply their heat to the green material passing through this zone. Obviously this utilizes the excess heat of the gases and reduces the labor placed on the condenser. In the illustration disclosed in Fig. 1, I have not shown the drawoff line 30 leading from the pan 14 of the compartment as communicating with any of the other compartments or zones of the retort. However, this line can communicate with any one of these zones depending upon

the work that is to be done, or it may, if desired, as shown, lead to any other apparatus such as a water gas recovery plant for recovering gas, ammonia, etc. The line 31 communicating with the pan 15 of the compartment E, which is the compartment in which steam is introduced for the production of water gas, practically leads by means of the line 32 directly to the compartment or zone B, into which it discharges through tube 19'. Steam and blue gas for collecting ammonia are usually passed through this line as such products are generally produced in the compartment E. It has been explained that from this compartment B the gases pass to the compartment D, and from this compartment they are withdrawn without any further introduction to other compartments or zones of the retort for the recovery of gas, ammonia, etc. It will furthermore be understood that this arrangement of the gas conveying pipes may be materially altered, and that the present specification merely describes a process which has been found to be highly desirable in the production of certain desired products. If other products are desired, the gases from one retort may be shifted to another as the action may demand.

In Fig. 2 of the drawings I have shown a slightly modified form of the invention wherein I have eliminated a water gas producing zone shown as E, in Fig. 1. In this figure, however, I have merely shown the apparatus as having three condensate collecting pans. The parts of the apparatus shown in this figure are all the same, and a detailed description need not be given. It suffices to say that in this embodiment of the invention vapors and gases from the zone B pass through the line 33 to the zone A, while vapors and gases from the zone A, may in this embodiment of the invention pass through the line 34 to the zone C. This process is used when it is desired to convey hot gases from the zone B to the zone A to recover their heat, and when such gases and vapors from zone A need superheating in zone C, to be cracked for the recovery of light oils, gases, etc., the products are discharged through the line 35 from this zone.

In the modified form of the invention shown in Fig. 3, I have provided a retort adapted primarily for the low temperature carbonization of coal. That is to say, in this retort I do not have in mind the utilization of the high temperatures practiced in the invention carried out in the apparatus shown in Figs. 1 and 2, and in which apparatus I have found it essential to divide the retort into compartments because of the temperatures employed. In Fig. 3 the retort 40 is of an elongated nature having a belt or endless conveyor 41 consisting of a series of pivotally connected perforated pans, which con-

veyor travels around the sprockets 42. An elongated pan 43 underlies the conveyor and it is into this pan that the products of distillation, condensate and the like collect. The raw fuel is fed to the conveyor from the hopper 44 and travels therethrough in the perforated pans. The carbonized product discharges into the hopper 45 from where it is led to a suitable point of collection. In this apparatus a series of gas burners 46 are provided which extend transversely through the retort. These burners as will be observed, overlie the conveyor. I preferably apply the material to the conveyor in a thin bed and move the conveyor rapidly through the retort. The bed of material in this operation is considerably thinner than the bed applied to the conveyors in Figs. 1 and 2 of the apparatus. In the operation of this process it will be observed that in the zone designated by the line $x-x$ the material becomes fused and more or less impervious to the heating gases. These gases however, will travel along the conveyor to the left and penetrate the green coal before it reaches the zone $x-x$ and before fusion takes place, and will travel to the right towards the discharge end of the conveyor and will penetrate the coke-like mass after it has become hard and porous. In other words, when the mass is passed through the zone $x-x$ it is often in that state of fusion where gases cannot penetrate, but as soon as it becomes hard and leaves this zone it becomes more or less porous, permitting penetration of the heated gases generated, which have been described.

Having thus described the invention, what I claim is:

1. A process of the character described, comprising passing a body of solid carbonizable fuel successively through zones of progressively increasing temperatures, under carbonizing conditions, removing volatiles from one zone and passing said volatiles to a succeeding zone of a higher temperature sufficient to crack the hydrocarbon vapors contained in said volatiles into light oil vapors but insufficient to completely decompose said volatiles.

2. A process of the character described, comprising passing a body of solid carbonizable fuel successively through zones of progressively increasing temperatures, under carbonizing conditions, removing volatiles from one zone and passing said volatiles to a succeeding zone of a higher temperature sufficient to crack the hydrocarbon vapors contained in said volatiles into light oil vapors but insufficient to completely decompose said volatiles, and thereafter introducing steam to the material passing through one of the higher heated zones to be decomposed and converted into gas.

3. A process of the character described comprising passing a body of solid carbon-

izable fuel successively through zones of progressively increasing temperatures under carbonizing conditions, removing volatiles from one zone and passing same to a succeeding zone of a higher temperature sufficient to crack the hydrocarbon vapors contained in said volatiles into light oil vapors but insufficient to completely decompose said volatiles, thereafter introducing steam to the material passing through one of the higher heated zones to be decomposed and converted into gas, and introducing the gas from said zone to one of the cooler zones to impart its heat to the green fuel therein and enrich said gas.

4. A process for obtaining volatiles from solid carbonaceous material which yields volatiles upon destructive distillation which comprises continuously moving said material through a plurality of successive heating zones, destructively distilling the material by introducing an independent stream of hot gas to the material in each of said zones, said gas being in sufficient amount and of sufficient temperature to destructively distil said material, removing resultant volatiles from each of said zones, and introducing volatiles removed from one of said zones into contact with the material in a succeeding one of said zones.

In testimony whereof I affix my signature.

WALTER EDWIN TRENT.

35

40

45

50

55

60

65