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PROCESS OF ACTIVATING CARBON

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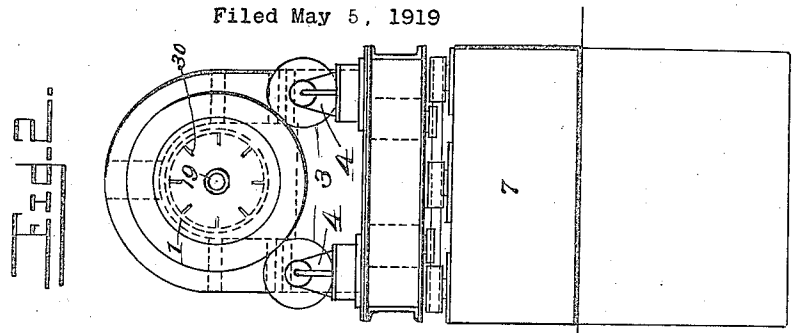

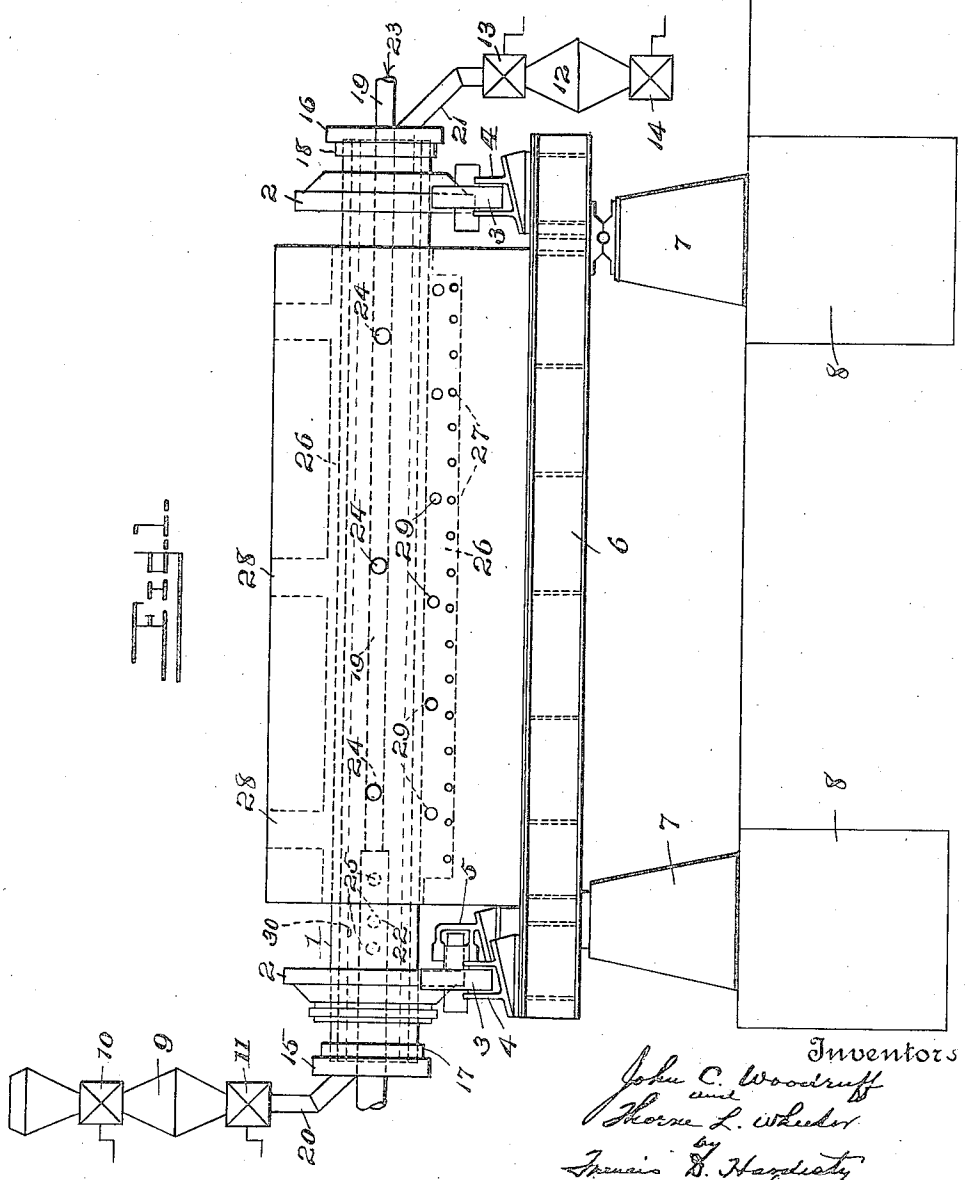

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UNITED STATES PATENT OFFICE.

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PROCESS OF ACTIVATING CARBON.

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To all whom it may concern:

Be it known that we, JOHN C. WOODRUFF and THORNE L. WHEELER, citizens of the United States, and residing at New York city and New York city, respectively, have invented certain new and useful Improvements in Processes of Activating Carbon, of which the following is a specification.

This invention relates to the manufacture of absorbent carbon such as charcoal and has special reference to a process of rendering the carbon highly active as an absorbent.

Heretofore, charcoal has been activated by means of steam in vertical tube furnaces called Dorsite treaters. This type of furnace consists of a nichrome tube symmetrically set in a vertical position and surrounded by a cylindrical combustion chamber heated to about 1100° C. by gas burners. On the inside of the above mentioned tube, there is concentrically located a nichrome steam pipe having part of its length perforated, and covered with nichrome wire cloth of rather fine mesh which is smaller than the particles of the material treated. The gaseous products of the reaction are drawn off through exhaust ports by means of a vacuum pump. Granular charcoal is introduced through a hopper valve feeding device at the top. The space surrounding the steam jet is kept full of carbon and as a portion is discharged from the bottom of the tube, thus lowering the level of material in the tube, the level is replenished through the feed valve at the top of the furnace. Thus a continuous gravity passage of the charcoal through the tube is maintained, unless interfered with by gas pockets, and the charcoal is activated by the superheated steam admitted through the steam jet.

The highest quality of absorbent charcoal is obtained only by running the material at a very slow rate or by re-running it several times through this type of furnace. This process requires a large amount of time and fuel. Difficulty is experienced in feeding due to the formation of gas pockets which hold the charcoal from sliding after material is discharged from the bottom. The exhaust lines constantly give trouble by becoming plugged with charcoal.

One of the objects of our invention is to provide a process which is more efficient and simpler to operate than the prior processes; also cheaper and which may be conducted in a continuous manner and which will overcome the disadvantages heretofore described in the prior processes.

Reference is to be had to the accompanying drawings in which:

Fig. 1 is a side elevation of the apparatus used for carrying out our process.

Fig. 2 is an end elevation.

The apparatus is provided with a large tube (1), preferably of nichrome, having carrying rollers (2) which rest upon radial rollers (3) supported by the bearings (4), the thrust being taken up by the thrust bearing (5). The bearings rest on a steel frame (6) which is supported on the concrete piers (7) and foundation members (8). The tube 1 is rotated through any suitable driving connection with a bevel gear attached to either of the rollers (2). It should be understood that any suitable supporting means may be used in place of that herein described without departing from the spirit and scope of this invention.

The charcoal is introduced into the tube (1) through the double seal hopper (9), provided with valves (10) and (11), and is discharged through another double seal hopper (12), having valves (13) and (14).

The ends of tube (1) are closed by plates (15) and (16) abutting the flanges (17) and (18) on the pipe (1) and each of these plates (15) and (16) contains a central opening through which a small tube (19), preferably of nichrome, passes and also another opening from which the pipes (20) and (21) lead to the hoppers (9) and (12), respectiely. The small tube (19) is preferably supported in the end plates (15) and (16) and rotates with the pipes (20) and (21) which are also supported by the plates (15) and (16). The hoppers (9) and (12) together with their attached valves (10), (11), (13) and (14) also rotate. The tube (1) rotates slowly, for example two revolutions per minute. When the hopper is in upright position as shown in Fig. 1, the operator has sufficient time while the hopper is rotating to close the valve (11), open the valve (10), insert a charge of raw material into the hopper (9), reclose the valve (10) and reopen the valve (11) before the hopper has traveled to a horizontal position. During the next revolution, when the hopper (9) is again in upright position the valve (11) is open and the charge from the hopper (9) is delivered into the pipe (20) and thus into the tube (1). On the next revolution, the

valve (11) is closed, valve (10) opened and another charge of raw material introduced into the hopper (9). In discharging the activated material from the apparatus, with the hopper (12) in the position shown in Fig. 1, valve (13) is opened and valve (14) closed. The material will flow from the tube (1) through the pipe (21) into the hopper (12) when the latter is in the down position. As the hopper revolves, the valve (13) is closed before the hopper reaches the horizontal position. On the next down movement of the hopper, the valve (14) is opened while the valve (13) is closed and the contents of the hopper (12) discharges through the valve (14) as the hopper approaches its low position. The tube (19) is perforated and serves to supply steam to the interior of tube (1). This tube (19) has an enlarged portion (22) at one end, which is separated from the main portion of the pipe (19). Steam enters the tube (19) at (23) through a stuffing box and passes through the perforations (24) into the pipe (1) containing the charcoal to be activated. The portion (22) is closed at the point where it joins the main portion of the pipe (19); this portion (22) being also provided with perforations (25) which serve to draw off the products of reaction from the tube (1).

The furnace is slightly inclined, so that charcoal fed in at the upper end, from the hopper (9), moves slowly down the tube (1) as it slowly rotates, and is activated by superheated steam from the steam jet.

The tube (1) is surrounded by a combustion chamber (26) which is stationary and heat is supplied to this combustion chamber from the burners (27), and the products of combustion pass out through the flues (28). In order to ascertain the temperature within the combustion chamber, pyrometers (29) are provided.

Although usually we prefer to introduce steam through a pipe such as (19) other means may be effectively substituted therefor. Steam may be introduced at one end of the pipe (1) through any suitable means and the products of combustion withdrawn from the other end. This type we have termed "open end" jet. The pipe (1) may also be provided with spurs or flights (30) which are either fastened to or cast in the pipe (1) and serve to agitate the material within the tube (1) by lifting and dropping the material as the tube (1) rotates. The material thus drops through the atmosphere of steam or other oxidizing gas, such as air or CO_2, used for activation. Also, the pipe (19) need not necessarily be circular in cross section, but any other convenient form may be used, and the use of rake like tubing instead of the straight tube (19) is also contemplated. Either of the methods herein described for introducing the activating gas or fluid may be used singly or in combination with one or more of the other methods.

We have found that the most desirable results are obtained when the charcoal is heated to a temperature between 700 and 1100° C., and this condition may be obtained in tube (1) by heating the combustion chamber to a temperature of about 1100° C. This will superheat the steam within tube (1). Of course, it should be understood that the steam entering tube (1) from tube (19) may or may not be superheated outside of the furnace as desired.

This process not only activates the charcoal in a much shorter period of time than the old processes, but the product is of an exceedingly high absorbing power, and the quality of the product is very much more uniform than that produced by the old processes. The successful accomplishment of the results described depends upon the employment of an oxidizing agent, preferably endothermic, such as steam, and the application of the oxidizing agent in a manner which insures repeated contact of all of the carbon therewith during its treatment. The acceleration of the reaction is accomplished through the combined agitation of the carbon and thorough distribution of the steam in the reaction chamber, which permits rapid passage of the carbon. While air and carbon dioxide have been employed for revivifying bone black and the like, they do not possess the advantages of the steam. The reaction employing the latter agent is endothermic so that oxidation is readily controlled and waste of active material is thereby prevented. Steam has been heretofore suggested as an oxidizing agent in the treatment of carbon, but it has never, so far as we are aware, been employed in the manner described to insure thorough distribution thereof through a mass of material under treatment for the purposes of our invention. The uniform and very active product may be used for a variety of purposes to which it is adapted and being produced economically forms a desirable article of commerce.

The present invention is not limited to the specific details set forth in the foregoing examples which should be construed as illustrative and not by way of limitation, and in view of the numerous modifications which may be effected therein without departing from the spirit and scope of this invention, it is desired that only such limitations be imposed as are indicated in the appended claims.

We claim as our invention:

1. A process of increasing the adsorptive power of carbon by oxidation, which comprises conveying the carbon through an elongated heated reaction zone, distributing an active oxidizing agent throughout the reaction zone so that all of the carbon there-

in is simultaneously subjected to the action of the oxidizing agent before the latter is materially contaminated by the end products of the reaction, the carbon being maintained during the reaction at a temperature sufficiently high to ensure rapid activation, by the external application of heated combustion products.

2. A process of increasing the adsorptive power of carbon by oxidation, which comprises agitating the carbon in an elongated heated reaction zone, distributing an active oxidizing agent throughout the reaction zone so that all of the carbon therein is simultaneously subjected to the action of the oxidizing agent before the latter is materially contaminated by the end products of the reaction, the carbon being maintained during the reaction at a temperature sufficiently high to ensure rapid activation, by the external application of heated combustion products.

3. A process of increasing the adsorptive power of carbon by oxidation, which comprises agitating the carbon in an elongated heated reaction zone, distributing steam throughout the reaction zone so that all of the carbon therein is simultaneously subjected to the action of the steam before the latter is materially contaminated by the end products of the reaction, the carbon being maintained during the reaction at a temperature sufficiently high to ensure rapid activation by the external application of heated combustion products.

4. A process of treating carbon by endothermic oxidation which comprises, subjecting the carbon to continued agitation while conveying it through a reaction zone, supplying steam to said zone during agitation of the carbon so that the steam is intimately mingled with the carbon and maintaining a temperature sufficiently high to insure rapid activation of the carbon by the external application of heated combustion products.

5. A process of treating carbon by endothermic oxidation which comprises, subjecting carbon to continued agitation while conveying it through a reaction zone of a heating chamber, supplying steam to said zone during agitation of the carbon so that the steam is intimately mingled with the carbon and maintaining a temperature ranging from 700° C. to 1100° C. within the chamber and during the oxidation by the external application of heated combustion products.

6. A process of treating carbon by endothermic oxidation which comprises, subjecting the carbon to continued agitation while conveying it through a reaction zone having walls of oxidation resistant material, supplying steam to said zone during agitation of the carbon so that the steam is intimately mingled with the carbon and heating said zone by transfer of heat through said walls to a temperature sufficiently high to insure a rapid activation of the carbon.

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