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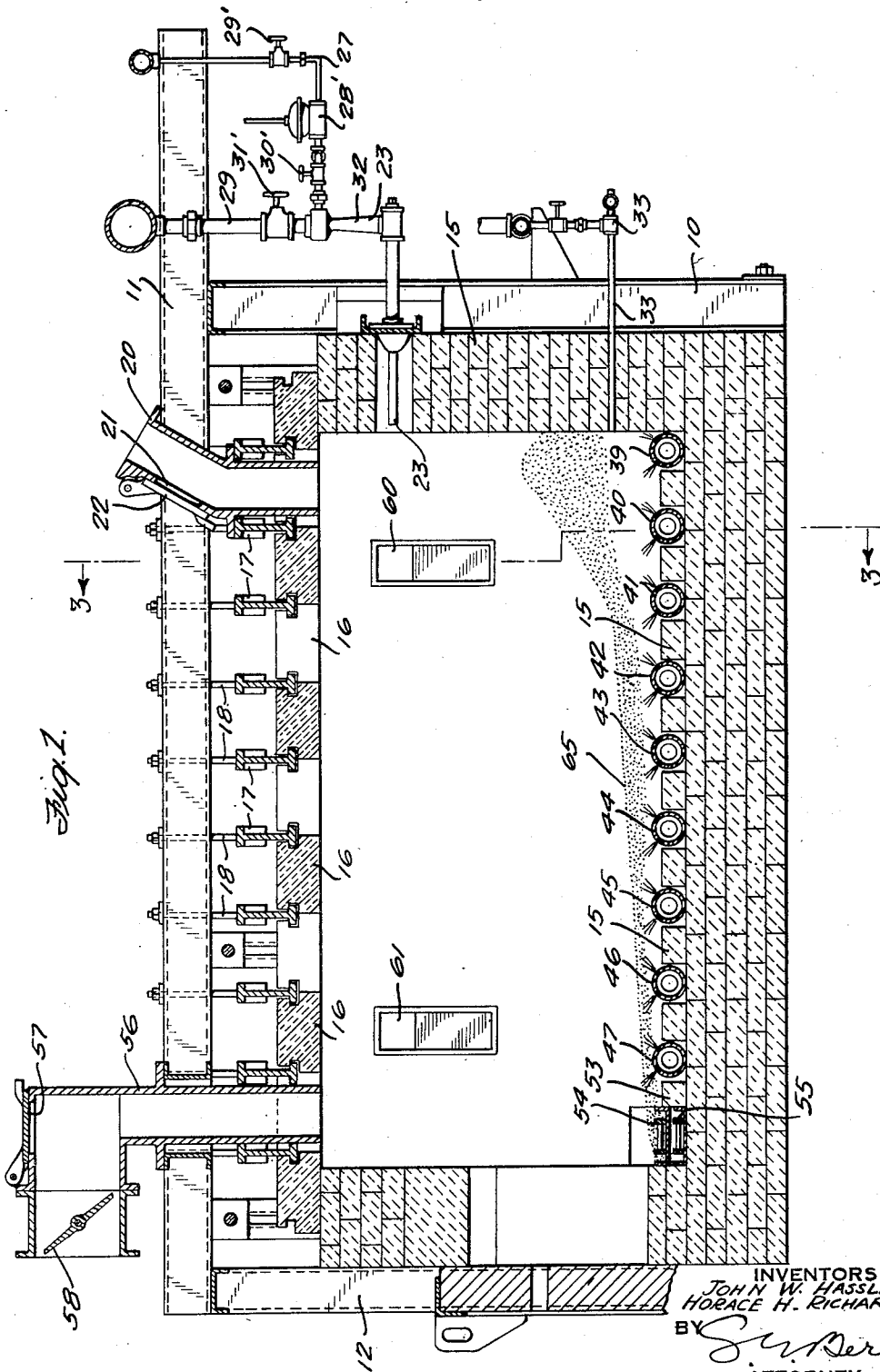
J. W. HASSLER ET AL

**2,296,438**

## METHOD OF ACTIVATING CARBON

Filed July 28, 1939

2 Sheets-Sheet 1



Sept. 22, 1942.

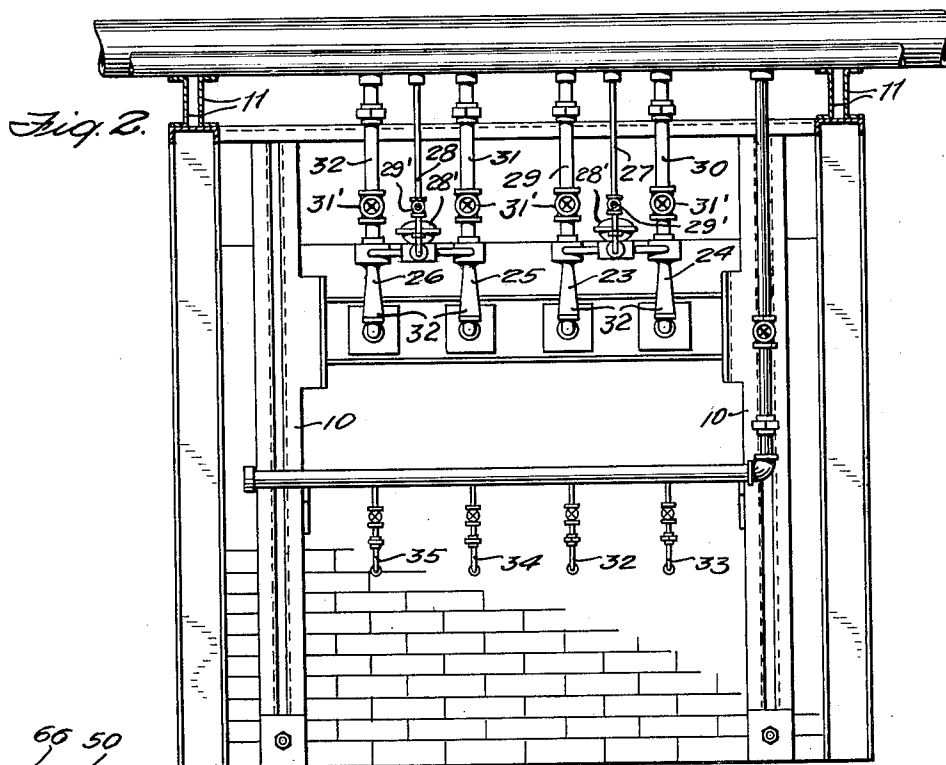
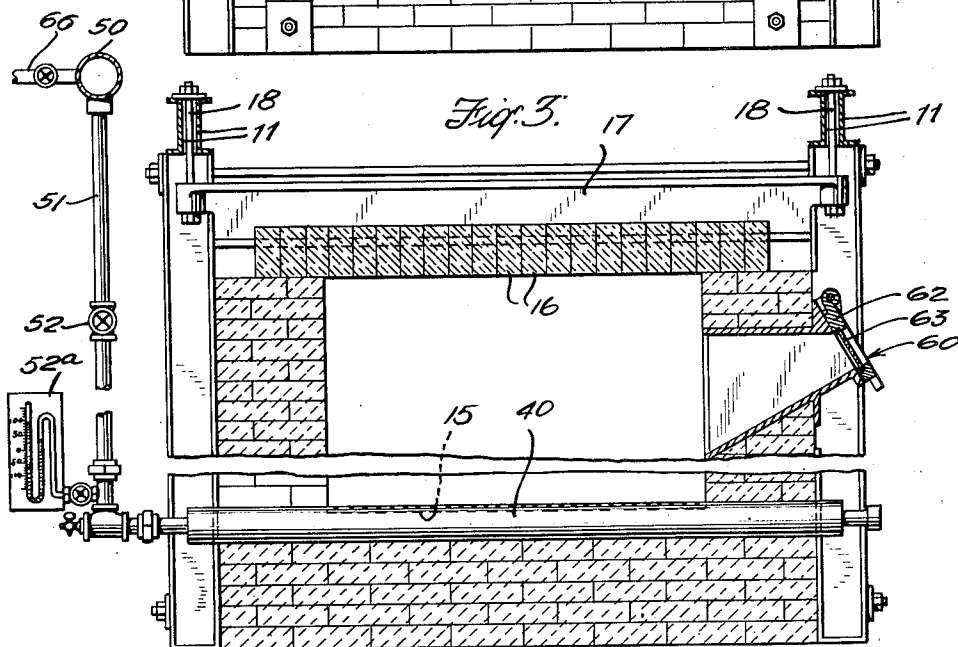
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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

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## METHOD OF ACTIVATING CARBON

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## 1 Claim. (Cl. 252—298)

Our present invention relates to an improved method of activating carbon. In general, processes for activating carbon are carried out by treatment at roasting temperatures with a chemical activating agent such as sulphuric, phosphoric acids, etc., or by oxidation with air or steam, or mixtures of air and steam. In the instance last mentioned, to which our invention particularly relates, the problem presented is to properly control the oxidation. As an aid to this in some furnaces external heating is provided, while in others the charge is heated by passing a current of electricity through the carbon particles to furnish in part at least the heat required. One drawback of such electric heating is that a considerable depth of charge is required to give the resistance of the charge the proper value, in which case when air is blown through the charge a rather high pressure is needed which results in the air at times having a too great velocity, with a consequent entrainment of the carbon particles by the air, necessitating special recovery and separating means in order to prevent undue loss of the material, and also resulting in wasteful oxidation thereof.

Our present invention seeks to avoid these mentioned drawbacks by providing a method in which the carbon to be activated is disposed in a layer of comparatively shallow depth, is blasted by a plurality of air streams (or stream and air) in such a manner that the particles are displaced, oxidized and propelled through the furnace without the use of mechanical propelling devices and without undue entrainment of the particles in the gaseous stream of oxidized products leaving the furnace. One advantage of such an arrangement is that a selective action is had whereby the heavier particles remain in the furnace longer and hence are subjected to a greater degree of oxidation. A further advantage is that it is possible, once the furnace has been started up, to carry on the activation solely by the heat of the oxidation whereby external heat is rendered unnecessary. Furthermore, no mechanical agitating means are required.

Our invention will be best understood by reference to the following detailed description taken with the annexed drawings in which

Fig. 1 is a view in longitudinal vertical section of a preferred embodiment;

Fig. 2 is a view in elevation seen from the right of Fig. 1, and

Fig. 3 is a view taken on line 3—3 of Fig. 1.

The furnace comprises external elements 10, 11, 12, etc., of structural steel constituting a

framework within which the furnace proper is erected of bricks 15 of suitable nature. The roof of the furnace may comprise heat insulating blocks 16 suspended from I-beams 17, which in turn are supported from longitudinal beams 11 by means of tie bolts 18. The floor of the furnace constituted by the topmost bricks 15 is preferably horizontal, as shown, but may be tilted slightly along its middle transverse axis either downwardly toward the rear or the reverse. The material to be activated is fed continuously into the furnace through conduit 20 by feed mechanism such as a Gump feeder, not shown. Conduit 20 is also provided with an auxiliary opening 21 having a cover 22, as shown in Fig. 1. At the front end of the furnace, preferably at the top thereof, are disposed gas burners 23, 24, 25, 26, said burners being supplied with gas through lines 27, 28, and air through lines 29, 30, 31, 32. Each gas line, as for example 27, has a pressure regulator 28, valves 29 and 30, whereas each air line has a valve 31. Mixing of gas and air occurs in the Venturi pipes 32. Also disposed at the front of the furnace, preferably in the lower portion thereof, are auxiliary valve controlled air inlets 33, 34, 35, 36.

Disposed along the bottom of the furnace and running preferably transversely thereto are perforated air pipes 39 to 47, inclusive, said pipes being perforated as shown in Figs. 1 and 3. Furthermore, each of said pipes is connected with a header pipe 50 constituting a source of supply, by means of downcomers 51, etc., one of which is seen in Fig. 3, and each of which has a regulating valve 52, below which is a manometer 52a, so that the amount of air admitted by each pipe 39 to 47 is independently controlled. The exact number of pipes is not critical and the number shown may in some cases be increased if desired. Behind a bridge wall 53, which is comparatively low, is disposed a conveyor 54 having a movement transverse of the furnace, such conveyor having a return course 55. This conveyor functions to convey the deposited material out of the furnace at one side thereof. Bridge wall 53 may under some circumstances be omitted. Disposed at the top of the furnace is exit pipe 56 having a covered opening 57 and a damper 58 for the removal of the gases of combustion. At spaced points throughout the length of the furnace are provided peep holes 60, 61, the same comprising a hinged cover 62 and a sight glass 63.

In operation the furnace is first heated up by igniting burners 23 to 26. Crude carbon in finely divided form is admitted through the inlet 20 by

suitable conveying means, not shown. At the same time air is admitted first to the pipes at the front of the furnace, i. e., 39, 40, 41, so as to start the flow of the carbon therethrough. Gradually the valves in the other pipes 42 to 47 are opened so that when the starting operation is completed the carbon will form a layer approximately as indicated by 65, i. e., the carbon is heaped up at the region beneath the inlet 20, from which it gradually tapers to the discharge end of the furnace at 54. At this point or prior thereto the burners 23 to 26 are preferably cut out. The action of the air streams is to render the material mobile and to cause it to feed through the furnace at a controlled rate until the conveyor 54 is reached, whereupon the activated carbon is withdrawn, the flow of the carbon through the furnace being facilitated by gravity acting on the carbon at the higher level at the front of the furnace, and by the flow of the gases of combustion through the furnace. Manipulation of the valves 52 may also be had to correct any unevenness of flow of the carbon. Air may also be admitted above the carbon to aid combustion, should this be desired. The operator also watches the manometers 52a and makes sure that an even distribution of air is had throughout the furnace, it being apparent that to accomplish such even distribution a less pressure is required in the pipes 42 to 47 in the direction of the discharge end of the furnace, due to the diminution in depth of the carbon bed and to the decrease in specific gravity of the carbon as more and more of its substance is burned away in the operation of activation.

The temperature of activation may be controlled as required by the type of activation desired. For high temperature activation this temperature will ordinarily run from 700° C. to 1700° C., carbon activated at certain temperatures being better adapted for certain purposes than that activated at other temperatures. Ordinarily from 25% to 60% of the carbon is oxidized, depending upon the nature of the carbon to be activated and the degree of activation desired. While conditions will vary greatly, depending upon various circumstances, we may state that for activating so called leacher refuse, which is the carbonized lignin component of the wood used in pulp making and which has an average particle size of 20 mesh, an average depth in the furnace of 3 to 12 inches has been successfully employed together with an air pressure of  $\frac{1}{2}$  inch to  $1\frac{1}{2}$  inch in the pipes 39 to 47. Passage through the furnace of the carbon particles may take from  $\frac{1}{4}$  to  $\frac{3}{4}$  hours. A further means for controlling the temperature may be had by admixing some steam or inert gas (through pipe 66) with the air admitted to the furnace. This is of advantage where it is desired to subject the

activated material to low temperature activation, e. g., 250-700° C. Frequently it is desirable, after high temperature activation has been accomplished, to subject the so activated material to a low temperature activation. If air alone were relied upon, the volume required for propulsion of the carbon particles through the furnace would give rise to a temperature higher than this. In lieu of steam, inert gas such as flue gas, nitrogen, carbon dioxide, etc. may be used.

Our improved process is adapted to the activation of carbon of various origins so long as the particle size is sufficiently small to be conveyed by the air. Our improved method is susceptible to considerable variation. Thus the amount of steam fed beneath the carbon layer may be so great as to result in insufficient heat for activation and such deficiency supplied by operating the burners 23. Also, a further control is had by virtue of the pipes 33 which normally admit air, such air being increased or decreased during the operation of the furnace as desired. Other changes will occur to those skilled in the art, without departing from the spirit of our invention or the scope of the appended claim.

#### We claim:

The method of activating carbon, which comprises admitting in divided form the carbon to be activated to a substantially horizontal floor of a furnace at one end of such floor so as to form a bed thereon, such carbon being fed at a rate so as to form a heap at such feeding end of the furnace, blasting with an oxidizing gas said bed of carbon from beneath same at a plurality of zones spaced longitudinally of the furnace and extending crosswise thereof to cause the particles of said carbon to be partially oxidized, such blasting effecting a mobile condition of the particles, thereby aiding the action of gravity on the particles to effect a substantially unobstructed flow of same from said heap toward the discharge end of the furnace with the thickness of said bed tapering in the direction of such discharge end, removing the stream of oxidized products at the remote end of the furnace, thereby further aiding the movement of the forward particles, and varying the pressure of the blasting gas at said plurality of zones as required by the decreasing depth of the carbon bed to effect even distribution of the blasting gas, removing the activated carbon from the remote end of the furnace and carrying out the steps of the carbon admission, blasting, and removal of activated carbon and gaseous oxidation products in a continuous manner.

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