Dec. 22, 1936. R. J. SERPAS 2,064,953

COMBINATION INCINERATOR AND EVAPORATOR

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Fig. 1.

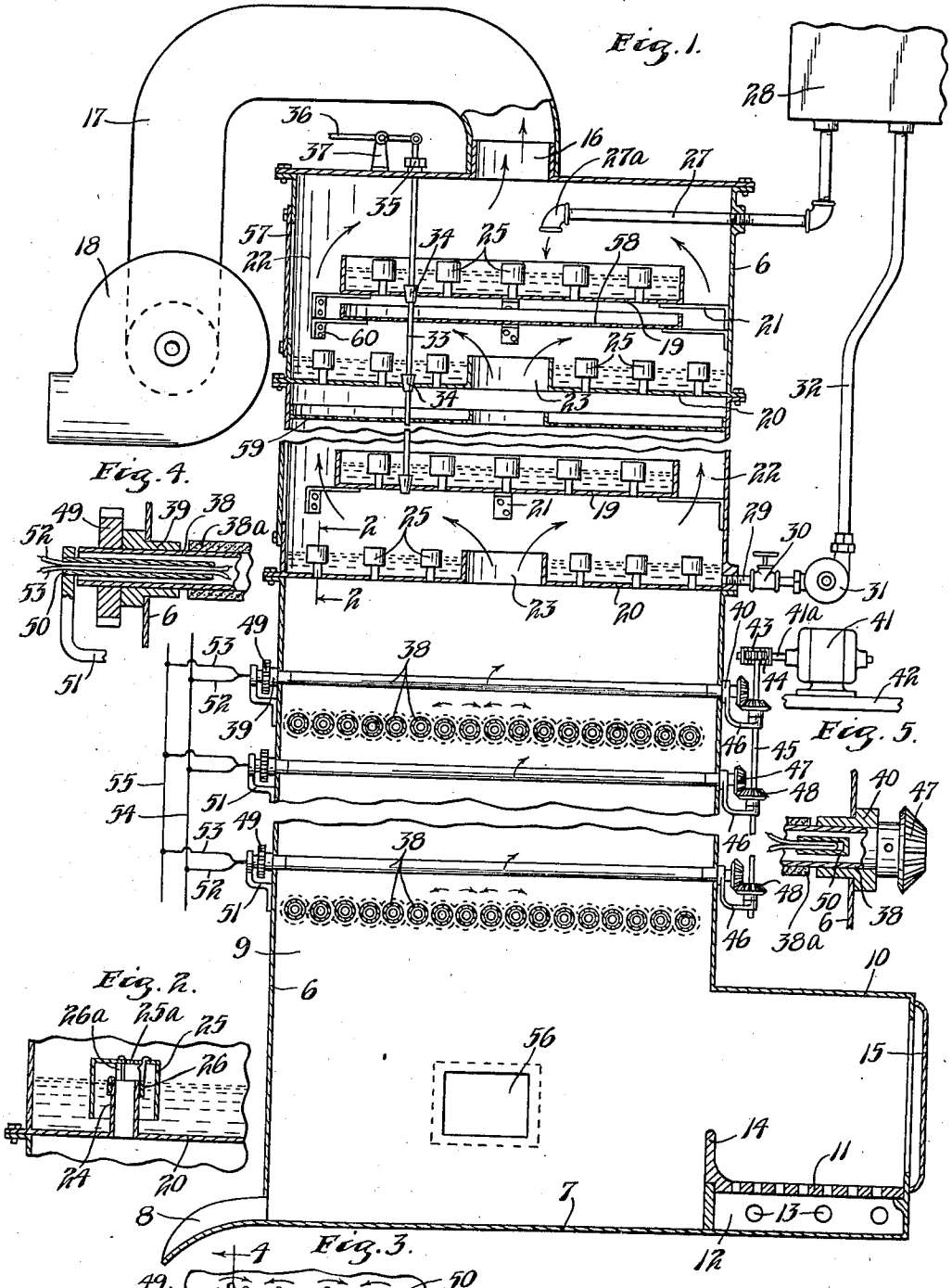
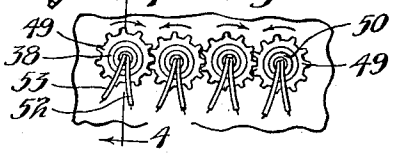


Fig. 4.

Fig. 5.

Fig. 2.

Fig. 3.



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COMBINATION INCINERATOR AND EVAPORATOR

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5 Claims. (Cl. 110—7)

This invention relates to incinerating and evaporating apparatus.

It is the general object of this invention to provide a novel and improved combination incinerator and evaporator, which, although capable of other uses, is particularly adapted for use in dehydrating the liquors from the digesters of pulp mills, burning the combustible constituents of the resulting dehydrated product while smelting any of the smeltable constituents of the said product and recovering valuable chemicals from the liquors in the smelt obtained.

More specifically, it is the object of the invention to provide a novel and improved apparatus into which liquors such as the liquors blown from the digesters of pulp mills and containing in solution both combustible and smeltable solids, can be introduced and wherein the liquors will be first concentrated, then passed to highly heated grilles and the solid constituents of the liquors there dried and thereafter the solid constituents will be subjected to a smelting action, the combustible constituents acting to supply at least part of the fuel for the smelting operations and the products of combustion acting to do the original concentrating of the liquors.

It is another object to improve my "Evaporating Apparatus" disclosed in United States Letters Patent No. 1,996,526, issued to me on April 2, 1935.

The objects and advantages of the invention will more fully appear from the following description, made in connection with the accompanying drawing, wherein like reference characters refer to the same or similar parts throughout the various views, and, in which,

Fig. 1 is a view taken chiefly in vertical section illustrating in a more or less diagrammatic way apparatus of the invention;

Fig. 2 is a vertical section in enlarged scale on the line 2—2 of Fig. 1, as indicated by the arrows;

Fig. 3 is a detail looking toward the left ends of certain of the grille rods, as shown in Fig. 1;

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 3, as indicated by the arrows; and

Fig. 5 is a view taken chiefly in vertical section through one of the grille rods and the mounting therefor, the right end of one of these rods as shown in Fig. 1, being illustrated.

The apparatus includes a large casing or container 6 of considerable height, which container is shown as being of square-shape in horizontal cross section from its bottom to a point somewhat below its mid-height and as being of circular horizontal cross section above this point. The bottom of the container 6 forms a smelter bed 7 from which a spout 8 leads. Above the smelter bed 7 is located a combustion chamber 9. A lateral extension 10 joins the combustion chamber 9 and this extension forms a furnace having grate 11, ash pit 12 provided with air draft openings 13, fire wall 14 and charging door 15 closing an opening above grate 11. A flanged outlet port 16 is provided in the top of the container and connected to this port is a conduit 17 connected with the intake port of a blower 18, the outlet port of which is shown as discharging to atmosphere.

In the upper part of the container 6 there are mounted a plurality of horizontal liquor holding trays 19 and 20 respectively. These trays 19 and 20 are disposed in spaced superimposed relation, the trays 20 being alternated relative to the trays 19 from the upper part of the container downwardly. The trays 19 are secured to the container 6 by means of brackets 21 and the peripheral edges of the trays 19 are flanged upwardly and spaced from the walls of container 6 to form passages 22 between the walls of the container and the peripheral edges of the trays 19. The trays 20 have their peripheral edges attached to the side walls of the container 6 and they are shown as being provided with central openings forming passages 23. The edges of the trays 20 adjacent the openings 23 are provided with upstanding flanges of the same height as the peripheral flanges of the trays 19.

Mounted in openings in the bottoms of the various trays 19 and 20 are a multiplicity of short open ended tubes 24, best shown in Fig. 2. These tubes extend upwardly from the bottoms of the trays to points spaced approximately level with or slightly below the upper edges of the flanges of the trays to which the tubes are secured. Caps 25 of inverted cup-shape extend over the upper ends of the tubes 24 and these caps are of considerably greater diameter than the tubes 24 and they may be conveniently attached to the tubes by means of apertured collars 26 attached to the tops of the caps, projecting downwardly therefrom and having lower portions embracing the upper portions of the tubes 24. The collars 26 are each provided with one or more inturned lugs 25a which overlie the upper edge of the tube 24 to which the particular collar is attached. The top of each cap 25 is spaced above the level of the upper end of its tube 24 and a small aperture 25a is

formed in the top of the cap immediately above the tube.

A liquor supply pipe 27 is mounted in the upper portion of container 6 and it has a discharge mouth 27a located above the uppermost tray 19 to discharge thereto. The pipe 27 is connected to the bottom of a storage tank 28 which carries a considerable quantity of the liquor. A short pipe 29 controlled by a valve 30 is mounted in the wall of container 6 to communicate with the interior thereof immediately above the bottom level of the lowermost tray 20, and this pipe 29 is connected to a pump 31, the discharge outlet of which connects with a pipe 32 running into the bottom of storage tank 28.

It is desirable at times to drain the contents of trays 19 and 20 above lowermost tray 20 into the said lowermost tray, and for this purpose the trays 19 and 20 above lowermost tray 20 are provided with vertically aligned apertures through which a rod 33 extends. The walls of the trays about the said apertures form valve seats with which valves 34 mounted on rod 33 cooperate. The upper portion of rod 33 extends through a packing gland 35 in the top of the container 6 and the upper end of rod 33 is pivoted to a lever 36 swingably mounted on a bracket 37 attached to the top of the container 36. By operation of lever 36, rod 33 may be raised to simultaneously raise all valves 34, thereby permitting any liquor held within trays 19 and 20 above the lowermost tray to drain into lowermost tray 20.

At spaced levels below the lowermost tray 20, groups of rods 38 are mounted in the squared portion of container 6. At each level a multiplicity of rods are provided, these rods being disposed in spaced parallel relation and being journaled for rotation in bearings 39 and 40 mounted in the walls of container 6. The rods extend between and through opposite walls of the container. Rods in adjacent groups are set normal to each other, i. e. the rods in the group at the highest level in the container extend between one opposite pair of side walls of the container, the rods in the group at the next to the highest level extend between the other opposite pair of side walls of the container, the rods in the group at the third from the highest level in the container extend between the first opposite pair of side walls, etc. The rods 38 are preferably of tubular construction and they are protected from being burned out by covering layers 38a of fire clay or other analogous material relatively resistant to the action of fire and chemicals. The various rods 38 are adapted to be slowly rotated and for this purpose in the embodiment shown separate driving mechanism for all the rods extending parallel to each other is provided. This driving mechanism as shown includes an electric motor 41 mounted as on a bracket 42 near one side wall of container 6. The motor shaft 41a of motor 41 carries a worm 43 meshing with a worm gear 44 mounted at one end of a vertical shaft 45 journaled in arms 46 carried by a single vertical line of the bearings 40. The rods 38 mounted in bearings 40 carrying arms 46 are equipped with beveled gears 47 at their ends near these said bearings and these beveled gears mesh with beveled pinions 48 mounted on shaft 45. The ends of all the rods 38 adjacent the side of the container 6 opposite that side adjacent which the motor 41 is disposed carry gears 49, best shown in Figs. 3 and 4. Gears 49 on adjacent grille rods 38 at the same level intermesh. As a result, when a motor 41 is set in operation, this motor will cause all the rods extending parallel to each other and disposed between two opposite walls of the container 6 to be turned, and it will cause adjacent rods in groups of rods at the same horizontal levels to be turned in opposite directions. Similar mechanism is provided for driving the rods 38 extending normal to those rods driven from the first motor 41.

Electrical heating elements 50 supported by brackets 51 attached to certain of the side walls of container 6 project into the tubular spaces formed by these rods and these heating elements are connected by wires 52 and 53 as to a source of electrical supply, such as line wires 54 and 55. The container 6 may be a sectional container as illustrated. A door 56 is preferably provided for access to combustion chamber 9. Removable plates 57 bolted to the container over openings therein are also preferably provided for access to the trays 19 and 20.

Let us assume that it is desired to recover by smelting operations certain chemicals found in the black liquors discharged from the digesters of a pulp mill operating under the sulfate and soda process. The tank 28 will be filled with this black liquor as blown off from the digesters. The said liquor contains in solution a large quantity of combustible solids and a large quantity of smeltable chemicals. To initially set the apparatus in operation, a fire may be kindled in the furnace formed by the extension 10 and also preferably electricity will be supplied to the heating elements 50. The blower 18 will be set in operation and the motors 41 will be set in operation so as to slowly turn the various rods 38. Black liquor will now be discharged from tank 28 through liquor supply pipe 27 and this liquor will run from the mouth 27a of the supply pipe into the uppermost tray 19. This tray will gradually fill up until the level of liquor therein rises slightly above the upper ends of the tubes 24 in this tray, whereupon the liquor will overflow into these tubes and pass downwardly through the tubes to drop into the tray 20 below uppermost tray 19. The liquor in finely divided particles will thus drop from the uppermost tray to the next lower tray and from the higher to the lower trays until the liquor reaches the lowermost tray 20. During this time the products of combustion from the fire kindled in the furnace formed by extension 10 will be carried up and through and around the various rods 38 and additional heat will be imparted to these products of combustion from these rods, which are intensely heated by the heating elements 50. The products of combustion will be drawn outwardly by blower 18 through conduit 17 and port 16 from the top of the container and these products of combustion will be caused to take a tortuous path between and around the various trays 19 and 20 through the passages 22 and 23. The hot gases will, accordingly, be brought into intimate association with the particles of liquor dropping from tray to tray, thereby absorbing large quantities of moisture from this liquor through vaporization of this moisture. Also these hot products of combustion striking the various trays will heat up the trays so as to heat the liquor therein, further assisting in the evaporating process.

In first starting up the apparatus, it may be desirable to carry the liquor through the trays 19 and 20 several times before the liquor is

allowed to discharge from the lowermost tray 19 onto the rods 38. In this manner, the liquor may be more highly concentrated before it is discharged from the lowermost tray 20 to the rods 38. For this purpose the pump 31 is provided and by setting this pump in operation and opening valve 30, the liquor dropping down to the lowermost tray 20 can be forced back up into the tank 28 to preconcentrate the liquor in this tank.

After the liquor in the tank 38 has been concentrated to the desired degree, pump 31 will be placed out of operation and valve 30 will be closed and thereupon after the liquor builds up in the lower tray 20 to a level above the tops of the tubes 24 therein, this liquor will overflow into the tubes and pass on down through the same to drop onto the uppermost rods 38. These rods, of course, are intensely heated and they form, in reality a grille which serves to evaporate very large quantities of moisture out of the concentrated liquor. The liquor passes from upper to lower rods 38 and there are sufficient of these rods set at different levels in the apparatus to cause practically all of the moisture in the liquor to be volatilized, so that merely the solid components of the liquor are discharged into the combustion chamber 9 from the lowermost rods 38. In the combustion chamber 9 the combustible constituents of the solids are ignited, thereby producing an intense heat which smelts out the smeltable constituents of the solids. The smelt of course drops down to the smelting floor 7 and drains out of the container through the spout 8. After the apparatus has been in operation for a short time, it may be found unnecessary to either operate the heating elements 50 or to supply fuel to the furnace formed by the extension 10. The combustible constituents of the liquor introduced may be sufficient to supply the necessary heat to completely carry on the smelting and evaporating processes. However, if the combustible constituents of the liquors are insufficient alone, either the heating elements may be used or the furnace may be used or both may be used in conjunction with the heat developed by the combustible constituents.

As the products of combustion pass upwardly through the container 6, there is a tendency for these products of combustion to carry off with them the fly ash separated out by the burning of the combustible constituents only of the solids previously held in solution by the liquor. This fly ash contains to a very high degree smeltable chemicals that can be recovered. The fly ash is caught by the fine particles of liquor passing through the products of combustion as these products follow their tortuous path upwardly through the container. This fly ash then assists in concentrating the liquors.

As the rods 38 are continuously rotating, all surfaces of the rods are presented to the extremely hot products of combustion arising from the combustion chamber 9 and there is thus no tendency for portions of the surfaces of these rods to gum up, so as to obstruct the passage of the products of combustion upwardly through the grilles formed by the rods at different levels. Any solids that might tend to accumulate on the grille rods 38 will be burned off. As a matter of fact, a great deal of the combustion will take place through and about the grille rods.

While the apparatus is particularly adapted for use in recovering chemicals from the liquors discharged out of the digesters for pulp mills, the apparatus may be used for many other purposes where it is desired to recover the solid constituents from a liquid or semi-liquid material. Where no combustible constituents are found in the liquor being treated, the necessary heat will be supplied by the heating elements 50 and/or the furnace formed by extension 10.

By alternating the direction of extension of the various grille rods 38 at different levels, it becomes almost impossible for particles of the liquor to pass completely through the different superimposed groups of grille rods without striking a considerable number of the rods. The number of trays 19 and 20 and the groups of grille rods disposed at different levels may be increased or decreased to suit the requirements of the particular liquor being treated.

In order to more finely divide the liquor dropping downwardly from the tubes 24 from the various trays 19 and 20 and thereby subject the liquor in more finely divided form to the action of the heated products of combustion passing upwardly through the container 6 in a tortuous path through and about the various trays, it is sometimes desirable to utilize reticulate members 58 and 59 below the respective trays 19 and 20. The reticulate member 58 is a disk supported by brackets 60 from the walls of container 6 and located directly below certain of the trays 19. This disk has an upturned peripheral flange and the body of the disk is provided with a multiplicity of small apertures so that the disk acts as a screen or sieve for distribution and division of the liquor dropping downwardly from the tubes 24 in the trays 19. The reticulate member 59 is a disk extending below a tray 20 and secured at its peripheral edge to the side walls of the container 6 and this disk has a central aperture aligned with the passage 23 and the disk is flanged upwardly around the said aperture. The body of the disk is provided with a multiplicity of small apertures for distribution and division of the liquor dropping downwardly onto the disk from the tubes 24 in the trays 20. In the illustrated embodiment the reticulate members 58 and 59 are shown as being provided only beneath the uppermost trays 19 and 20 respectively. It may only be necessary or desirable to provide these reticulate members under the uppermost trays, although it is, of course, possible to provide them beneath all the various trays. The reticulate members 58 and 59 are respectively spaced below the respective trays 19 and 20 a short distance, so that the reticulate members are accessible for cleaning as by brushes moved into the container 6 through the opening closed by the plates 57 when these plates are removed.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departure from the scope of the present invention, which, generally stated, consists in the matter shown and described and set forth in the appended claims.

What is claimed is:—

1. In an incinerator and evaporator having a combustion chamber, means for discharging the concentrate of the liquid being evaporated in finely divided state above the combustion chamber and means for withdrawing the gases from above said discharging means, a multiplicity of grille rods below said first mentioned means and above said combustion chamber and onto which

said first mentioned means discharge and through and about which the gaseous products of combustion from the combustion chamber travel upwardly and means independent of the heat generated in said combustion chamber for heating said rods.

2. In an incinerator and evaporator having a combustion chamber, means for discharging the concentrate of the liquid being evaporated in finely divided state above the combustion chamber and means for withdrawing the gases from above said discharging means, a multiplicity of grille rods below said first mentioned means and above said combustion chamber and onto which said first mentioned means discharge and through and about which the gaseous products of combustion from the combustion chamber travel upwardly, means for rotating said grille rods, and means for heating the grille rods independently of the heat supplied thereto from said combustion chamber.

3. In an incinerator and evaporator having a combustion chamber, means for discharging the concentrate of the liquid being evaporated in finely divided state above the combustion chamber and means for withdrawing the gases from above said discharging means, a multiplicity of grille rods below said first mentioned means and above said combustion chamber and onto which said first mentioned means discharge and through and about which the gaseous products of combustion from the combustion chamber travel upwardly, said rods being arranged in groups, the individual rods of each group being laterally spaced from each other and the groups being disposed at different levels.

4. The structure defined in claim 3, the grille rods at adjacent levels being angularly set relative to each other.

5. The structure defined in claim 3, the grille rods in groups being horizontally disposed in parallel relation and adjacent groups being angularly set relative to each other.

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