July 17, 1928. 1,677,784

W. W. KEMP

METHOD OF AND APPARATUS FOR REDUCING MATERIALS BY HEAT

Filed Nov. 7, 1921

Fig. 1.

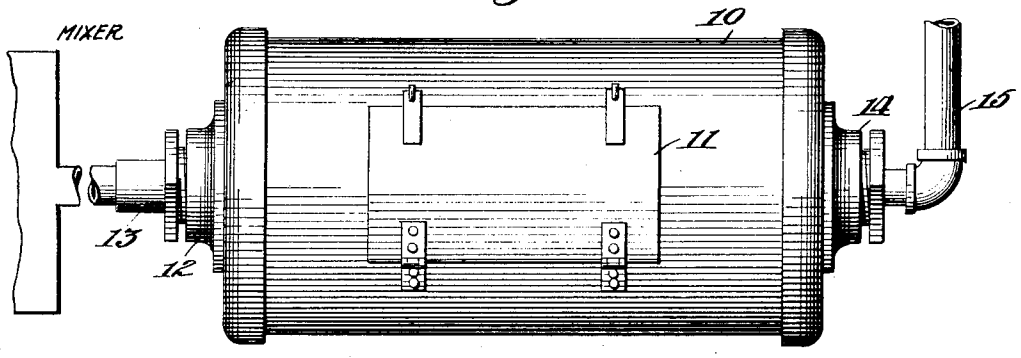


Fig. 2.

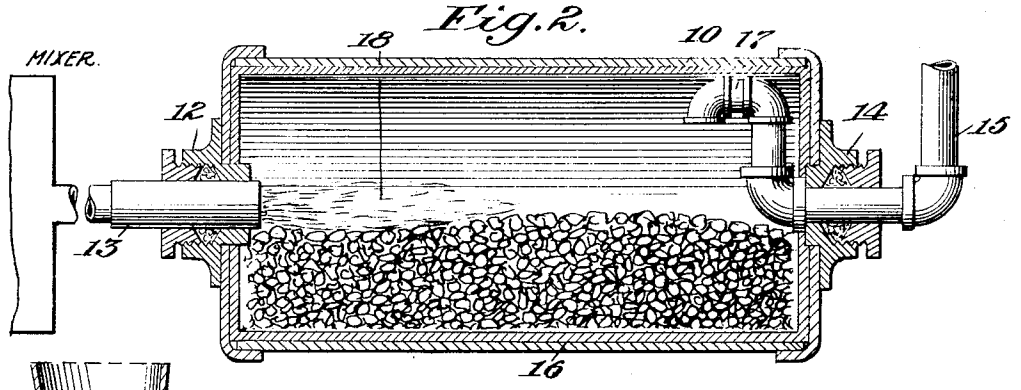
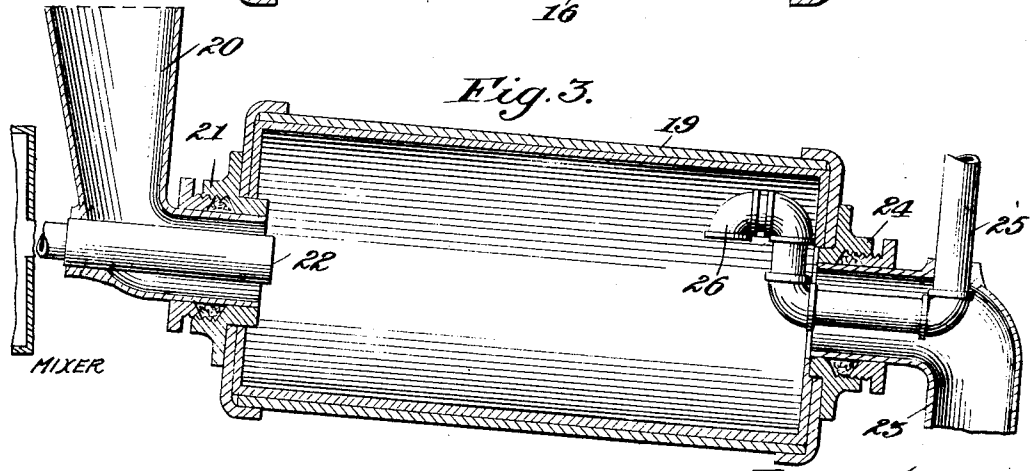


Fig. 3.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR REDUCING MATERIALS BY HEAT.

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The present invention relates to a method of and apparatus for the reduction of solid, liquid or semi-liquid materials, among which may be mentioned carbonaceous materials, and its purpose is the provision of novel means and an improved method for the complete and economical reduction of materials to liberate the volatile constituents and reduce the materials to an inert carbon.

Under present methods, the distillation of materials, among which may be mentioned wood, bone, lignite, peat, and, in fact, any material which is capable of distillation, the practice has been to place such material in retorts, and, by external firing of those retorts, distill the material, driving off the gaseous elements and reducing the solids to inert matter. This external firing method requires a very high and destructive heat which tends to break down rapidly the retorts in which the distillation is carried on so that it is uneconomical in this respect, and, furthermore, in practical operation, this method requires relatively long intervals between the successive operations of firing the retort to bring it to proper distilling temperature, cooling it after the operation is complete, and removing the reduced materials.

Under the present method and utilizing the apparatus which will be hereinafter described, and one embodiment of which is illustrated in the drawings accompanying this case, it is proposed to internally fire the retort and subject the material to be reduced to a temperature sufficiently high to free the gaseous constituents or impurities and leave the char or charcoal in an ash free revivified condition in the retort. This internal firing is accomplished in the absence of sufficient air to support combustion, either of the volatile products, or the material under reduction, while, at the same time, the heat generated is sufficiently high to accomplish the result aimed at, the heat being produced by the flame of a self-sustaining mixture introduced into the retort. As a result of this method, the distilling of the material is effectively carried out, but since there is insufficient air in the retort to support combustion, either of the liberated gases, or of the material in the retort, all danger of burning of the material or gases, or explosion of these gases, is eliminated, and a true distilling action takes place.

As stated, in order to effectively accomplish this, I propose to subject the material to be reduced to the flame or the heat of a self-sustained fuel mixture, preferably gaseous, which mixture will sustain combustion in the absence of air sufficiently to reduce the material, but which will not cause any burning of the liberated gases or the material under treatment, since there is not sufficient oxygen in the air of the mixture to support combustion of anything but the gas or fuel portion of the mixture.

In order that the invention may be clearly understood by those skilled in the art, I have shown, in the accompanying drawings, embodiments of my invention, but it will be understood that this disclosure is merely illustrative, and in no sense restrictive of the invention, as it may be carried out by the use of other expedients and apparatus.

In the drawings:—

Fig. 1 is a view in elevation of a reduction apparatus.

Fig. 2 is a view in section of the apparatus shown in Fig. 1, and

Fig. 3 is a view of an apparatus similar to that shown in Figs. 1 and 2, with certain additions and auxiliary appliances applied thereto.

Referring to the drawings by numbers, like numbers indicating like parts in the several views, 10 indicates the reduction chamber, which may be of any approved form, but is preferably, as shown, in the form of a cylinder which may be rotated in any suitable manner, and is provided with a suitable filling opening having the door or closure 11. The receptacle 10 may be lined, if desired, with refractory material, as conventionally illustrated, and may be mounted for rotation as may be desired, and any convenient means for driving it may be provided.

At one end of the receptacle 10 is provided a stuffing box 12 through which passes an inlet pipe 13 for the fuel, preferably gaseous. At the opposite end of the container 10 is provided a similar stuffing box 14 through which extends the outlet pipe 15 for the volatile products driven off from the material 16, conventionally illustrated, as well as the gases of combustion from the internal firing flame. Preferably the delivery pipe 15 will have an upwardly turned neck 17 within the container 10 to receive the gases rising from the material 16 to the upper part of the chamber.

The exclusion of air from the container 10 so as to prevent supplying enough oxygen to effect combustion of the material, or liberated gases, and maintain a true distilling action is ensured by providing a closed container, such as the container 10, and by maintaining within that container a pressure from the inlet pipe 13 through which the self sustaining mixture passes sufficient to prevent the entrance of air under atmospheric pressure through any openings or joints in the container.

Preferably, the container 10 will be made as air tight as practicable, but it will be understood that it need not be absolutely sealed from atmosphere because the action of the internal pressure, above referred to, ensures the exclusion of atmospheric air from the container.

I accomplish the reduction of the material 16, however, by internal firing, without any danger of burning of the volatile products, by delivering through the pipe 13 a fuel, which is preferably gaseous, and of a self-sustaining character, so that it will burn in the air-tight container, the jet of burning fuel being conventionally illustrated at 18 in Fig. 2. The fuel delivered through the pipe 13 is a mixture of gas and air so regulated as to proportion that it will burn in a confined space, there being just sufficient air to furnish the oxygen required to support combustion of the fuel, but insufficient to cause ignition and burning of the material 16 or any of the volatile products of the material so that a true distillation is carried on, and the gaseous constituents, as they are liberated, accumulate in the container 10 and are drawn off through the neck 17 and the delivery pipe 15.

The combustible mixture constituting the gaseous fuel supplied through the pipe or burner 13 is thoroughly pre-mixed outside the container and before being admitted to the burner, and as above noted, the gas and air composing the same are so proportionated that the oxygen of the air will not exceed that required to effect combustion of the gas that is thoroughly mixed with the air. This fuel, in which gas and air are thoroughly pre-mixed outside the container, in contrast to a stratified mixture of gas and air produced by admixing such elements in a burner or within a container, is herein defined as being of a "self-sustaining" character.

The "self-sustaining" mixture may be produced by any suitable means and the drawing therefore contains merely a diagrammatic showing thereof. An example of an apparatus adapted to provide a combustible mixture such as employed in practicing the present invention is disclosed in patent of Kemp and Van Horn No. 1,420,658 dated June 27, 1922.

In operation, the cylinder or retort 10 will receive its load of material which is to be reduced, the jet 18 will be ignited, the door 11 closed, and the retort 10 will then be revolved to agitate the material 16 and bring fresh material into the zone of action of the reducing jet.

In the form of the invention shown in Fig. 3, the cylinder 19 will be constructed in the form shown in Figs. 1 and 2, but in order that a continuous feed of material through the retort may be secured, I incline this retort 19, as shown, and at the upper feeding end of the retort 19 I provide a feed hopper 20 passing through a stuffing box 21 in the retort, with the jet pipe 22 for the self-sustaining mixture traversing the feed pipe of the hopper 20 as shown. The hopper 20 may, if desired, be provided with a cover and any suitable valved feed trap (not shown) at its upper end so that material may be fed to the hopper and thence to the retort continuously.

At the lower or delivery end of the retort 19 a delivery pipe 23, to receive the reduced inert material, will be provided, this pipe delivering through any suitable receptacle and having cut-offs (not shown) to prevent entrance of any considerable volume of air to the retort from that end. A suitable stuffing box 24 will surround the pipe 23, and the gas delivery pipe 25 having the receiving neck 26 within the retort 19 will be provided.

With this apparatus a continuous operation may be carried on, it being understood that the internal firing and the reduction of material is the same as described in connection with Figs. 1 and 2, but a continuous operation is effected by proper feeding through the hopper 20 of the material to be reduced, the reduced material passing out through the pipe 23 as the retort is rotated.

I have found it preferable, or at least desirable, to deliver the self-sustaining fuel, as conventionally illustrated at 18, under a pressure which will not blow the flame too far from the pipe 13 so that danger of driving the flame into the smothering atmosphere of the container and extinguishing it will be avoided, and it will remain adjacent the point of exit from the pipe so as to insure proper ignition and burning of the self-sustaining fuel.

By this means also any possibility of particles of the material being treated or the gases evolved therefrom being drawn into the stream of fuel prior to its being ignited, is entirely avoided.

Following this method and utilizing apparatus capable of performing it, I am able to reduce material by internal firing very effectively and rapidly, and do away with the somewhat cumbersome methods now in use of firing the retorts externally. Furthermore, under this method and with this

apparatus, there is great economy in the matter of fuel, for the application of the distilling temperature being internal and directly supplied to the material under reduction, there is no loss of heat as in external firing. Additionally, the initial cost and the cost of maintenance of apparatus necessary to carry out my method is very much reduced over the cost of apparatus used in external firing methods.

While I have shown a particular apparatus for carrying out my invention and have described particular steps for practicing it, it will be understood that such variations as are merely the work of the skilled mechanic may still be made without departing from the range of my invention.

I claim:

1. Apparatus for reducing material by heat, comprising a revoluble container from which air is excluded, a stuffing box at one end of said container, a burner pipe delivering a jet of self-sustaining fuel interiorly of said container through said stuffing box, a stuffing box at the other end of the container, and a gas pipe passing through said second stuffing box to deliver gas from said container exteriorly thereof.

2. Apparatus for reducing material by heat; comprising an inclined, revoluble container from which air is excluded, a feed hopper at one end of said container to deliver a substantially continuous stream of material thereto; a delivery pipe at the opposite end of said container to deliver the reduced product in a substantially continuous stream from said container; a burner pipe delivering a jet of self-sustaining mixture interiorly of said container at the feeding end thereof; and a gas delivery pipe communicating with said container at the delivery end thereof to deliver the volatile products exteriorly of said container.

3. Apparatus for reducing materials by heat, comprising an inclined, revoluble container from which air is excluded, having a stuffing box at each end, a feed hopper at the upper end of said container traversing a stuffing box to deliver a substantially continuous stream of material thereto, a delivery pipe at the lower end of said container traversing a stuffing box to deliver incinerated products in a substantial stream from said container, a burner pipe traversing said feed hopper and delivering a jet of self-sustaining mixture interiorly of said container, and a gas delivery pipe traversing the delivery pipe for incinerated products to deliver the volatile products exteriorly of said container.

4. The method of driving off the volatile constituents of gas producing material by heat, which consists in enclosing the material in a container; excluding air from said container; subjecting the material to the heat of a self-sustaining flame produced from a burning combustible mixture injected into the said container and removing the volatile constituents from said container.

5. The herein described process for the distillation of carbonaceous material which consists in forming a perfectly combustible mixture of uniform composition consisting of gases including oxygen, admitting such mixture to and burning it in an air tight retort, and passing the material through the retort and subjecting it to the direct action of the flame, thereby heating the material to separate the volatile matter from the material through decomposition and preventing the ignition or burning of the volatile matter or residue.

6. The herein described process for the distillation, of carbonaceous material such as lignite, which consists in feeding the carbonaceous material into an air-tight retort moving the carbonaceous material along in the retort, subjecting the material to the direct action of a flame produced by burning a previously formed combustible mixture, of uniform composition consisting of gases including oxygen within the retort to heat the material and the retort and to cause the volatile matter to separate from the material through decomposition without igniting or burning such material and then discharging the volatile matter from the retort togther with the products of combustion of the said flame, and separately removing the residue from the retort.

7. An apparatus for the treatment of carbonaceous material consisting in an air-tight retort, means for passing the carbonaceous material through the retort, a burner adapted to direct a flame upon the material during its passage through the retort, means to thoroughly mix combustible materials and a supporter of combustion and to feed the same to the burner, to produce a flame to heat the material and separate the volatile matter from the residue of the material in the manner described.

8. The herein described method of treating carbonaceous material which consists in enclosing the material in a container, and subjecting it to the heat of a burning mixture, injected into the container and composed of combustible material and a supporter of combustion thoroughly mixed outside the container and so proportioned as not to include oxygen in excess of that required to effect oxidation of the combustible material thereof, while excluding from the container air which would supply oxygen sufficient to effect combustion of the material being treated or gases evolved therefrom.

9. The herein described method of reducing carbonaceous material which consists in

enclosing the material in a container, agitating the material in the container, and subjecting it to the heat of a burning mixture, injected into the container and composed of gas and air thoroughly mixed outside the container and so proportioned as not to include oxygen in excess of that required to effect combustion of the gas thereof, while excluding from the container air which would supply oxygen sufficient to effect combustion of the material being treated or gases evolved therefrom.

10. The herein described method of reducing carbonaceous material which consists in enclosing the material in a container, rotating the container to agitate the material, and subjecting the agitated material to the heat of a burning mixture, injected into the container and composed of gas and air thoroughly mixed outside the container and so proportioned that the air therein will not furnish oxygen in excess of that necessary to effect combustion of the gas thereof, while excluding from the container air which would supply oxygen sufficient to effect combustion of the material being treated or gases evolved therefrom.

11. The herein described method of reducing carbonaceous material which consists in passing the material in a substantially continuous stream through a container, and subjecting the material within the container to the heat of a burning mixture, injected into the container and composed of gas and air thoroughly mixed outside the container and so proportioned that the air therein will not furnish oxygen in excess of that required to effect combustion of the gas thereof, while excluding from the container air which would supply oxygen sufficient to effect combustion of the material being treated or gases evolved therefrom.

12. The herein described method of reducing carbonaceous material which consists in enclosing the material in a container, subjecting it to the heat of a burning mixture, injected into the container and composed of gas and air thoroughly mixed outside the container and so proportioned that the air therein will not furnish oxygen in excess of that required to effect combustion of the gas thereof, while excluding from the container air which would supply oxygen sufficient to effect combustion of the material being treated or gases evolved therefrom, and discharging the volatilized constituents of the material from the container.

13. The herein described process for the treatment of carbonaceous material which consists in introducing the material into a chamber from which air is excluded and subjecting the same to the direct action of a flame produced by burning a previously formed mixture, of uniform composition, consisting of combustible material and a supporter of combustion, the amount of the latter not exceeding that required to effect combustion of the combustible material, thereby heating the carbonaceous material to dissociate the same into volatile matter and residue while preventing ignition or burning of the volatile matter or residue. to effect separation to the desired extent.

14. The herein described process for the distillation of carbonaceous material which consists in forming a mixture, of uniform composition, consisting of combustible material and a supporter of combustion, the amount of the latter not exceeding that required to effect combustion of the combustible material, introducing the carbonaceous material into a retort from which air is excluded, and burning said combustible mixture in said retort so as to subject the retort and the carbonaceous material to the direct action of the flame and thereby deprive the material of its moisture and decompose it to separate the volatile matter therein from the residue.

15. The herein described process for the treatment of carbonaceous material which consists in forming a mixture, of uniform composition, consisting of combustible material and a supporter of combustion, the proportion of the latter not exceeding that required to effect combustion of the combustible material, burning this mixture in a retort, from which air is excluded, and passing carbonaceous material through the retort and subjecting it during its travel to the action of the heated retort and the direct action of the flame resulting from burning the combustible mixture.

16. The herein described process for the treatment of carbonaceous material which consists in forming a mixture, of uniform composition, consisting of combustible material and a supporter of combustion, the amount of the latter not exceeding that required to effect combustion of the combustible material, burning such mixture in a retort from which air is excluded, passing carbonaceous material through the retort and subjecting it during its travel to the action of the heated retort and the direct action of the flame obtained by burning the combustible mixture, and then separating the volatile matter from the residue of the carbonaceous material.

17. The herein described process for the distillation of carbonaceous material such as lignite, which consists in feeding the carbonaceous material into a retort from which air is excluded, moving such material along in the retort, subjecting the material in the retort to the direct action of a flame produced by burning within the retort a previously formed combustible mixture of uniform composition, consisting of gases including oxygen, the amount of oxygen not ex-

ceeding that required to effect combustion of the mixture, to heat the carbonaceous material and the retort and cause the volatile matter to separate from the carbonaceous material through decomposition without igniting or burning such material, discharging the volatile material from the retort together with the products of combustion of the flame, and separately removing the residue of the carbonaceous material from the retort.

18. The herein described process for reducing carbonaceous material which comprises introducing the material into a retort from which air is excluded, subjecting the material to the heat of a burning mixture injected into the retort and comprising a supporter of combustion not exceeding that required to effect combustion of the mixture, and maintaining the flame of such mixture at the point of its admission to the retort whereby particles of the material being treated and gas evolved therefrom are prevented from entering said mixture at points between said point of admission and that at which combustion of the mixture starts and combustion of such material and gas evolved therefrom is prevented.

In testimony whereof I have hereunto set my hand.

WILLIAM WALLACE KEMP.