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METHOD AND MEANS FOR TREATMENT OF COAL DISTILLATION GASES AND VAPORS

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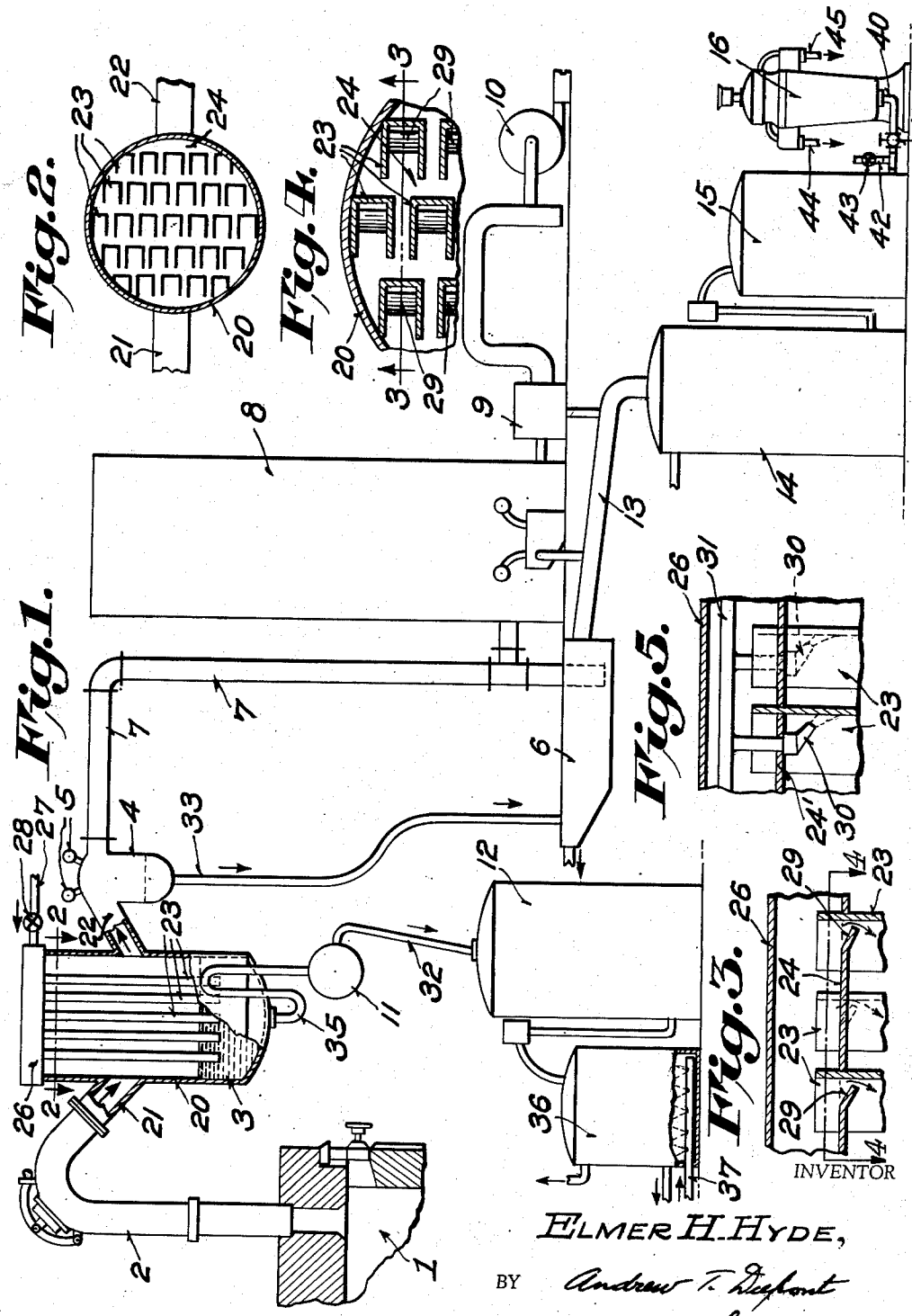


Fig. 1.

Fig. 2.

Fig. 4.

Fig. 5.

Fig. 3.

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METHOD AND MEANS FOR TREATMENT OF COAL DISTILLATION GASES AND VAPORS

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3 Claims. (Cl. 202—30)

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The present invention relates to improved means for treatment of coal distillation gases and vapors to obtain valuable products therefrom, and to methods of obtaining such products. The invention relates more particularly to means for and methods of fractional separation of solid suspensions of different characteristics carried over into the gas collecting and condensing systems of coal gas plants and coal distillation plants. Improved tar distillates are not only obtained thereby but solid particulate materials with the aforesaid different characteristics are separately removed in separate stages in an advantageous manner.

In plants of the aforesaid types, it has been difficult to obtain distillates which are free from solid, insoluble suspensions, particularly by treatment of the vapors generated during gas making and coking operations. The distillates have generally been subjected to settling or filtration treatments, and to centrifugalization, and combinations of any two or all of these treatments. Centrifuging is considered most effective and desirable, particularly when dealing with finely divided or colloidal suspensions such as those obtained in tarry condensates.

By-product recovery plant-equipment, for instance, usually includes one or more collecting mains connected to the oven coking chambers by means of standpipes; coolers, extractors, exhausters, and collecting tanks, etc. The coolers, extractors, exhausters, etc., are connected in series to the collecting mains. Condensates from the various units in the recovery chain are run into decanters and collecting tanks. These condensates, which are of tarry nature, contain appreciable amounts of a mixture of solid suspensions including carbonaceous particles, and mineral or cinder particles called coke breeze or grit. The carbon particles are soft and substantially non-abrasive, whereas the breeze or grit, which is harder than steel, is highly abrasive. The separation of the suspension mixture from tar in centrifuges, therefore, is impractical since the rotor of a centrifuge becomes scored, thereby ultimately rendering the centrifuge useless.

In the present invention the aforementioned grid or coke breeze is effectively removed initially from the vapors or gases generated during distillation and gasification of coal in coke oven, horizontal retort, vertical retort, water gas plants and blast furnace plants. Thereafter, during condensation of tarry constituents from the generated gases and vapors, condensates are collected which contain nonabrasive carbon particles in suspension and are substantially free from the grit. Such condensates are efficiently treated in a super-centrifuge without destructive effects, to obtain, as separate commodities, finely divided carbon, and tar which is relatively free or substantially completely free from suspended solids.

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For removing the grit particles in this procedure, an improved system of traps is installed at, or as close as practicable to, the gas outlet of a coking or gasification chamber.

The invention has for its objects the accomplishment of numerous purposes, as will be seen from the description that follows. One object is to provide improvements in means for and in the operation of coal distillation and coal gasification plants whereby improved by-products are obtained. A further object is to provide combined means and combined process steps whereby separation of suspended solids from coal gases and vapors is conveniently and efficiently effected and whereby separate recovery of abrasive grit, free carbon, and tar products, is made possible during distillation or gasification of coal.

By way of illustration and exemplification, the invention is described hereinbelow with reference to by-product recovery in the coking of coal. Apparatus therefor is shown in the accompanying drawing, in which—

Fig. 1 is an elevational view, partly in section, of apparatus including a by-product recovery chain in which grit and carbon are separately removed from overhead products;

Fig. 2 is a section on line 2—2 of Fig. 1 in the direction of the arrows;

Fig. 3 is an enlarged sectional view of a fragment of the grid remover means shown in Fig. 1, taken on line 3—3 of Fig. 4 in the direction of the arrows;

Fig. 4 is a section on line 4—4 of Fig. 3 in the direction of the arrows; and

Fig. 5 is a fragmentary section showing a modification of means illustrated in Fig. 4.

The method of the present invention will be understood from the description of the apparatus and its operation. Similar reference characters designate similar parts of the apparatus.

In Fig. 1, a coke oven 1 of a coke oven battery is shown provided with a standpipe 2 through which hot gases and vapors ordinarily pass to the collecting and condensing system of a by-product recovery plant during a coal-coking operation. The gases and vapors including suspended grit and carbon particles and prior to cooling the

same to condense the tar are directed by the standpipe 2 into a grit removing chamber 3 (to be described in detail below) from which gases and vapors and suspended unremoved carbon particles are conducted into a collecting main 4 of a type usually employed in coke oven plants for collection from a plurality of coking chambers in a battery. Aqueous flushing liquor, supplied through pipes 5 in a circulatory system of the usual type (not shown), is sprayed into the collecting main 4 and condensates formed therein are flushed out into a decanter 6. Uncondensed vapors and gases from the main 4 are passed through pipe 7 into a cooler 8 to further reduce the temperature thereof, and then are drawn through a tar extractor 9 by an exhauster 10.

The grit and other materials, removed initially from the gases and vapors in the chamber 3 in the present process, are collected in a main 11 from which they pass into a tank 12 for separate and subsequent treatment. Tar, containing non-abrasive carbon, passes through pipe 13 from the decanter 6, cooler 8, and extractor 9 into a tar separating tank 14 and thence into a tar collecting tank 15.

The tar in tank 15 is in highly improved condition and is utilizable for various purposes particularly where a grit-free tar is desirable. For separate removal of the carbon suspension in this tar, and in order to improve the tar further, a supercentrifuge 16 can be employed to provide a tar that is substantially free from solid suspended matter. In the use of centrifugal apparatus for this purpose, the tar being free from grit, wear and tear due to abrasion is practically eliminated, thus adding considerably to the life of such apparatus.

With reference to the grit-removing means, and its detailed construction included in Fig. 1 and in Figs. 2 to 5, this comprises an enclosure 20 with traps preferably of the type shown, which are highly effective in the present process. The enclosure 20 is preferably circular in cross section, as shown in Fig. 2, though it may be of any shape depending upon the arrangement of traps employed. The grit-laden gases enter the chamber 3 at one side through an inlet pipe or passage 21, and the grit-free gases are emitted through an outlet pipe or passage 22 diametrically opposite the pipe or passage 21. The pipe 21 is connected to the standpipe 2 and directs the gases preferably downwardly into the chamber 3. The pipe 22 conducts the gases upwardly from the side of the enclosure 20 and to the collecting main 4.

The above-mentioned traps consist of a plurality of solid channel-like elements 23 which depend preferably vertically from an upper wall 24 (Fig. 3) or 24' (Fig. 5) of the chamber 3, across the path of the gases. The elements are arranged in a plurality of spaced rows, and the concave face of each element is directed toward the oncoming gases. The rows are perpendicular to the general direction of flow of the gases, and the elements in each row are staggered with respect to the elements in a next adjacent row. The outer side of each element at the outer ends of one or more of these rows should preferably be in contact with the side wall of the enclosure 20. Groupings of these channel-like elements 23, other than that shown may be employed, and the number of rows in a group may be increased or decreased to obtain the desired effect. The proportions of the channel-like elements are greatly exaggerated in the drawing for illustrative purpose. Actually they are considerably smaller in cross-section in relation to the chamber in which they are located. Instead of in a chamber such as 3, the channel-like elements may be positioned in the standpipe 2 across the path of the gas and may be installed in either vertical or inclined position.

As shown in Figs. 3 and 5, means are provided for maintaining a flowing film of water on each of the channel-like elements 23. In Figs. 3 and 4, these elements are shown with their upper ends projecting through the upper wall 24 which is spaced from the top of the enclosure 20 to form a compartment 26 to which water is fed through a pipe 27 controlled by a valve 28. The end of the portion of the wall 24 projecting into each channel 23 is struck out as at 29 so as to provide a narrow space through which the water flows and forms a continuous film or stream that flows downwardly over the concave face of each channel element.

In the arrangement shown in Fig. 5, which is preferable, the channel elements 23 depend from a solid wall 24', and they are continuously sprayed with an aqueoas medium such as water or flushing liquor as by means of spray nozzles 30 fed from a manifold 31. A valve (as at 28) in pipe 31 is provided to control the flow of liquid to the sprays.

The liquid in the bottom of the chamber 3 containing the suspension of grit is conducted therefrom into the main 11 which extends along the battery above the oven doors. One chamber 3 may be connected to each oven or to two or more adjacent ovens in a battery. The liquid outlet pipe 32 for the main 11, as in the case of the liquid outlet pipe 33 for the main 4, may be at one end of a battery so as not to interfere with coke pushing operations. A grit removing chamber may be provided for each oven in a battery, or groups of two or more ovens may be connected to one such chamber. If desired, the level of the liquid collection in the chamber 3 may be maintained above the lower ends of the channel elements 23 when spaced from the bottom of the chamber. A trap 35 or other suitable means may be used for this purpose.

When bituminous coal is distilled or coked in a by-product coke oven and the temperature at the grit-removing chamber is above 1000° F. under a vacuum of one-half to two inches, coke breeze, and some heavy tar are collected with the water or flushing liquor in the tank 12. The water separates by settling and may be recirculated and treated in accordance with common practice. Tar mixed with coke breeze and some free carbon may be treated in a tank 36 to remove, if desired, all water emulsified therewith by blowing air under pressure into the mixture through a perforated pipe 37. The tar may also be removed, by distillation. Various valuable uses are found for the coke breeze, for the tar and coke breeze mixture, and for the emulsified mixture. For instance in road surfacings, the presence of coke breeze acts as an excellent skid resistant.

By introduction of air or other gas in a coking or coal distillation chamber, the proportion of coke breeze produced can be increased.

After the removal of coke breeze and while the hot gases and vapors pass into and through the collecting main 4, increased quantities of free carbon are formed. The tar collected in the tank 15 can be used as such for various purposes or the free carbon is removed by means of the supercentrifuge 16. For instance, the tar from tank 15 can be centrifuged while in heated or

diluted condition to remove substantially all free carbon or to reduce its proportion to at least below 0.5%.

When conducting tar with free carbon to the supercentrifuge 16 through a pipe 40, provided with a valve 41, a suitable diluent can be introduced with the tar through a pipe 42 provided with a valve 43. Carbon particles and water removed from the tar are emitted through a pipe 44, and tar free from suspended matter is emitted through pipe 45. Naphthalene can also be removed by cooling the tar freed of suspended matter and centrifuging the cooled tar.

The tar freed from suspended particles is a highly improved tar from the standpoint of its increased ductility and waterproofing characteristics. For many purposes, tar free from suspended particles meets a demand which results in increased sales, as in coatings and molded products, and impregnated fibrous articles of various kinds. In wood preserving, this tar can be used directly. It is a new product known as "Cretar."

In the tar plant during distillation, owing to absence of coke breeze, higher distillation temperatures are reached with less danger of coking in a still. Less wear and tear and other undesirable effects on stills, pumps and other equipment, also result from absence of the abrasive grit.

The separated free carbon can be washed and dried, and sold as such, as carbon flour for use as pigment and filter material. It can also be mixed with the centrifuged tar in controlled proportions to meet various specifications.

It is readily seen from the aforegoing description that numerous advantages are realizable by the practice of the present invention. The art of bituminous paintings and coatings, road materials, roofings, waterproofings, pitches and creosotings will be improved by these methods. Many different embodiments of this invention may be made without departing from the spirit and scope thereof, or from the appended claims.

I claim:

1. The method of fractionally separating the products discharged from coking ovens while the distillation of coal takes place therein; said method comprising the forming of said products as they are being discharged into a stream, stripping coke breeze from the stream by directing the latter downwardly toward the lower portions of a plurality of parallel downwardly extending paths of flow arranged in rows and supplying aqueous liquid to said paths from a source of supply arranged above said paths and in heat exchange with the interior of the zone in which the stripping takes place, collecting the breeze in a pool of liquid resulting from the downflow of the aqueous liquid through said paths and removing the collected breeze from said zone, and

meanwhile forming the products remaining from the first mentioned stream into a second stream, conducting said second stream from said zone, condensing the vapors from said second stream and separating free carbon from the vapors condensed from said second stream.

2. The combination, with apparatus for the destructive distillation of coal, of standpipe structure connected to said apparatus for conducting therefrom products discharged from the apparatus during such distillation; structure for stripping, from such products, coke breeze, said structure including an enclosure having an inlet connected to said standpipe structure and arranged to conduct said products in a downwardly directed stream into said enclosure, an upwardly directed outlet pipe leading from said enclosure, a partition having perforations therein and arranged adjacent to the top of said enclosure to divide the interior thereof into a liquid receiving space and a space for the stripping of coke breeze to be effected therein, and a plurality of channel-like elements extending in a succession of rows through said partition from the first mentioned space to a level adjacent to the bottom of said enclosure, the channel-like members of each row interposed between two other rows being staggered with respect to the channel like members of such two other rows and each channel-like member being arranged to receive liquid passing through said perforated partition; a collector device connected to the outlet of said stripping structure; means for progressively removing from said stripping structure coke breeze removed from the stream supplied thereto; means for supplying to said collector device flushing fluid to condense vapors discharged from said stripping device; a decanter; means for conducting the condensate formed in said collector to said decanter; and means for conducting the uncondensed residual products from said collector.

3. A structure of the type recited in claim 2, which includes a device for cooling said uncondensed residual products and means for exhausting such products from the last mentioned device.

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