

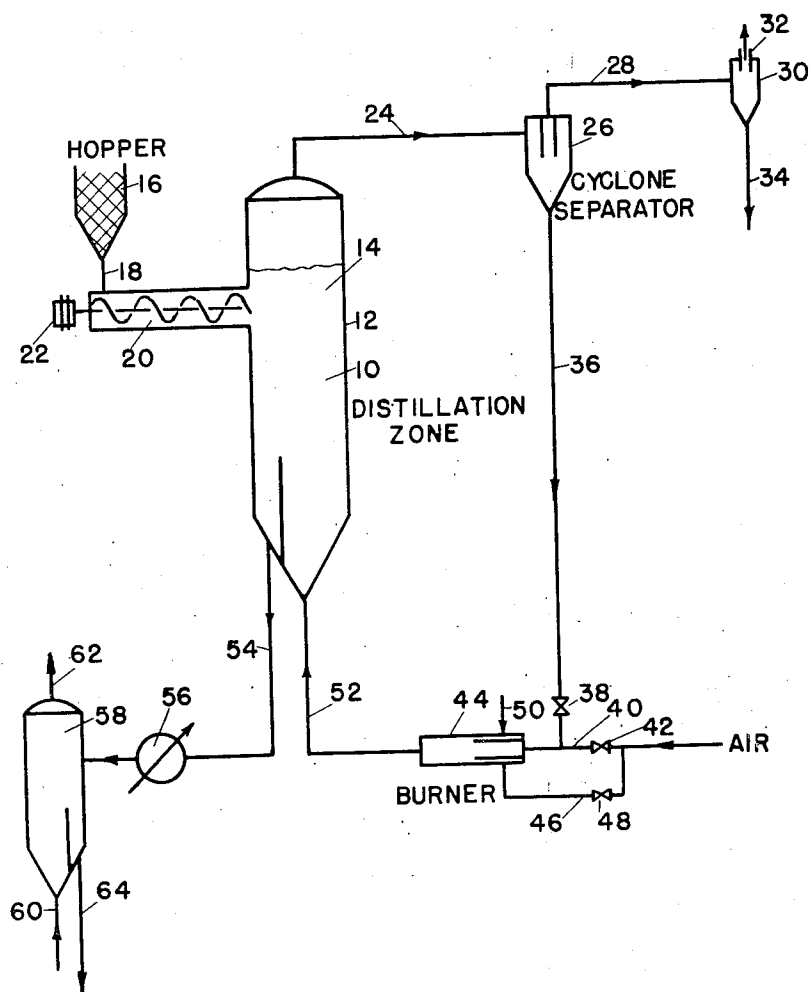
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TREATMENT OF CARBONACEOUS SOLIDS

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TREATMENT OF CARBONACEOUS SOLIDS

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1 Claim. (Cl. 202—19)

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The present invention relates to the treatment of solids and, more particularly, to the distillation of carbonaceous solids such as coal, lignite, and the like.

It has hitherto been proposed to effect low temperature distillation of coal by maintaining a fluidized bed of finely divided coal in a vessel at a temperature within the low temperature distillation range of the coal being treated. The fluidization of the coal is effected by oxygen-containing gases, or superheated steam or both. The heat required to elevate the bed to the desired distillation temperature is provided either by partial oxidation of the coal products or by the sensible heat contained in superheated steam. Partial combustion of the coal is undesirable because part of the coal is thereby rendered unavailable for the production of the distillation products. The use of superheated steam is likewise undesirable because of the cost of heating the steam. It would be desirable if a method and apparatus could be developed for effecting both heating and fluidization of the coal in the distillation zone without utilizing part of the coal which is to be distilled and without having to use superheated steam.

The primary object of the present invention is to provide an improved method and apparatus for effecting low temperature distillation of carbonaceous solids.

Another object of the present invention is to effect low temperature distillation of coal in a fluidized bed without utilizing part of the available distillable coal as a source of heat.

A further object of my invention is to provide a method and apparatus for the low temperature distillation of coal which does not utilize the sensible heat of superheated steam to effect distillation of the coal.

In accordance with my invention, the distillation of carbonaceous solids is carried out in a distillation zone in which the carbonaceous solids are maintained in a fluidized condition. The novel features of my invention reside in utilizing the carbonaceous solid fines entrained in the volatile products and fluidizing gas as the source of heat of distillation and also as the source of the fluidizing gas itself. These solid fines are separated from the gases issuing from the distillation zone and are then conveyed to a combustion zone where they are substantially completely burned. The hot combustion gaseous products are thereafter circulated through the bed of finely divided solids in the distillation zone. The temperature, the volume, and the superficial velocity of the volatile hot combustion products are regulated in such a manner as to effect fluidization of the carbonization solids in the distillation zone and also to elevate the temperature thereof to the desired distillation temperature. It is thus ap-

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parent that I have provided a method and apparatus which is substantially self-sufficient wherein a product of the distillation is utilized as a source of heat and fluidization which otherwise has very little, if any, value.

For a better understanding of my invention, reference should be had to the following description and to the attached drawing in which an apparatus for practicing a preferred embodiment of my invention is diagrammatically illustrated. Other objects and advantages than those above specified will be apparent from the following.

Referring to the drawing, numeral 10 designates a distillation zone which comprises a stationary vertical vessel 12 in which a fluidized bed 14 of carbonaceous solids is adapted to be maintained. A hopper 16 serves to supply finely divided carbonaceous solids through conduit 18 to a screw feeder 20 which is driven by motor 22. The screw feeder communicates as shown with the upper portion of the vessel 12. Conduit 24 connects the top of the vessel 12 with a cyclone separator 26. The latter in turn is connected through a conduit 28 to a second cyclone separator 30. A conduit 32 serves to convey gaseous products from the cyclone 30 to suitable purification and treatment zones while a conduit 34 serves to carry away the separated solids, ash, in this case. A conduit 36 conveys solids from the cyclone separator 26 under the control of a regulating valve 38 to a conduit 40 through which air is circulated under the control of a valve 42. The air and solids are conducted to a combustion zone 44 which as shown is a powdered fuel burner. Supplemental air may also be introduced into the system by means of conduit 64 under the control of valve 48. Steam may be introduced through conduit 50. The hot combustion products from the burner 44 are carried by conduit 52 to the bottom of the vessel 12.

The solid products of distillation in the vessel 12 are carried away by conduit 54 through a cooler 56 and thereafter to a separation zone 58. The latter is a vessel through which air is introduced through conduit 60. The air and entrained dust are conducted away from the vessel through a conduit 62 at the top. Dust-free solids are removed from the vessel through conduit 64.

The operation of my invention as applied to the distillation of coal will now be described for the purpose of illustration only and not by way of limitation. Finely divided coal (i. e., all ranks of coal including lignite) is fed into the vessel 12 from the hopper 16 by means of screw feeder 20. Initially, in order to establish a fluidized bed of this coal in the vessel 12, it is necessary to circulate a fluidizing gas therethrough which, in this instance, may be air fed through conduit 52. By partial combustion of the coal, the temperature within the distillation zone is raised to a point

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where distillation takes place, which, for bituminous coal, is of the order of 800° F. to 1400° F. The temperature, however, is one which is readily determined by experiment. Distillation of coal results in the production of volatile products and a solid char-like material which is still high in carbon content. While this char is substantially the same size as the finely divided coal introduced into the distillation zone, a certain amount of extremely finely divided char is produced as a result of agitation in the bed, etc. These so called fines become entrained in the fluidizing gas and volatile products and are ordinarily carried along with such gases to suitable purification and separation apparatus.

According to the present invention, the mixture of gases and entrained fines are conducted through conduit 24 to the cyclone separator 26 where the fines are deposited from the gases. They are led through the conduit 36 to conduit 40 where they are picked up and conveyed to the burner 34 by air in conduit 40. The quantity of fines fed to the burner is controlled by regulator 38. Substantially complete combustion of the fines is effected in the burner by air introduced either as the carrying medium for the fines through conduit 40 under the control of valve 42, or by introducing supplemental air through conduit 46 under the control of valve 48. Steam may also be introduced into the burner through conduit 50 in the well known manner if it is desired to effect distillation of the coal in the presence of steam or to supplement the heat produced by the burner 44. By regulation of the amount of fines, air and steam (if any) introduced into the burner, the total volume of combustion products can be regulated so as to provide a fluidizing gas suitable for effecting fluidization of the finely divided coal in the vessel 12 at the desired distillation temperature. Where the temperature of the distillation zone is in the neighborhood of 800° F. to 1400° F., I have found it desirable to provide hot combustion products from the burner 44 at a temperature of 1400° F. to 1600° F.

The ash from the burner 44 is very fine fly ash which ordinarily will be carried through the distillation zone 10 and on through the first cyclone separator 26. From this separator the fine fly ash is carried by the solid products through conduit 32 to a second separator which is required to effect complete separation of the fine fly ash from the gaseous products. The fly ash is then led away through conduit 34 while the volatile products are conducted through conduit 32 for further treatment.

The char products of distillation are removed from the vessel 12 through conduit 54 and are conducted to a cooler 56 for reducing the temperature to the point where it can be handled. In some instances, it may be desired to conduct this char directly to other reaction zones for treatment wherein the char is gasified for the production of carbon monoxide and hydrogen mixtures and the like. From the cooler, char is conducted to a chamber 58 where air introduced through conduit 60 is led through the finely divided hot char and out the top through conduit 62. This air serves to remove from the char any fine fly ash which may be carried along with the char from the vessel 12. The dust free char is then conducted from the chamber 58 through conduit 64.

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It will thus be seen from the above that a method and apparatus are disclosed which utilizes the minimum amount of heat and extraneous gases to effect distillation of coal and similar substances to yield liquid and gaseous products as well as solid carbonaceous materials. The liquid products in the case of coal are liquid tars which may serve as fuels or as a source of chemicals. The gaseous products are high B. t. u. gases useful as fuels. The solid products, known as char or semi-coke may be used as fuel or as a raw material for the production of gases.

While I have described my invention as applied to the low temperature distillation of carbonaceous solids, it will be readily apparent that it is generally applicable to the treatment of carbonaceous solids wherever heat is required to effect the treatment and wherever an appreciable amount of carbonaceous fines are carried away from the treatment zone by product gases, etc.

According to the provisions of the patent statutes, I have explained the principle, preferred construction, and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claim, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

The method of treating carbonaceous solids which comprises circulating gas through a bed of finely divided carbonaceous solids at an elevated temperature under fluidizing conditions in a confined reaction zone, feeding fresh carbonaceous solids to said reaction zone to maintain the desired level of said fluidized bed, conducting effluent gases and carbonaceous solid fines which are entrained in said effluent gases from said reaction zone to a separation zone separating said fines from said effluent gases in said separation zone, separately withdrawing solids which are not entrained in the effluent gases from the fluidized bed, effecting substantially complete combustion of said separated carbonaceous fines and only said fines in a combustion zone which is separate from said reaction zone, thereafter recirculating the hot gases and fine ash from said combustion zone through said fluidized bed in direct heat exchange relation therewith, and separating said effluent gases from said fine ash after circulation through said separation zone where said carbonaceous fines are removed.

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