Dec. 6, 1927. 1,651,994

H. B. CANNON

PROCESS OF DISTILLING MATERIALS

Filed April 11, 1924 3 Sheets-Sheet 1

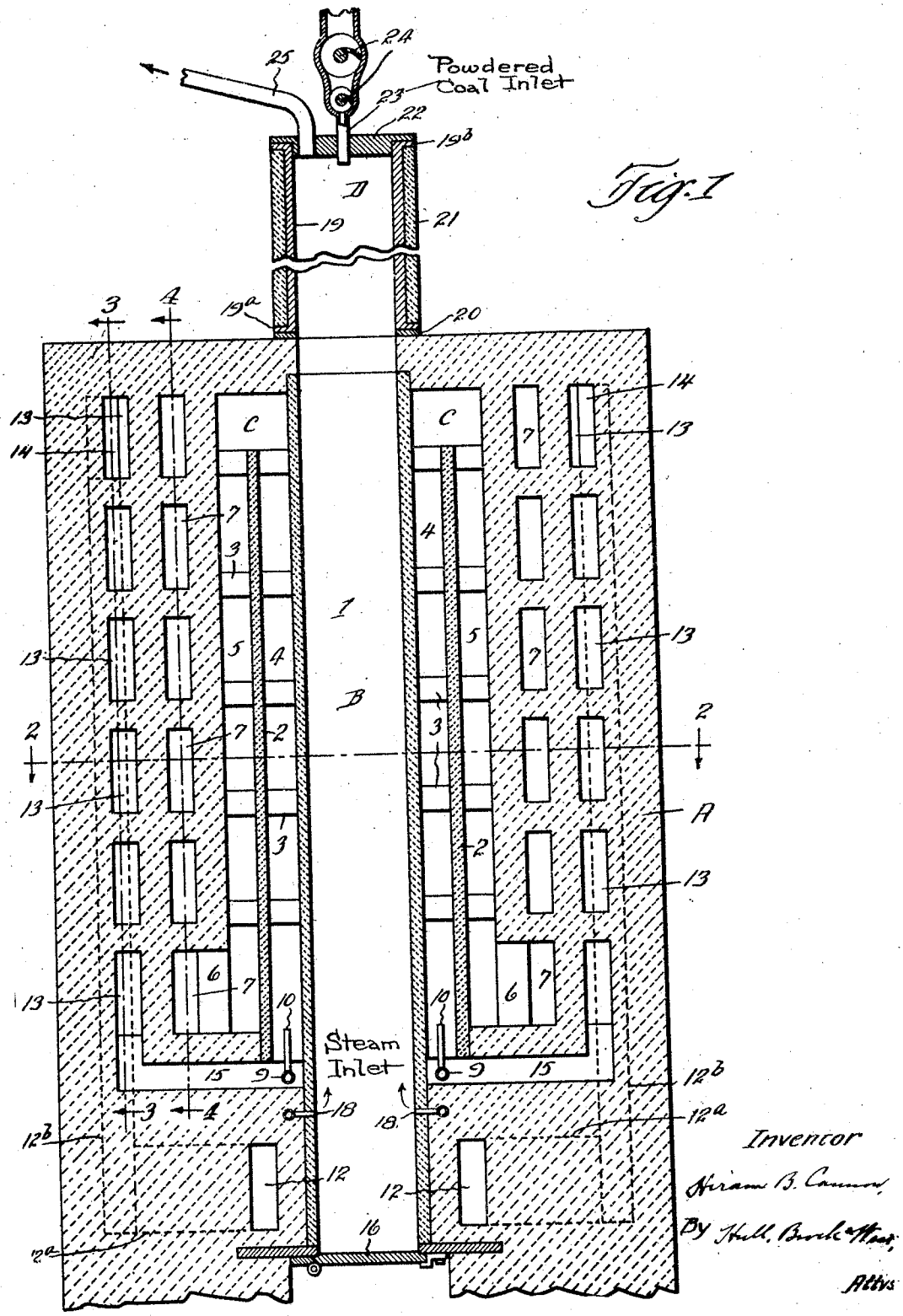


Fig. 1

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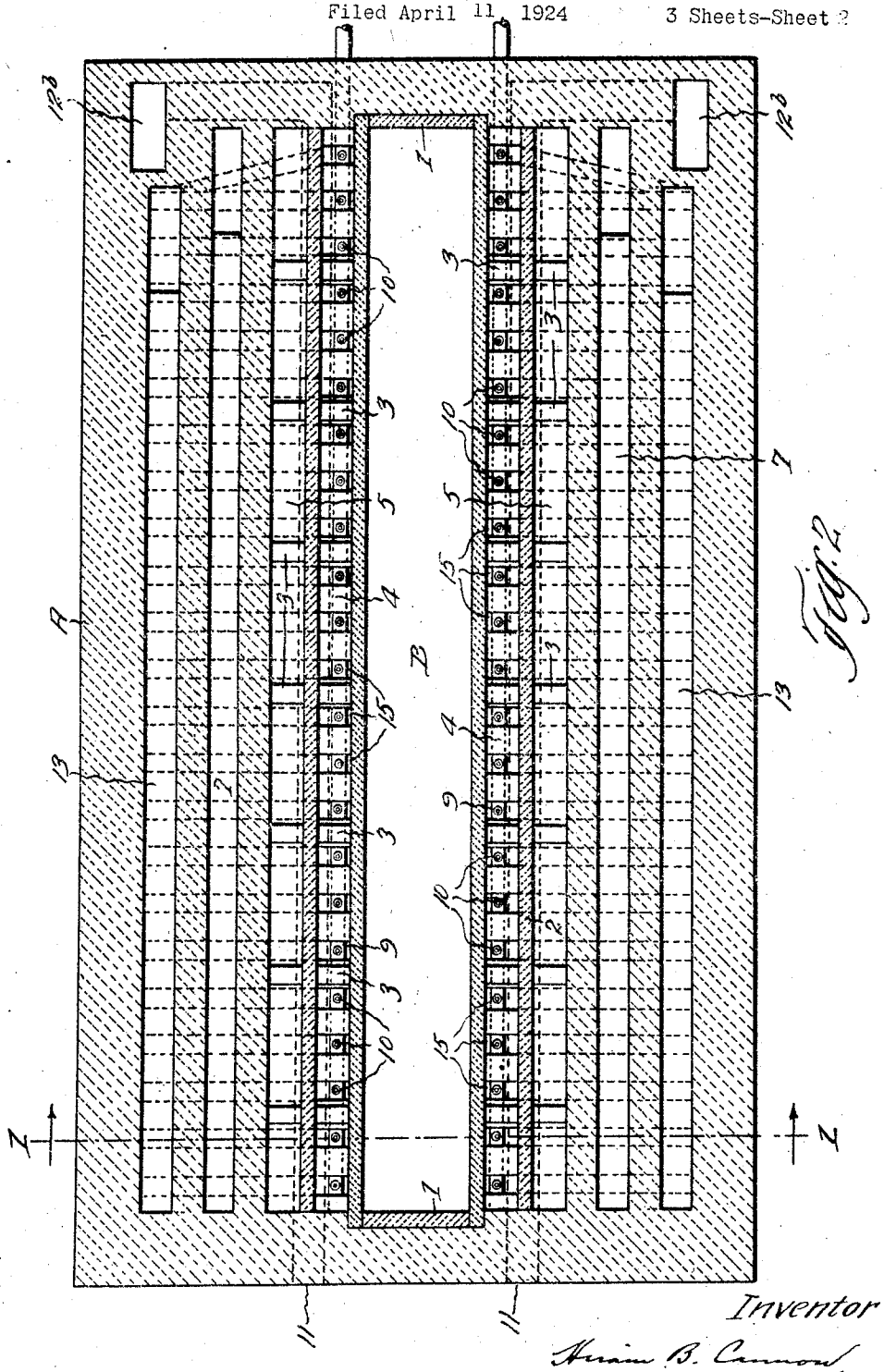


Fig. 2

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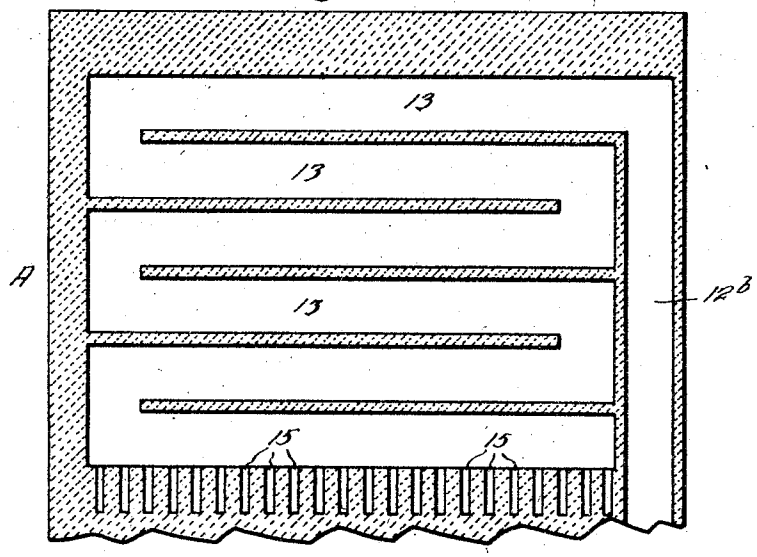
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Filed April 11, 1924 3 Sheets-Sheet 3

Fig. 3



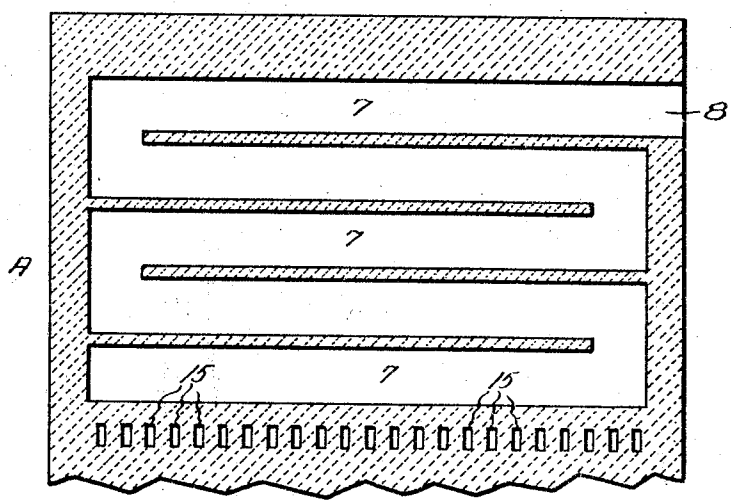


Fig. 4

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UNITED STATES PATENT OFFICE.

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PROCESS OF DISTILLING MATERIALS.

Application filed April 11, 1924. Serial No. 705,720.

This invention relates to a process for the distillation of liquid and solid materials or compounds, and is particularly well adapted for the purpose of reclaiming, in a commercial condition, volatile and solid constituents of carbon-containing compounds, although the invention is not limited in its application to such compounds.

It is the general purpose and object of the invention to provide a process which will enable the foregoing result to be accomplished in an efficient and economical manner. Further and more limited objects of the invention will be set forth hereinafter in connection with the detailed description of my process and of the apparatus by which the same is realized, the said apparatus being shown in the accompanying drawings, wherein Fig. 1 represents a vertical sectional view corresponding to the line 1—1 of Fig. 2; and Figs. 2, 3 and 4 sectional views corresponding respectively to the lines 2—2, 3—3 and 4—4 of Fig. 1.

The apparatus by means of which my process is realized consists generally of a retort having therein a reaction chamber, the walls of which are formed of material of high heat-radiating quality, a recuperative tower extending above and providing an extension of the said chamber and arranged to discharge into such reaction chamber material supplied to said tower; means within the said retort for heating the radiating walls of the said chamber; also means for recuperatively heating the air employed to support the combustion of the fuel employed to heat such walls.

Describing the various parts by reference characters, A denotes the retort generally, the same being made in the form of a thick casing of any standard refractory material and having the reaction chamber B therein, the said chamber extending from near the top to near the bottom of the casing and from end to end thereof, being defined by and between walls 1 of refractory material, such as silicon carbide, having high heat-radiating qualities.

Located on opposite sides of the side walls 1 and spaced therefrom and arranged preferably parallel therewith are walls 2, also preferably of silicon carbide. Each wall 2 is located in a chamber C on each side of the chamber B and extends from the bottom of such chamber C nearly to the top thereof, each wall being braced and held in proper relation to the adjacent wall 1 and the opposite side of its chamber C by means of supporting and stabilizing projections 3.

The walls 2 divide their chambers C into ascending and descending flues 4 and 5, respectively. The bottom of each flue 5 communicates by means of lateral passages 6 with the bottom transverse flue 7 of a vertical series of such flues, the lowermost flue communicating at one end with the flue immediately thereabove and the latter flue communicating at its opposite end with the next flue thereabove, and so on. Each uppermost flue 7 communicates with an outlet 8 delivering the products to the stack (not shown). In the bottom of each flue 4 is located a gas supply pipe 9, each pipe having nipples 10 projecting upwardly therefrom and serving to discharge gas into the lower portions of the said flues.

The air for supporting combustion in the flues 4 is conducted thereto through a vertical series of transversely extending air-heating flues located within the casing A and between the outer sides thereof and the flues 7. Air is supplied through ducts 12, located on opposite sides of and adjacent to the bottom of the chamber B, the said ducts extending from one end of the casing nearly to the opposite end thereof and communicating each by an outwardly extending duct 12^a with a vertically extending duct 12^b, the ducts 12^b being located adjacent to opposite sides of the casing A, respectively, and each discharging through a port 14 into the uppermost flue 13 of a vertical series of such flues, the series of flues being arranged on opposite sides of the casing. The air admitted to each upper flue is conducted therethrough from one end to the other thereof and from such last-mentioned end to the adjacent end of the flue therebeneath, through such second flue to the adjacent end of the flue therebeneath, and so on to the lowermost flue of each series, the air being circulated through the flues 13 counter-current to the flow of the products of combustion through the flues 7.

The bottom of each of the lowermost flues 13 communicates by inwardly extending passages or flues 15 with the bottom of the cooperating flue 4, thereby delivering recuperatively heated air in operative relation to the nipples 10 to mix with the gas delivered therefrom and to support the combustion of the gas within the flues 4 and 5.

It will be noted that the chamber B extends downwardly below the chamber C and that the bottom of this chamber is closed by means of a suitable door or doors 16 (preferably of cast iron) extending transversely of the structure A. Above the bottom of the chamber B and on each side thereof and below the passages 15 are pipes 17 each provided with nozzles 18 for delivering into the lower portion of such chamber steam supplied to the pipes 17 from any suitable boiler or generator (not shown).

Mounted on top of the retort A and forming a continuation of the chamber B is a recuperative tower D. This tower comprises an inner wall 19, preferably of cast iron or steel construction and of the same cross section as the chamber B, said wall being provided with a bottom flange 19^a resting upon a base support 20. The upper end of the tower wall is flanged outwardly, as shown at 19^b, providing seats with the lower flange for the reception of insulating material 21.

Fitted within the top of the tower is a cover 22. Projecting through this cover and extending substantially the full length of the tower, from front to rear, is a distributing feeder 23 which, in the embodiment shown herein, communicates at its upper end with feeding mechanism 24 for pulverized material, such as coal. Projecting through the cover 22 and communicating with the top of the space or chamber within the tower is a series of outlet pipes 25 for the purpose of conducting volatile products from such tower to a suitable container or to the point of use.

With the parts described and arranged as hereinbefore set forth, my process will be carried out in the following manner, referring, for purposes of illustration, to the treatment of coal: The mixture of gas and air will be ignited at the bottoms of the flues 4, heating the walls 1 which, by virtue of the material of which they are composed, will quickly and effectively heat the chamber B by radiation. The products of combustion in their passage to the outlets 8 will recuperatively heat the air supplied through the flues 13 to the bottoms of the flues 4.

Pulverized coal, being distributed, at a rate predetermined by the feeding mechanism, through the elongated distributor duct 23 into the top of the chamber provided within the tower will be subjected to a heated atmosphere produced by the steam and by the volatile fluids evolved from particles which have been treated by such steam. The coal (or other material to be treated) will fall to the bottom of the chamber B, being held in retarded gravitational suspension by the volatile products ascending from the particles therebelow and by the ascending current of steam. Within the recuperative tower there will be some devolatilization of the coal at a temperature gradient of approximately 1000° F. at the bottom of such tower to not less than 212° F. at the top. As the fine particles of coal (or other material treated) fall slowly through the tower and chamber B, they are subjected to a gradually increasing temperature which reaches its maximum adjacent to the top of the chamber B. Owing to the fact that the steam admitted to the bottom portion of chamber B is ordinary low-pressure saturated steam, as distinguished from superheated steam, it serves to produce a substantially uniform temperature in the mixture of steam and volatile products throughout said chamber, which temperature is that at which a coal will yield up its maximum of light volatiles without cracking the same. As the particles fall through the chamber B, they are subjected to radiant heat from the walls 1, being swept and scrubbed by the ascending mixture of steam with the volatile products liberated from the particles there below.

The radiant heat delivered to the falling particles causes the latter to superheat the steam to the maximum temperature desired for the subsequent distilling operation, which is mainly effected in the tower D. This distillation will be substantially completed by the time the particles reach the upper part of the chamber B, after which the main function of the particles will be to receive heat by radiation from the walls 1 and deliver the same by convection to the ascending mixture of steam and volatile products.

Meanwhile the volatile products which have been evolved by reason of the passage of the particles through the tower D and chamber B will be delivered through the pipes 25 to the point of reclamation, use or storage.

Except for the possible periodical suspension of operations required for the removal of the accumulated solid material from the bottom of the chamber B, the process is continuous. The finely divided material supplied to the upper end of the tower D is subjected to an increasing temperature from the top of such tower to the bottom thereof and, in its passage through such tower and the chamber B, is subjected to the action of the steam, as well as to the action of heated volatile products and to radiant heat from the walls 1 in the chamber B.

While I have described my process as applicable to the distillation of coal at comparatively low temperatures, it is also applicable to the like treatment of other materials, such as oil shale, petroleum, and carbonizable or carbonaceus colloidal materials.

It will be evident that the retarding of

the gravitational suspension of the particles by the ascending heated fluid will prolong the time required for their descent from the top of the tower to the bottom of the reaction chamber with a correspondingly longer exposure to the distilling conditions within such tower and chamber and will thus ensure their distillation and required temperature elevation by the time of their arrival at the bottom of the reaction chamber.

Furthermore, instead of introducing coal or like solid material in a pulverized or finely divided condition, the material to be distilled may be fed in as an amalgam in thin ribbon form. Other variations in the material and mode of feeding the same into the recuperative tower will suggest themselves to those skilled in the art, and such variations are within the scope of my invention.

No claim is made herein to the apparatus, it being intended to protect the same by means of a separate co-pending application.

Having thus described my invention, what I claim is:—

1. The process of evolving volatile products from carbonaceous material which consists in dropping said material in a finely-divided condition through an elongated vertical chamber; introducing low-pressure saturated steam into said chamber adjacent to the bottom thereof; heating the steam by radiation from the walls of the lower portion of said chamber to a temperature sufficient to effect low-temperature distillation in the upper portion of said chamber; and passing the steam thus heated upwardly through the chamber, the material in the upper portion of the said chamber being heated only by the gases passing therethrough and by such incidental radiation as it may receive from the lower portion of said chamber.

2. The process of evolving volatile products from carbonaceous material which consists in dropping said material in a finely-divided condition through an elongated vertical chamber; introducing low-pressure saturated steam into said chamber adjacent to the bottom thereof; subjecting the steam and the particles in the lower portion of said chamber to radiant heat from the walls of such portion, whereby the steam is superheated by such radiant heat and by convection from the particles in such lower portion and the steam and such gaseous products as are evolved from such particles in such lower portion are heated to a temperature sufficient to effect low-temperature distillation in the upper portion of said chamber; and passing this steam and gaseous products thus heated upwardly through the chamber, the material in the upper portion of the said chamber being heated only by the gases passing therethrough and by such incidental radiation as it may receive from the lower portion of said chamber.

In testimony whereof, I hereunto affix my signature.

HIRAM B. CANNON.