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Sept. 28, 1926. 1,601,222

J. J. NAUGLE

ELECTRIC FURNACE FOR THE TREATMENT OF COMMINUTED CARBONACEOUS MATERIAL AND THE LIKE

Filed April 21, 1923

Fig. 1.

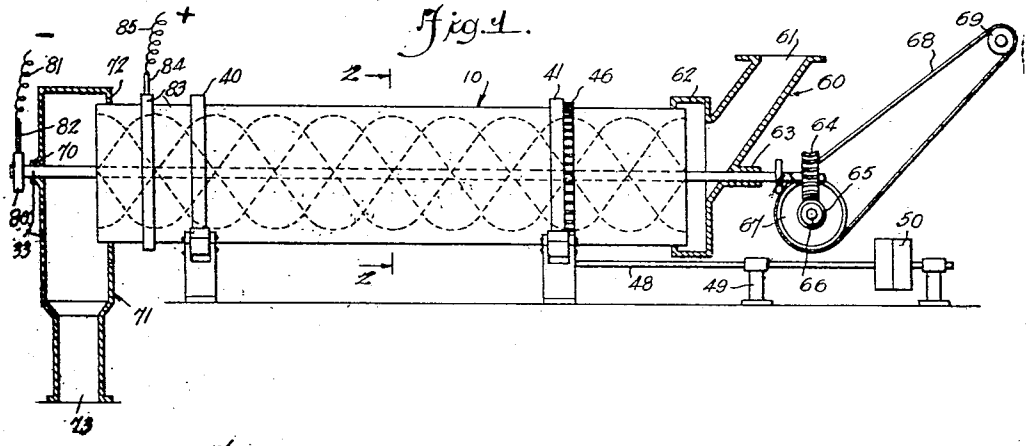


Fig. 2.

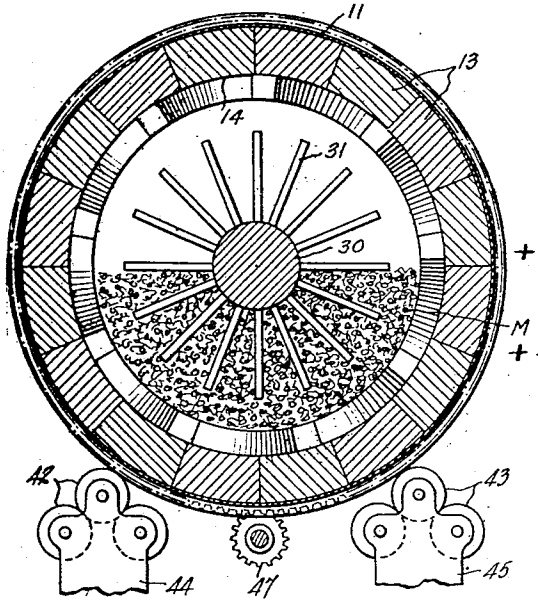


Fig. 3.

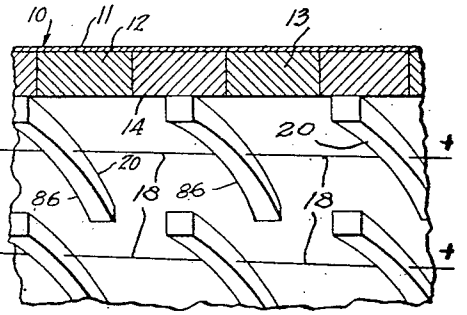


Fig. 5.

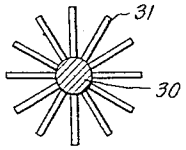
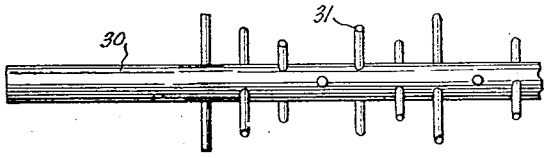


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ELECTRIC FURNACE FOR THE TREATMENT OF COMMINUTED CARBONACEOUS MATERIAL AND THE LIKE.

Application filed April 21, 1923, Serial No. 633,644. Renewed October 22, 1925.

My present invention relates to electric furnaces, particularly, but not exclusively, such as are intended for the treatment of comminuted material, especially comminuted carbonaceous material, and aims to devise structures of the general character designated above which shall be simple in construction, and which shall have few parts and shall, therefore, be quite economical to manufacture and to assemble. Another object of the present invention is to devise structures of the character specified above which shall be certain and dependable in operation; which shall require little power for mechanical and heat generating purposes; which may be readily assembled and as readily disassembled for repair or other purposes; which shall make ample provision for the proper feeding of the material into, within and through the furnace during its treatment therein; which shall also make adequate provision for the proper and efficient stirring and mixing of the material during its treatment; which shall provide proper current distribution through the material for the heating treatment; 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 above which shall permit the substantially continuous production of products of a high degree of purity. In particular, if comminuted carbonaceous material, such as comminuted carbonized lignin residues, derived from the cooking liquors obtained from the treatment of wood by the alkali (soda) process for the production of wood pulp, is treated in a furnace of the character designated above for the preparation of highly activated decolorizing carbons, the result is a remarkably pure decolorizing carbon characterized by a high degree of purity and high electrical 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 purposes of illustration only.

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

Fig. 1 is a side elevation, partly broken away, of the furnace comprising the aforesaid illustrative embodiment;

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 fragmentary longitudinal sectional view of the casing and associated electrodes;

Fig. 4 is a side view, and

Fig. 5 is an end view, of the central shaft and associated electrodes.

Referring now to the aforesaid illustrative embodiment of the present invention, and more particularly to the drawing illustrating the same, the furnace comprising said illustrative embodiment includes a casing 10, which is preferably of substantially cylindrical form. While the casing 10 may be made of various materials, I prefer that the same shall comprise an outer shell 11 of metal, such as iron or steel, provided with an inner lining 12 of some heat insulating and electrically non-conducting material, such as the fire brick 13.

Mounted on the inner face 14 of the casing 10 are a plurality of combined feeding means and outer electrodes which may have any desired form, but are preferably in the form of a series of conveyor vanes or blades 20. The vanes or blades 20 preferably comprise a plurality of series of spiral elements, nine such longitudinally disposed series being shown in the specific embodiment herein described for purposes of illustration only. Preferably, the successive series of conveyor vanes or blades 20 are staggered with respect to each other, as more clearly shown in Fig. 3 of the drawing.

Suitably mounted within the casing 10 is a shaft 30 carrying a plurality of combined stirring rods and electrodes in the form of rods 31. The rods 31 are arranged on the shaft 30 in pairs, the rods of each pair being preferably diametrically oppositely disposed. Successive pairs of rods, however, as more clearly shown in Fig. 4 of the drawing, are angularly disposed with relation to each other. This arrangement, I have found, is very suitable for effecting the proper stirring of the charge within the furnace, and for bringing about a proper

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distribution of current through the mass of material being treated in the furnace.

Suitable means are provided for effecting a relative movement, such as a relative rotation, of the inner shaft 30, carrying the inner electrodes 31, with respect to the casing 10 carrying on the inner surface 14 thereof the outer electrodes 20. For this purpose I may rotate either the casing 10, carrying the outer electrodes 20 on the inner surface 14 thereof, or the inner shaft 30, carrying the inner electrodes 31. Or else, I may, as more clearly shown in Fig. 1 of the drawing, rotate both sets of electrodes relatively to each other, either in the same direction at different angular rates of rotation, or, and preferably, in opposite directions at predetermined angular speeds of rotation.

While various means may be employed for this purpose, I prefer to use the means shown in Figs. 1 and 2 of the drawing, and comprising a plurality of bearing bands 40 and 41 surrounding the outer wall of the casing 10 and bearing on a plurality of sets of cylindrical roller bearings 42 and 43, respectively, within the bearing boxes 44 and 45, respectively. Also mounted on the outer periphery of the casing 10 is a gear wheel 46 meshing with a pinion 47 carried by a shaft 48 which is suitably borne by a standard 49. The shaft 48 is driven from any suitable source of power, diagrammatically shown in the drawing and indicated by reference character 50.

The shaft 30 carrying the electrodes 31 is likewise rotated. For this purpose, I provide the charge or feed hopper 60, having the feed inlet 61 and the flanged collar 62, within which the shell 10 may freely rotate, with an integral extension 63 in the form of a sleeve through which the end 32 of the shaft 30 passes. At its outer extremity, the end 32 of the shaft 30 carries a spiral gear 64 meshing with a worm gear 65 carried by a shaft 66 which also carries a pulley 67 operated by a belt 68 mounted on a drive pulley 69 operated from any suitable source of power, not here deemed necessary to be shown. The other extremity 33 of the shaft 30 passes through an extension 70 on the discharge hopper 71 which is provided, as at 72, with a bearing permitting the free rotation of the casing 10 within the same and with the discharge outlet 73 at its lower end.

In order to provide current conducting means for the sets of electrodes 20 and 31, I provide the end 33 of the shaft 30 with a conductor ring or sleeve 80 contacting with a brush 81 leading, by means of the wire or connector 82, to one of the poles, such as the positive pole, of any suitable source of current supply, not here deemed necessary to be shown. In this way connection is made with the shaft 30 and with the electrodes 31 carried thereby. The casing 10 carries a conductor ring or sleeve 83 disposed about the periphery of the casing, this ring contacting with a brush 84 connecting, by means of the wire or connector 85, with the negative pole of the source of current supply already referred to. By any suitable connection means, generally indicated by reference character 86, the conductor ring 83 may be readily connected with some or all of the outer electrodes 20.

The manner of assembling the machine described above is substantially clear from the foregoing description. The manner of operating the machine is also substantially clear from the foregoing description and may be briefly summarized as follows: Assuming that the material treated in the furnace, for the purposes of illustration, is the comminuted carbonized lignin residues already referred to, and assuming that the machine is used to carry out the process 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, the raw material, generally indicated by reference character M, is continuously fed into the machine through the hopper 60 and thus enters the heating chamber generally designated by reference character 10″, where it is brought into operative contact with the cooperating sets of electrodes 20 and 31.

The electrodes 31, by the continuous rotation of the shaft 30 on which the same are carried, are brought into intimate contact with the material within the furnace and serve to thoroughly mix and stir the same. The spiral feeding members 20, some or all of which may serve as electrodes by being connected with the connection means 86, serve at the same time, by reason of the continuous rotation of the casing 10 on the inner surface of which the members 20 are carried, to continuously feed the material M within the furnace forward during the heating operation from the feed hopper 60 towards the discharging hopper 71. The electrodes 20 and 31 being connected as above described, current of the desired density will pass through the material M within the furnace.

In this way the material M will be heated to the desired degree. The degree of heat will, of course, depend upon the particular material being treated within the furnace and the characteristics of the end product desired to be produced. The heat should, in general, be sufficient to volatilize the volatile substances present in the charge of the material, and to fuse the fusible mineral substances present in such material to the condition of small aggregates or clinkers

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which adhere to the electrodes 20 and 31, and also to the inner wall 14 of the casing 10 carrying the electrodes 20, as well as to the shaft 30 carrying the electrodes 31. In this way the volatile and fusible substances referred to are removed from the charge as it passes progressively and continuously from the inlet towards the outlet end of the furnace.

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 furnace described above:

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

Analysis of final 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_3)	0.39
	2.40

The time of treatment will, of course, depend upon 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, and often as much as 20 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 comparatively few parts, and is capable of very economical and convenient fabrication, assembly and operation. In operation, the machine is certain and dependable, requiring a minimum of power for mechanical and heating purposes. The operative parts of the machine, particularly the electrodes, may be readily installed and as readily removed for cleaning, repair or replacement. The machine is so constructed and arranged as to provide for the proper feeding and mixing of the material within the furnace during its treatment therein, as well as proper distribution of the heating current through such material, being at the same time capable of producing a high grade of material under conditions permitting a very high yield, considering the amount of raw material and current employed, all of these desirable results being accomplished with a minimum amount of equipment, power, labor and material.

It may here be stated that the carbonized lignin residues referred to herein are the residues remaining after leaching the residues obtained by carbonizing the spent or used cooking liquors derived in the treatment of wood by the alkali (soda) process in the production 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 comminuted carbonaceous or like material, a heating chamber, a plurality of outer electrodes disposed in the outer portions of the space within said heating chamber, a plurality of inner electrodes disposed within said outer electrodes, and means for moving both the outer and inner electrodes.

2. In an electric furnace for the treatment of comminuted carbonaceous or like material, a heating chamber, a plurality of outer electrodes disposed in the outer portions of the space within said heating chamber, a plurality of inner electrodes disposed within said outer electrodes, and means for moving both the outer and inner electrodes, one of said sets of electrodes being formed to advance the comminuted material during the relative movement of said two sets of electrodes.

3. In an electric furnace for the treatment of comminuted carbonaceous or like material, a heating chamber, a plurality of outer electrodes disposed in the outer portions of the space within said heating chamber, a plurality of inner electrodes disposed

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within said outer electrodes, and means for effecting relative movement of said outer and inner electrodes, the electrodes of said set of outer electrodes being in the form of spiral elements for advancing the comminuted material during the relative movement of said two sets of electrodes.

4. An electric furnace for the treatment of comminuted carbonaceous material and the like, comprising a container, a plurality of outer electrodes carried by said container adjacent the inner wall of the same, a plurality of inner electrodes disposed within said outer electrodes, and means for moving both outer and inner electrodes relative to each other.

5. An electric furnace for the treatment of comminuted carbonaceous material and the like, comprising a substantially cylindrical container, a plurality of outer electrodes carried by said container adjacent the inner wall of the same, a plurality of inner electrodes disposed within said outer electrodes, and means for rotating said container and the outer electrodes carried thereby, said electrodes being adapted to advance the material through the furnace upon rotation thereof.

6. An electric furnace for the treatment of comminuted carbonaceous material and the like, comprising a container, a plurality of outer electrodes carried by said container adjacent the inner wall of the same, a plurality of inner electrodes disposed within said outer electrodes, and means for effecting a relative movement of said outer and inner electrodes, the electrodes of said set of outer electrodes being in the form of spiral elements for advancing the comminuted material during the relative movement of said two sets of electrodes.

7. An electric furnace for the treatment of comminuted carbonaceous material and the like, comprising a substantially cylindrical container, a plurality of outer electrodes carried by said container adjacent the inner wall of the same, a plurality of inner electrodes disposed within said outer electrodes, and means for rotating said container and the outer electrodes carried thereby to thus effect a relative movement of said outer and inner electrodes, one of said sets of electrodes being formed to advance the comminuted material during the relative movement of said two sets of electrodes.

8. An electric furnace for the treatment of comminuted carbonaceous material and the like, comprising a substantially cylindrical container, a plurality of outer electrodes carried by said container adjacent the inner wall of the same, a plurality of inner electrodes disposed within said outer electrodes, and means for rotating said container and the outer electrodes carried thereby to thus effect a relative movement of said outer and inner electrodes, the electrodes of said set of outer electrodes being in the form of spiral elements for advancing the comminuted material during the relative movement of said two sets of electrodes.

9. An electric furnace for the treatment of comminuted material, comprising a container, a plurality of outer electrodes supported on the inner surface of said container, a shaft passing through said container, a plurality of inner electrodes carried by said shaft, and means for rotating said container, and the outer electrodes carried thereby, and said shaft, and the inner electrodes carried thereby, in opposite directions, to thus bring about a relative rotation of said outer and inner electrodes.

10. An electric furnace for the treatment of comminuted material, comprising a container, a plurality of outer electrodes supported on the inner surface of said container, a shaft passing through said container, a plurality of inner electrodes carried by said shaft, and means for effecting a relative rotation of said outer and inner electrodes, the electrodes of said set of outer electrodes being in the form of spiral elements for advancing the comminuted material during the relative rotation of said two sets of electrodes.

11. An electric furnace for the treatment of comminuted material, comprising a container, a plurality of outer electrodes supported on the inner surface of said container, a shaft passing through said container, a plurality of inner electrodes carried by said shaft, and means for rotating said container and the outer electrodes carried thereby to thus bring about a relative rotation of said outer and inner electrodes, the outer electrodes being formed to advance the comminuted material during the relative rotation of said two sets of electrodes.

12. An electric furnace for the treatment of comminuted material, comprising a container, a plurality of outer electrodes supported on the inner surface of said container, a shaft passing through said container, a plurality of inner electrodes carried by said shaft, and means for rotating said container, and the outer electrodes carried thereby, and said shaft, and the inner electrodes carried thereby, in opposite directions, to thus bring about a relative rotation of said outer and inner electrodes, the electrodes of said set of outer electrodes being in the form of spiral elements for advancing the comminuted material during the relative rotation of said two sets of electrodes.

13. In an electric furnace for the treatment of comminuted material, a heating chamber, and a plurality of electrodes within said chamber, said electrodes being in the form of spiral elements so as to effect an

advance of said material within said chamber, and means for effecting a relative movement of said electrodes with respect to said material.

14. In an electric furnace for the treatment of comminuted material, a heating chamber, and a plurality of electrodes carried by the inner wall of said chamber and being shaped to effect an advance of said material within said chamber, and means for effecting a relative movement of said electrodes with respect to said material.

15. In an electric furnace for the treatment of comminuted material, a heating chamber, and a plurality of electrodes carried by the inner wall of said chamber, said electrodes being in the form of spiral elements so as to effect an advance of said material within said chamber, and means for effecting a relative movement of said electrodes with respect to said material.

16. An electric furnace for the treatment of comminuted material, comprising a heating chamber, a plurality of electrodes within the same, and feeding means secured to the inner wall of said chamber for effecting an advance of said material.

17. An electric furnace for the treatment of comminuted material, comprising a heating chamber, a plurality of agitating electrodes within the same and rotatable independently of said chamber, means for effecting a relative movement of said electrodes with respect to said material, and means independent of said electrodes and secured to the inner wall of said chamber for effecting an advance of said material.

18. In an electric furnace for the treatment of comminuted material, a heating chamber, and an electrode within said chamber, said electrode being in the form of a spiral element so as to effect an advance of said material within said chamber upon the relative movement of said electrode with respect to said material.

19. In an electric furnace for the treatment of comminuted material; a heating chamber, and an electrode carried by the inner wall of said chamber and being shaped to effect an advance of said material within said chamber upon the relative movement of said electrode with respect to said material.

20. In an electric furnace for the treatment of comminuted material, a heating chamber, and an electrode carried by the inner wall of said chamber, said electrode being in the form of a spiral element so as to effect an advance of said material within said chamber upon the relative movement of said electrode with respect to said material.

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

JOHN J. NAUGLE.