July 27, 1926. 1,593,879

J. J. NAUGLE

ELECTRIC FURNACE

Original Filed April 21, 1923 2 Sheets-Sheet 1

Fig. 1.

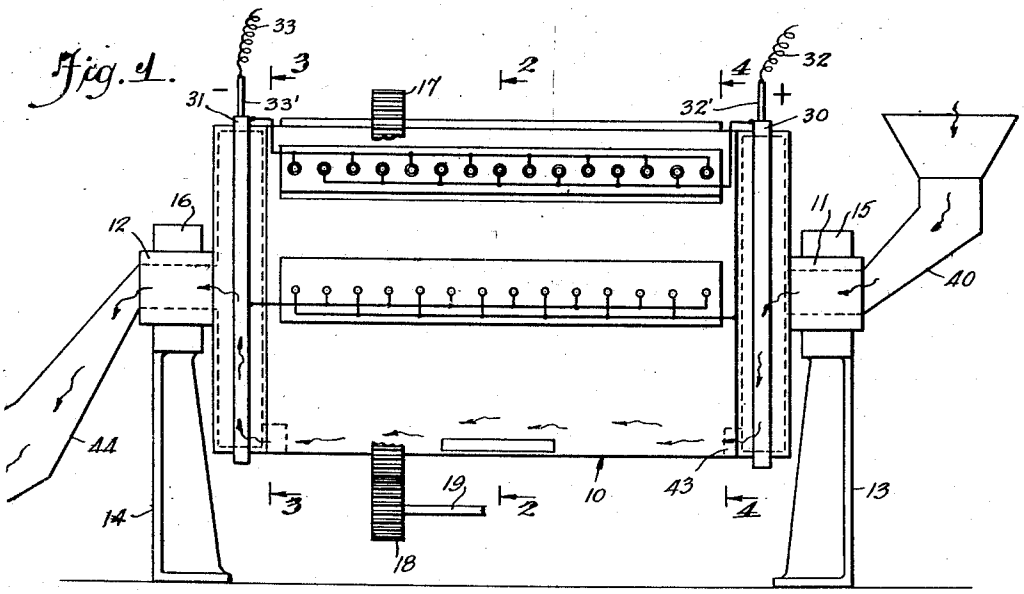
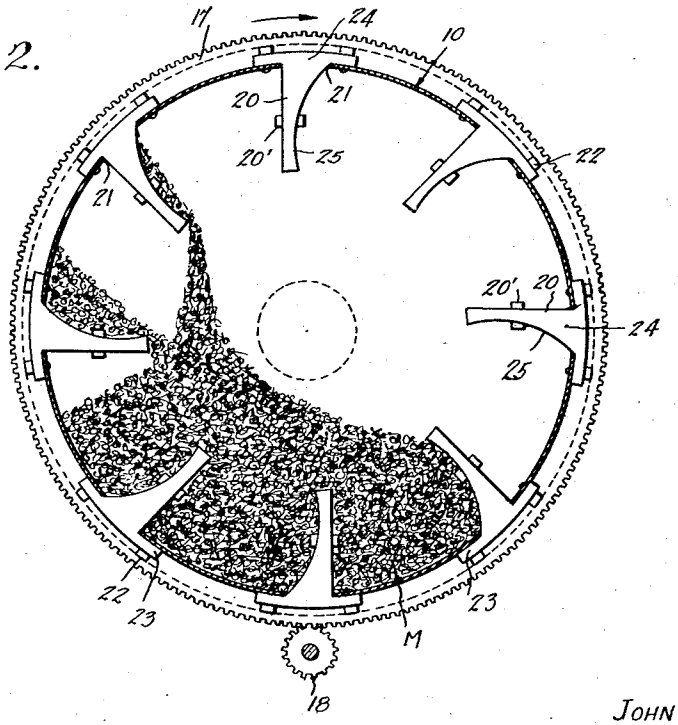


Fig. 2.



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Fig. 3.

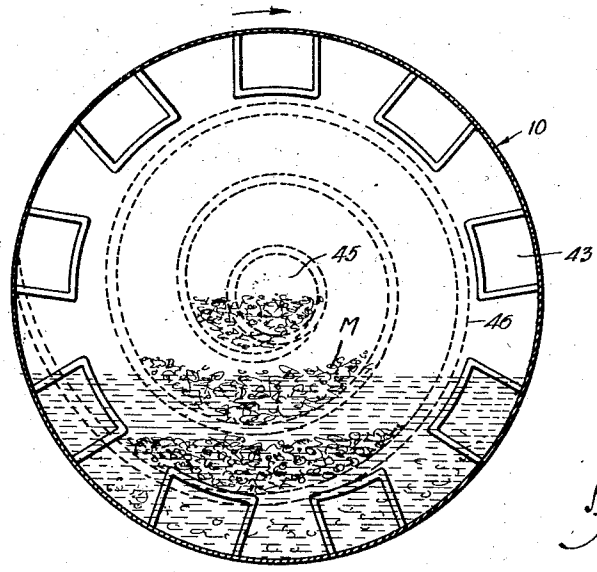


Fig. 5.

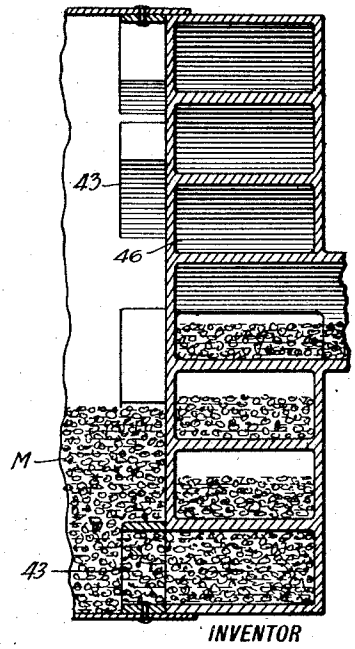
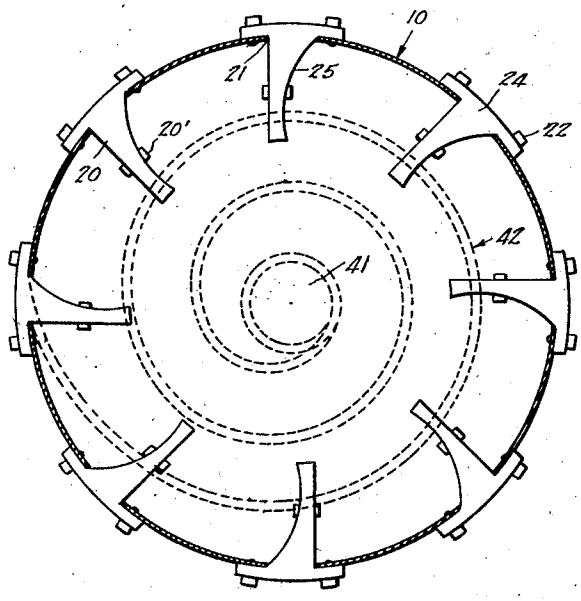


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN J. NAUGLE, OF BROOKLYN, NEW YORK.

ELECTRIC FURNACE.

Application filed April 21, 1923, Serial No. 633,639. Renewed October 27, 1925.

My present invention relates to electric furnaces, particularly, but not exclusively, such as are intended for the treatment of comminuted carbonaceous or other material, and aims to devise structures of the general character designated above which shall be simple in construction, which shall have few parts and shall therefore be quite economical to manufacture. Another object of the present invention is to devise structures of the character designated which shall be certain and dependable in operation, which shall require little power for mechanical and heat generating purposes; in which the operative parts may be readily replaced; which shall make ample provision for the proper feeding of the material treated in such furnaces and for its proper and efficient mixing during the treatment; which shall make provision for proper current distribution; and which shall be capable of continuous, as distinguished from batch, operation.

A further object of the present invention is to devise furnaces of the general character specified which shall permit the substantially continuous production of material of a high degree of purity. In particular, if comminuted carbonaceous material, such as comminuted carbonized lignin residues intended for the preparation of highly activated decolorizing carbons, is treated in a furnace of the character designated above, the result is a remarkably pure carbon of high conductivity corresponding to a very high degree of activation and decolorizing power.

In the accompanying specification I shall describe, and in the annexed drawing show, an illustrative embodiment of the device of the present invention. It is, however, to be clearly understood that my invention is not limited to the specific embodiment thereof herein shown and described for the purposes of illustration only.

Referring to the drawing, wherein I have illustrated the aforesaid illustrative embodiment of the present invention:

Fig. 1 is a view in longitudinal section, partly broken away and partly in elevation, showing the furnace comprising the aforesaid illustrative embodiment of the present invention;

Fig. 2 is a cross sectional view of the same taken along line 2—2 of Fig. 1 of the drawing;

Fig. 3 is a cross sectional view of the same taken along line 3—3 of Fig. 1 of the drawing;

Fig. 4 is a view similar to Fig. 3 taken along line 4—4 of Fig. 1 of the drawing; and

Fig. 5 is an enlarged detail, longitudinal sectional view at the outlet end of the machine.

Referring now to the aforesaid illustrative embodiment of the present invention, and more particularly to the drawing illustrating the same, the furnace comprising the aforesaid illustrative embodiment includes the casing 10, preferably of substantially cylindrical form, having the inlet tube 11 and the outlet tube 12, said tubes being likewise of substantially cylindrical form and comprising bearings for the casing 10 and the parts contained therein. The casing 10 and the tubes 11 and 12 are supported by a plurality of standards 13 and 14, of which the standard 13 provides a bearing sleeve 15 for the tubular bearing 11, while the standard 14 provides a bearing sleeve 16 for the tubular bearing 12.

In the form illustrated by way of example herein, I provide means for effecting a preferably continuous rotation of the casing 10. For this purpose, I may provide the annular toothed gear 17 carried by and surrounding the casing 10, and adapted to cooperate with a spur gear or pinion 18 carried by a shaft 19 driven from any suitable source of power not here deemed necessary to be shown. By the meshing of the gears 17 and 18, the casing 10 and its associated parts may be rotated at any desired rate of speed.

Within the casing 10 are a plurality of mixing and stirring members generally indicated by reference character 20, and carrying the electrodes 20′ in insulated relation. Each of the members 20 is preferably replaceable or readily removable from the casing 10, as by having each such member pass through an opening or orifice 21 in the wall of the casing 10. By means of suitable bolts 22, passing through flanges 23 forming a part of the base 24 of each member 20,

each such member may be readily installed and as readily removed for cleaning, repair or replacement, as desired.

In order to bring about an effective mixing of the material and the proper distribution of current through the same, I prefer to provide some or all of the members 20 with a hollowed-out surface for the reception and subsequent discharge of a portion of the material in the furnace. For this purpose, that face of each or some of the members 20 which, during the rotation of the casing 10, first comes into contact with the material M in the furnace, is dished-out or made slightly concave, as indicated at 25.

It will be noted that each set of members 20 is disposed in spaced relation along the circumferential periphery of the inner face 10′ of the casing 10. It will also be noted that the members 20 of each such set are substantially radially disposed. I have found, by trial and experiment, that this disposition of the members 20 and the electrodes carried by the same is of considerable importance for the proper treatment of the material within the furnace, by insuring proper mixing of the material and the proper distribution of current through the mass being treated.

The electrodes 20′ are in the form of longitudinally arranged knobs or studs, preferably located on both sides of each of the members 20, which members are preferably of insulating material or are properly insulated, so as to avoid connection with the electrodes, and also to avoid short-circuiting the furnace through the metallic portions of the casing and other parts of the machine. While various types of electrical connections may be employed with considerable success for the electrodes 20′, I prefer to use conductor rings 30 and 31 mounted at the inlet and outlet ends of the casing 10, and suitably insulated from the metallic structure of the casing. At 32 and 33 I have indicated leads for supplying current to the conductor rings 30 and 31, respectively. I prefer that the electrodes 20′, of which several peripheral sets or rows, here shown as fifteen peripheral rows each including eight peripherally disposed electrodes, may be employed, shall be so connected to the conductor rings 30 and 31, and the leads 32 and 33 supplying current thereto, that successive electrodes in each peripheral set will be oppositely charged and that successive electrodes in each longitudinal set will be likewise oppositely charged. I find that this arrangement of electrodes is highly desirable in that it assists in effecting the proper distribution of current through the charge of material within the furnace.

In order to continously feed material into the furnace for treatment and out of the furnace after the same has been subjected to the desired treatment for the desired length of time, I provide any suitable means, but preferably an inlet hopper 40 for feeding untreated material into the machine through the tubular bearing 11. The tubular bearing 11 communicates with the central chamber 41 of a spiral feeding device, generally indicated by reference character 42. The spiral feeding device 42 is located at the inlet end of the machine, and is provided with the discharge opening 43 leading into the heating chamber 10″ within the casing 10. Similarly, the discharge outlet is in the form of a conduit 44 communicating at its upper end with the tubular bearing 12 which leads into the central opening 45 of a spiral outlet feeding device, generally designated by reference character 46, and similar in most respects to the spiral inlet feeding device 42. The feeding device 46 has the inlet opening 45 communicating with the spiral passage in the feeding device 46 for the admission of treated material from said spiral passage for its subsequent discharge from the machine.

The manner of assembling the machine will be substantially clear from the foregoing description. The manner of operating the machine and its advantages in operation, particularly the highly important results obtained by the use of the machine when the same is used to treat comminuted carbonaceous material, such as comminuted carbonized lignin residues for the preparation of highly activated decolorizing carbons, may be briefly described as follows, using this particular material as an example and assuming the machine is used to carry out the processes described and claimed in one of my copending applications bearing Serial No. 633,640, filed of even date herewith, in the preparation of the material described and claimed in another of my copending applications bearing Serial No. 633,641, also filed of even date herewith.

In the operation of the machine described above for the practice of the process in the preparation of the material referred to, comminuted carbonaceous material, particularly comminuted carbonized lignin residues, generally indicated by reference character M, is continously fed into the machine through the hopper 40 and the feeding means 42, and thus enters the heating chamber 10″, where it is brought into operative contact with the electrodes 20′. The electrodes 20′, by the continuous rotation of the casing 10 carrying the same, are brought into intermittent contact with the material M and serve to intermittently and continously stir and mix the same. This desired action is facilitated by the particular form which the members 20 possess. This form, resulting from the dished-out surfaces 25 with which these members are provided, serves to cause these members to intermittently receive and sub-

sequently discharge a portion of the material M being treated within the furnace.

The course of such material is diagrammatically illustrated in Fig. 2 of the drawing, which approximates the position of the mass of material M within the casing for a particular speed of operation of the machine. The electrodes 20′ serve, by reason of their connection with the conductor rings 30 and 31 and the lead wires 32 and 33 supplying current thereto, to discharge a current of regulated and controlled density through the mass M of material being treated in the furnace. The current should be such as to readily volatilize volatile matter contained in the mass of comminuted carbonized lignin residues being treated in the furnace, in the particular example given. The current should also be strong enough to fuse the fusible mineral substances present in the material being treated.

The following is an example of an average analysis of an average sample of comminuted carbonized lignin residues, such as may be treated to remarkable advantage in the present furnace.

Analysis of comminuted carbonized lignin residues.

	Per cent.
Carbon	90
Ash	10

Analysis of ash.

Silicious matter	0.13
Silica	0.75
Ferric oxide	0.34
Alumina	0.47
Lime, CaO	0.23
Magnesia, MgO	0.11
Chlorine as chlorides	0.47
Sulphuric anhydride	2.65
Carbon dioxide	1.00
Alkalies (by diff.)	3.85
	10.00

The result of the aforesaid fusing action on the fusible mineral substances contained in the carbonized lignin residues, which residues are obtained by carbonizing the spent cooking liquors obtained by the treatment of wood by the soda process for the production of wood pulp, is to sinter or clinker such fusible mineral substances and to cause the same to adhere principally to the parts 20 and 20′. Some of the fused material may adhere to the inner wall of the casing 10, thus requiring the removal of such fused, non-conductive material from time to time. Likewise, the fused material adhering to the parts 20 and 20′ should be removed from time to time, either by scraping off the electrodes or by replacing the same with clean electrodes.

The resulting product is of great purity and of very high conductivity corresponding to a high degree of activation and high decolorizing power. An average analysis of the treated product is substantially as follows:

Analysis of treated product.

Carbon	97.60
Ash	2.40

Analysis of ash.

Calcium	0.16
Sodium, Na_2O	0.35
Magnesium, MgO	0.16
Chlorides, (Cl_2)	0.06
Sulphates (SO_3)	0.78
Silica, SiO_2	0.50
Iron and alumina (Fe_2O_3, Al_2O_2)	0.39
	2.40

The time of treatment will, of course, depend on the particular material being treated, but in general is about 15 to 60 minutes. The conductivity of the final product may be as great as five times that of the raw material initially admitted to the machine. The product also possesses a high degree of neutrality, which is very desirable, and possesses a decolorizing power substantially, often as much as ten per cent, greater than the best activated carbons hitherto produced.

From the foregoing description, it will be noted that the machine is simple in construction, possesses few parts, and is capable of very economical and convenient fabrication. In operation, the machine is certain and dependable, requiring a minimum of power for its rotation and for heating purposes. The operative parts of the machine, particularly the electrodes, may be readily installed and as readily removed for repair or replacement. The machine is so arranged as to provide proper feeding and mixing of the material during treatment, and proper distribution of the heating current through the same, being at the same time capable of continuous operation for the production of a high grade of material with a minimum amount of equipment, material and labor. It may here be stated that the carbonized lignin residues referred to herein are the residues remaining after leeching the residues obtained by carbonizing the spent or used cooking liquors obtained in the treatment of wood by the alkali (soda) process in the treatment of wood pulp; and that the terms "activation" and "decolorizing" or their equivalents, as used in the specification and claims, include also deodorization, purification and filtration.

What I claim as my invention is:

1. In an electric furnace for the treatment of carbonaceous material or the like, a con-

tainer, a plurality of electrodes within the same and extending longitudinally along the inner periphery thereof, and means for effecting a movement of said electrodes whereby the electrodes are intermittently immersed in the carbonaceous material.

2. In an electric furnace for the treatment of carbonaceous material or the like, a container, a plurality of radially disposed electrodes within the same and extending longitudinally along the periphery thereof, and means for effecting a movement of said electrodes whereby the electrodes are intermittently immersed in the carbonaceous material.

3. In an electric furnace for the treatment of carbonaceous material or the like, an electrode support having a dished-out surface for the reception of material to be treated.

4. In an electric furnace for the treatment of carbonaceous material or the like, an electrode support having a dished-out surface for the intermittent reception of material to be treated.

5. In an electric furnace for the treatment of carbonaceous material or the like, a container, a plurality of mixing electrodes within the same and extending longitudinally along the periphery thereof, and means for effecting a movement of said electrodes relatively to the mass of material within the furnace, said electrodes upon movement thereof, being immersed intermittently in said material.

6. In an electric furnace for the treatment of carbonaceous material or the like, a container, a plurality of mixing electrodes peripherally and radially disposed within the same, and means for rotating said container and the mixing electrodes carried thereby whereby said electrodes are intermittently immersed in said material and said material forced through said container.

7. In an electric furnace for the treatment of carbonaceous material or the like, a container, a plurality of mixing electrodes within the same, one or more electrode carriers each having a dished-out surface for the reception of material to be treated, and means for effecting a movement of said electrodes relatively to the mass of material within the furnace.

8. In an electric furnace for the treatment of carbonaceous material or the like, a container, a plurality of mixing electrodes peripherally disposed within the same, electrode carriers each having a dished-out surface for the intermittent reception of material to be treated, and means for effecting a rotary movement of said electrodes relatively to the mass of material within the furnace.

9. In an electric furnace for the treatment of carbonaceous material or the like, a container, a plurality of mixing electrodes peripherally and radially disposed within the same, one or more electrode carriers in the form of scoops for the intermittent reception of the material during treatment, and means for effecting a rotary movement of said electrodes relatively to the mass of material within the furnace.

10. An electric furnace for the treatment of carbonaceous material or the like, comprising a container, means for continuously feeding material to be treated to said container, a plurality of mixing elements within said container and adapted to be moved relatively to the mass of the material to be treated and so formed as to receive and discharge a portion of the material during movement of said elements, electrodes secured to said mixing elements, and means for continuously removing treated material from said container.

11. An electric furnace for the treatment of carbonaceous material or the like, comprising a container, means for rotating said container, means operated by the rotation of said container for continuously feeding material to be treated to said container, a plurality of electrodes within said container and carried thereby, and adapted to be moved through the mass of the material to be treated, and means operated by the rotation of said container for continuously removing the treated material from said container.

12. An electric furnace for the treatment of carbonaceous material or the like, comprising a container, means for continuously feeding material to be treated to said container, a plurality of knob-like electrodes within said container and adapted to be moved relatively to the mass of the material to be treated and to intermittently receive and discharge a portion at least of such material, and means for continuously removing treated material from said container.

13. An electric furnace for the treatment of carbonaceous material or the like, comprising a container, means for rotating said container, means operated by the rotation of said container for continuously feeding material to be treated to said container, a plurality of knob-shaped stirring electrodes within said container and carried thereby, and adapted to be moved through the mass of the material to be treated and to intermittently receive and discharge a portion at least of such material, and means operated by the rotation of said container for continuously removing treated material from said container.

14. An electric furnace for the treatment of carbonaceous material or the like, comprising a container, means for rotating said container, means operated by the rotation of said container for continuously feeding ma-

terial to be treated to said container, a plurality of electrodes within said container and carried thereby, and adapted to be moved through the mass of the material to be treated, means within said container and operated by the rotation of the same for stirring the material to be treated in the furnace, and means operated by the rotation of said container for continuously removing treated material from said container.

15. An electric furnace for the treatment of carbonaceous material or the like, comprising a container, means for continuously feeding material to be treated to said container, a plurality of knob-like, peripherally disposed electrodes within said container and adapted to be moved relatively to the mass of the material to be treated and to be intermittently immersed in said material to receive a portion at least of such material, and means for continuously removing treated material from said container.

16. An electric furnace for the treatment of carbonaceous material or the like, comprising a container, means for rotating said container, means operated by the rotation of said container for continuously feeding material to be treated to said container, a plurality of knob-shaped stirring, peripherally and radially disposed electrodes within said container and carried thereby, and adapted to be moved through the mass of the material to be treated and to intermittently receive and discharge a portion at least of such material, and means operated by the rotation of said container for continuously removing treated material from said container.

17. An electric furnace comprising a container, means for rotating said container, means at one end of said container for continuously feeding material to be treated to said container, said container feeding being dependent upon rotation of the container, means for forcing material from one end of said container to the other, and means at the other end of said container for continuously removing treated material from said container upon rotation of the same.

In testimony, whereof, I have signed my name to this specification this 30th day of March, 1923.

JOHN J. NAUGLE.