March 28, 1939. R. D. HARDY ET AL 2,151,849

DISTILLATION OF SOLID CARBONACEOUS MATERIALS AND APPARATUS THEREFOR

Filed April 6, 1936 4 Sheets-Sheet 1

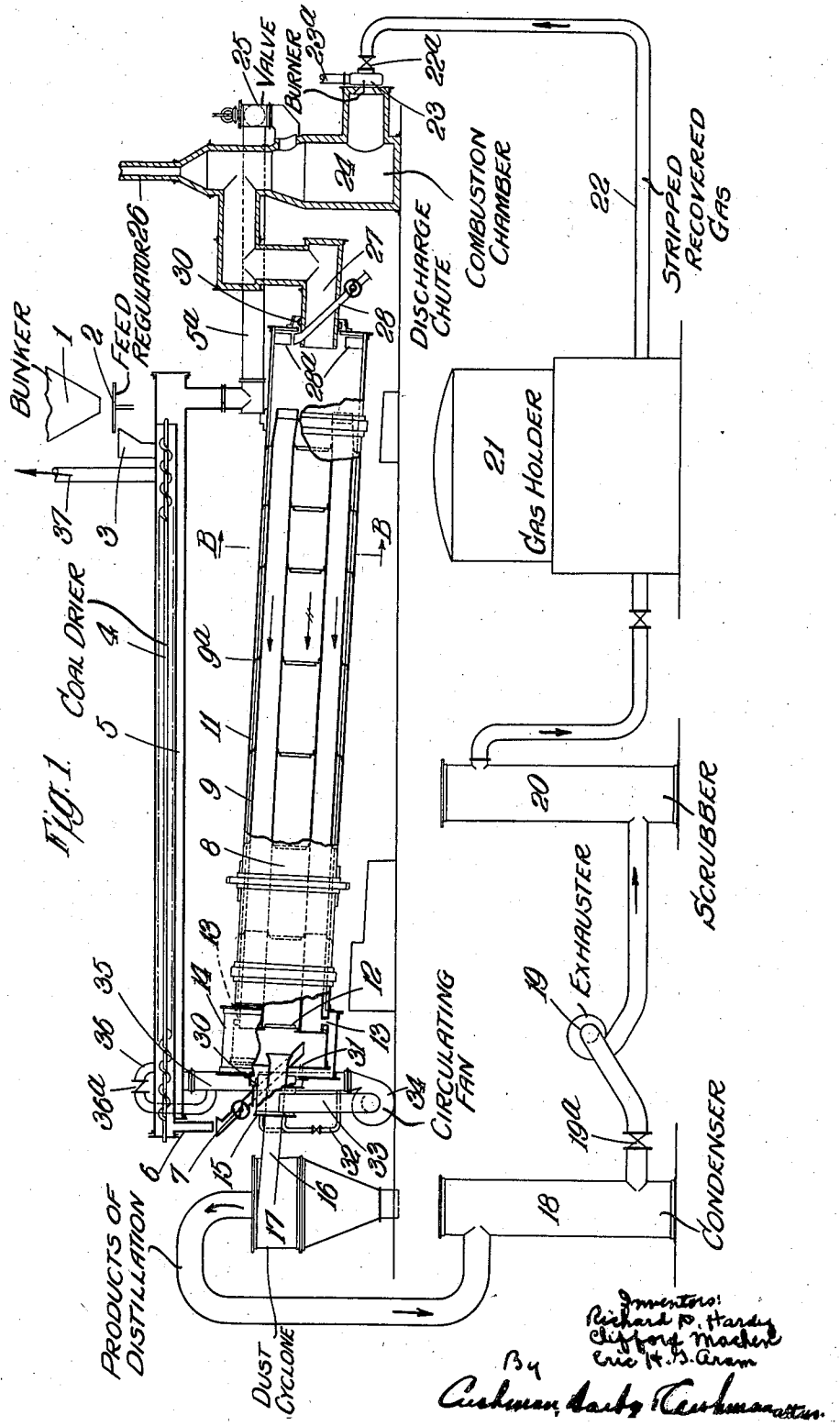

FIG. 1.

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Fig. 2.

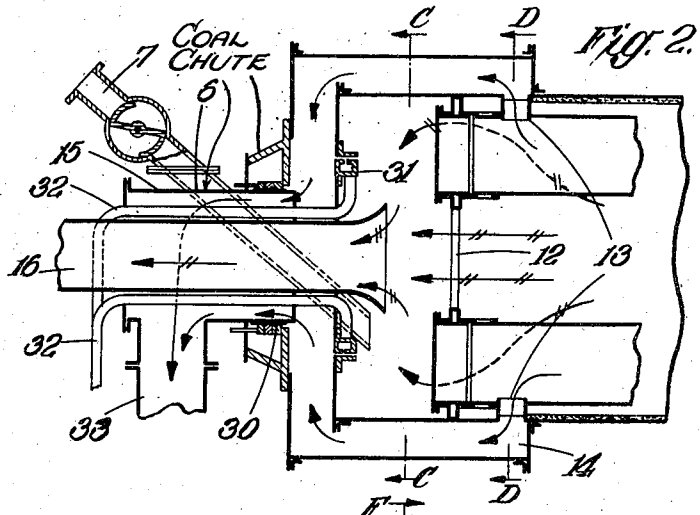

Fig. 3.

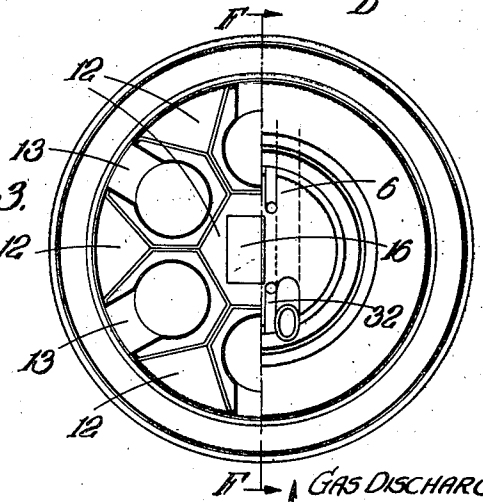

Fig. 6.

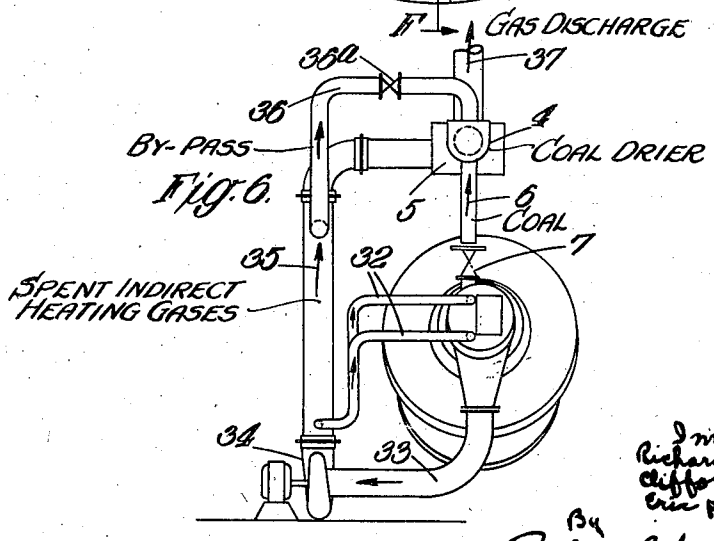

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Fig. 4.

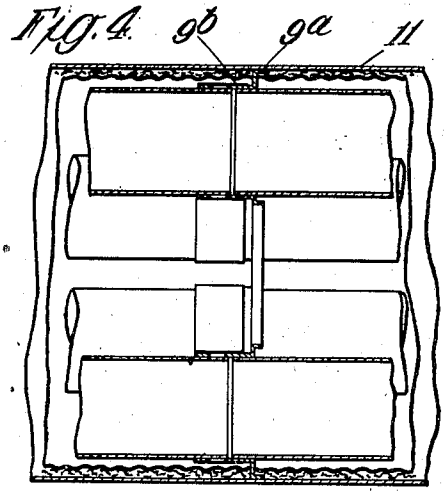

Fig. 5.

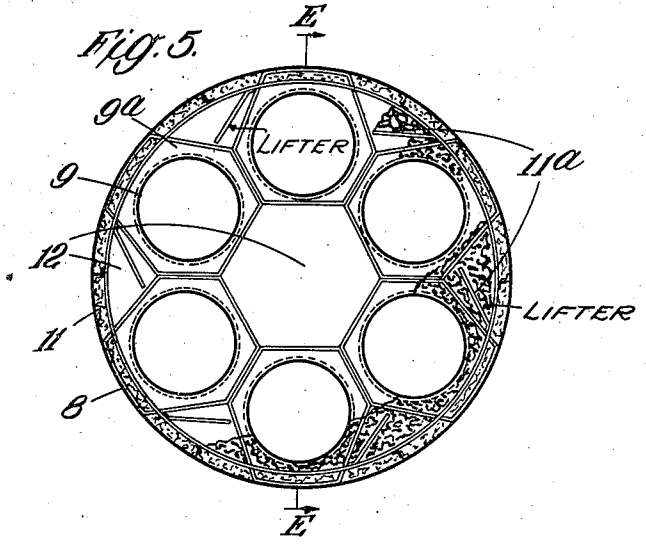

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Fig. 7.

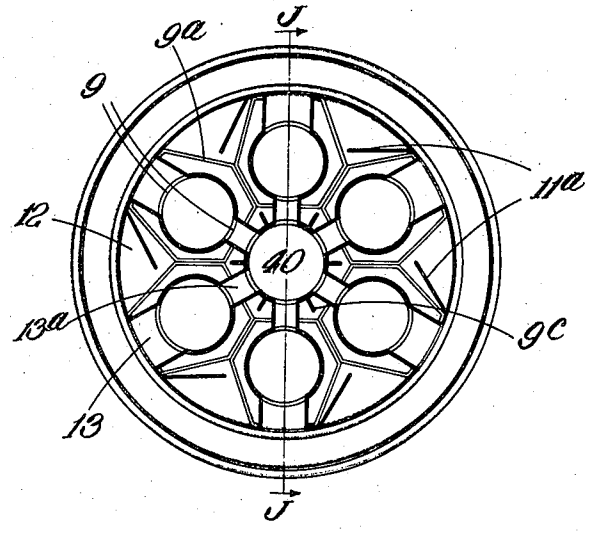
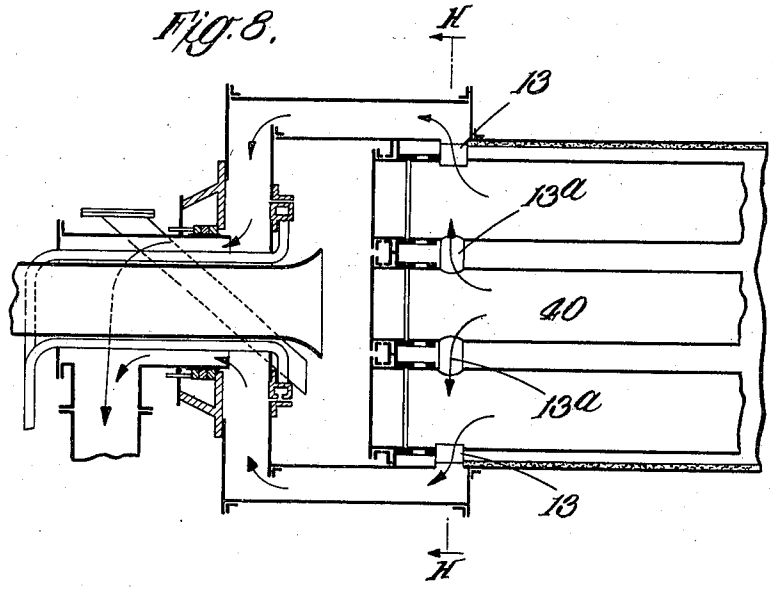


Fig. 8.



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UNITED STATES PATENT OFFICE

2,151,849

DISTILLATION OF SOLID CARBONACEOUS MATERIALS AND APPARATUS THEREFOR

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Application April 6, 1936, Serial No. 73,040
In Great Britain March 20, 1936

2 Claims. (Cl. 202—131)

This invention relates to the distillation or heat treatment of solid materials, especially carbonaceous materials, such as coal, lignite, brown coal, peat, wood, shale and the like, in rotary retorts of the kind which comprise an outer shell containing a plurality of tubes or tubular compartments, through which retort the material undergoing heat treatment is caused to pass in contraflow to heating gases.

According to the present invention, the solid carbonaceous or other material which is to be distilled or subjected to heat treatment, is passed externally of tubes or tubular compartments in direct contact with a controlled volume of heating gas which is sufficient to carry off in suspension to the condensers, scrubbers, oil washers, etc., the oil or other vapours evolved from the solid material; the balance of the heat necessary to effect distillation or heat treatment and to maintain the desired temperature gradient, being applied internally of the tubes or tubular compartments and therefore not in direct contact with the material travelling outside the said tubes. In other words, contact gases and solid carbonaceous material are passed externally of the tubes or tubular compartments and, through the intermediary of the hot gases which pass through the interior of the tubes or tubuluar compartments, the requisite additional volume of heat to obtain effective distillation is applied indirectly to the solid carbonaceous materials by the heating gases which pass through the interior of the said tubes or tubular compartments.

The carbonaceous material undergoing heat treatment may be fed or caused to pass due to the rotation and inclination of the retort; gas circulating passages being provided between and/or around the said tubes or tubular compartments, together with a chamber at the gas inlet end of the retort which is rotatable with and forms part of said retort, and with which chamber, said tubes or tubular compartments and said gas circulating passages are in communication, means being also provided for admitting heating gas to said chamber, together with means for causing said gas to pass under control from said gas chamber through the interior of said tubes or tubular compartments and also through the passages provided between and/or around the said tubes or tubular compartments.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be described more fully with reference to the accompanying drawings, in which,

Figure 1 is an inclined diagrammatic layout partly in section of a rotary retort and associated recovery plant, embodying one method of carrying the present invention into practice.

Figure 2 is a longitudinal section through the retort at the gas outlet and coal inlet end of Figure 1.

Figure 3 illustrates on the left hand side of said figure, a half section in the direction of the arrow D—D of Figure 2, while the right hand side of Figure 3 is a half section taken in the direction of the arrow C—C of Figure 2.

Figure 4 is an enlarged section on the line E—E of Figure 5,

Figure 5 is an enlarged section on the line B—B of Figure 1, and

Figure 6 is an end view showing certain details in connection with the method of controlling the heating and circulating gas.

Figure 7 is a section on the line H—H of Figure 8 showing a modified form of retort, and,

Figure 8 is a section of the charging end of the retort taken on the line J—J of Figure 7 showing the gas outlet and coal inlet end of the retort.

The raw material (hereinafter called coal) is stored in a bunker 1. A feed table, or other suitable feed regulating device 2, controls the flow of coal and discharges the same into the feed hopper 3. 4 is a coal dryer consisting of an enclosed conveyor, provided with a suitable gastight jacket 5, which is so proportioned that it forms a flue or duct for the passage of the return portion of the externally circulating gas to the combustion chamber 24; a gas main 5a connecting the end of the jacket 5 to the said combustion chamber. A coal chute 6 and coal feed valve 7 convey the dried and preheated coal from the discharge end of the dryer to the retort inlet.

The cylindrical shell 8 of the retort contains a number of longitudinally disposed tubes 9 which are supported from the shell by segmental tube plates 9a. The tubes 9 may be arranged either in circular manner around the retort axis as in Figure 5, or if desired, a central tube 40, as shown in Figures 7 and 8, may be used. It will be seen that the addition of a central tube or a plurality of tubes increases the indirect heating surface over which the coal passes due to the rotation of the retort, and by interrupting the fall of the coal as it pours from the lifters 11a avoids unnecessary breaking down of the material and formation of dust clouds in the retort. As shown in Figures 7 and 8 the central tube 40 (or tubes when provided) are connected to the outer ring of tubes by ports 13a whereby the gas passes out through ports 13 to the annular chamber 14,

whilst an even gas pressure in all tubes is maintained. If desired longitudinal vanes 9c may be attached to the centre tube or tubes to retain the coal in contact with the tube surface for a longer period. Expansion joints 9b (see Figure 4) are provided and so constructed as to allow the differences of expansion between the internal tubes 9 which attain the temperature which the carbonaceous material reaches during distillation, and the external retort shell 8 which is maintained at approximately atmosphere temperature by the insulation 11.

The insulating material is shown attached to the retort shell by means of light gauge steel sheets which may be corrugated to give strength and also to allow for longitudinal expansion.

Tube plates 9a are provided which are constructed in such a manner as to leave ports 12 around the tubes for the passage of the external circulating gases. Ports 13 are also provided in the retort shell 8 at the coal inlet end, for the passage of the indirect heating gas from the retort into an annular receiving chamber 14 attached to the end of the retort. From thence, the spent indirect heating gas is withdrawn through a stationary annular outlet pipe 15 and connecting mains 33 to an external gas circulating fan 34.

The direct heating or carrier gases and the products of distillation are withdrawn from the end of the retort chamber through the stationary pipe 16; the pipe 16 being supported within the annular pipe 15. The pipe 16 serves to support the gland 31 and convey the direct heating or carrier gas to the dust cyclone 17. Thence the gas passes through the condenser 18, exhauster 19, and scrubber 20 to a gas holder 21, the amount of carrier gas being controlled by a valve 19a. The gas main 22 conveys stripped gas to a burner 23, the amount of gas supplied to the burner being controlled by a valve 22a. Air for combustion enters the burner through a pipe 23a. Combustion is completed in the combustion chamber 24, the volume of air and gas being regulated so that no excess oxygen is present in the resulting products. To dilute or attemperate the resulting combustion products, so that a correct working temperature and volume can be maintained, the spent indirect heating gases may be cooled in a gas jacketted conveyor 5, and introduced to the combustion chamber through a valve 25.

These admixed heating gases of controlled temperature and volume pass from the combustion chamber and enter the retort through a stationary and common gas inlet pipe 27. The proportion of indirect heating gas required is drawn from the common chamber fed by the common gas inlet pipe 27 and passed through the tubes also in counterflow to, but not in contact with, the coal, giving up its heat to the tubes which in turn heat the coal. Ports 13 are provided at the coal inlet end, for the passage of the indirect heating gas from the tubes into an annular receiving chamber 14 attached to the end of the retort. From thence the indirect heating gas is withdrawn through a stationary annular outlet pipe 15 and connecting mains 33 to a circulating gas fan 34.

To prevent leakage and loss of direct heating or carrier gas from the retort into the indirect heating gas system, gas sealed glands 30 and 31 are arranged at the connections between the rotary retort and the stationary annular pipe 15, 16. Gas connections 32, connect the gland 31 to the pressure side of a fan 34. The volume of gas admitted to the gland 31 is so controlled as to be slightly in excess of the quantity which can pass from the end of the retort chamber into the annular chamber 14 so that the distillation products and direct heating gas are slightly diluted with indirect heating gas and leakage of rich gas into the indirect heating gas system is avoided.

In the compartment at the hot gas inlet end of the retort, the gases immediately divide between the direct and indirect heating systems in accordance with the relative suctions applied thereto. The gas passing in direct contact with the coal is drawn through by exhauster 19 and its volume controlled by a valve 19a, whilst the gas passing through the indirect heating system is drawn through by the fan 34 and its volume is controlled by the valves 25 and 36a, the latter controlling the amount of waste gas passing out of the system.

35 is a pipe which establishes communication between the retort and the gastight jacket 5 of the coal dryer 4, and through which pipe a portion of the exhaust gases used for the indirect heating of the retort is passed so as to heat the same externally, said gases, as aforesaid, being returned to the combustion chamber through the gas main 5a. 36 is a bye-pass pipe, and 36a, as aforesaid, is a central valve thereon. The function of the pipe 36 and control valve 36a is to bye-pass from the pipe 35 to the internal or coal compartment 4 of the dryer that portion of spent indirect heating gas from the retort which, after giving up its heat directly to the incoming charge, is passed to atmosphere by the pipe 37.

To effect the discharge of the solid carbonised residue from the retort, lifters 28a are provided which are secured to the rotary retort shell and which become filled with residue due to their rotation beneath the material which is elevated and discharged through a chute 28 and valve 29 secured to the stationary gas inlet pipe 27.

We claim:

1. Apparatus for heat treatment of solid carbonaceous materials, comprising a rotary inclined retort, a plurality of tubes longitudinally disposed within the retort, said tubes terminating short of each end of the retort whereby a material charging chamber and a combined gas charging and material discharging chamber are formed at the upper and lower ends respectively of the retort, an annular gas discharging chamber concentrically surrounding the material charging chamber, said material charging chamber constituting a discharge chamber for the products of distillation and provided with a tube extending axially therefrom whereby the distillate leaves the retort, said tubes being spaced substantially from the wall of the retort and from each other to provide a number of longitudinal passages whereby the solid material may pass from said material charging chamber downwardly and around said tubes to said combined gas charging and material discharging chamber, the lower ends of said tubes being unobstructed and open to said combined gas charging and material discharging chamber, the upper ends of said tubes terminating in the material charging chamber but being closed from said chamber, passages extending from apertures adjacent the upper closed ends of said tube to said gas discharging chamber, and material lifters projecting inwardly from the wall of the retort into the passages between the tubes whereby the material

passing therethrough is lifted and spilled over the tubes.

2. Apparatus for heat treatment of solid carbonaceous materials, comprising a rotary inclined retort, a plurality of tubes longitudinally disposed within the retort, said tubes terminating short of each end of the retort whereby a material charging chamber and a combined gas charging and material discharging chamber are formed at the upper and lower ends respectively of the retort, an annular gas discharging chamber concentrically surrounding the material charging chamber, said material charging chamber constituting a discharge chamber for the products of distillation and provided with a tube extending axially therefrom whereby the distillate leaves the retort, said surrounding tubes being spaced substantially from the wall of the retort and from each other to provide a number of longitudinal passages whereby the solid material may pass from said material charging chamber downwardly and around said tubes to said combined gas charging and material discharging chamber, the lower ends of said tubes being unobstructed and open to said combined gas charging and material discharging chamber, the upper ends of said tubes terminating in the material charging chamber but being closed from said chamber by transverse plates, radially disposed passages extending between apertures in the inner portion of the peripheral walls of each of said surrounding tubes and corresponding apertures in the wall of said central tube adjacent the upper closed ends of the tubes, said surrounding tubes having passages extending from apertures in the outer peripheries thereof to said gas discharging chamber, and material lifters projecting inwardly from the wall of the retort into the passages between the tubes whereby the material passing therethrough is lifted and spilled over the tubes.

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