J. CHURCHWARD.

FURNACE.

APPLICATION FILED APR. 26, 1911.

1,069,601.

Patented Aug. 5, 1913.

2 SHEETS—SHEET 1.

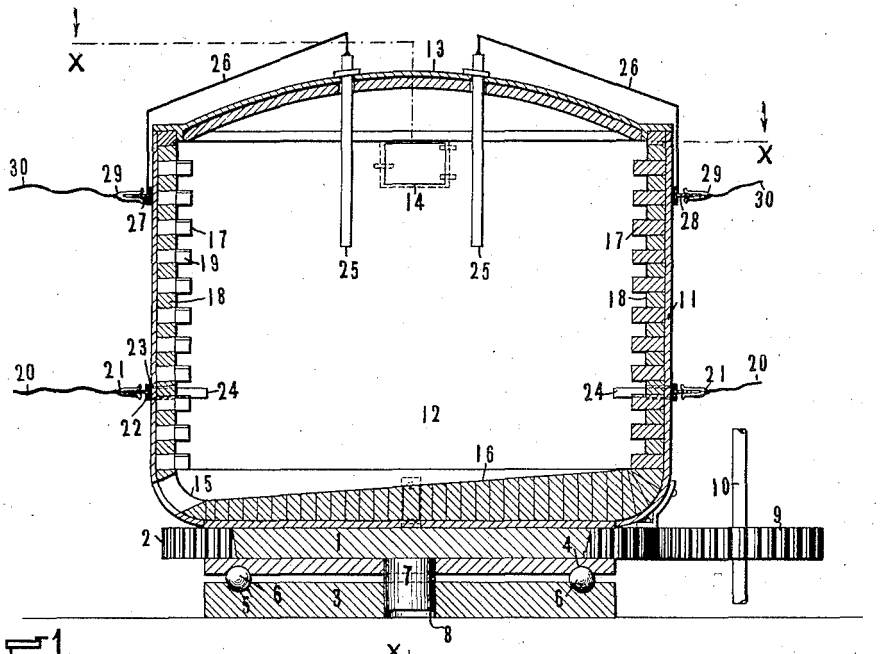


Fig. 1.

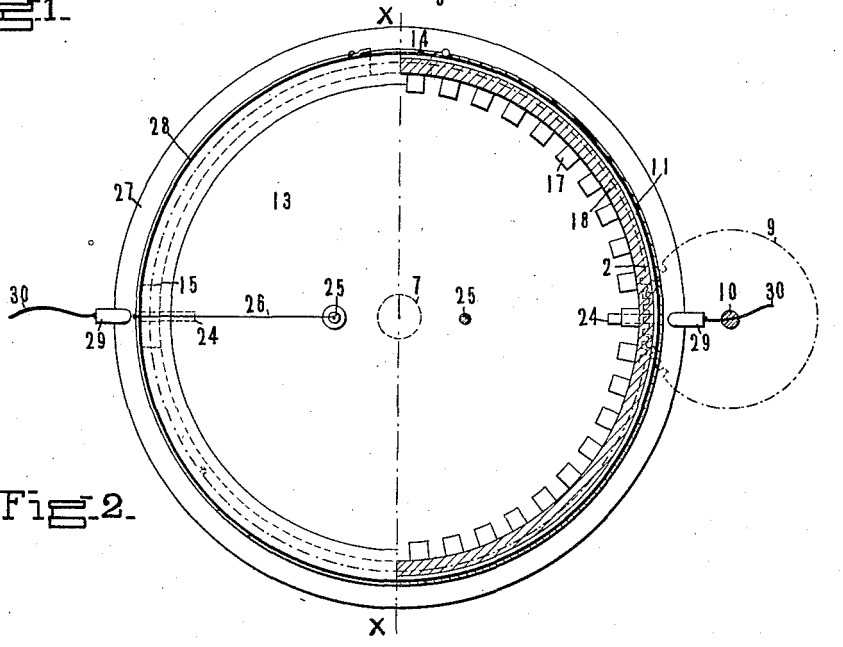
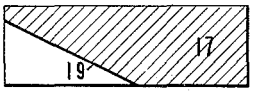


Fig. 2.

Fig. 5.



WITNESSES

INVENTOR

J. Churchward

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2 SHEETS—SHEET 2.

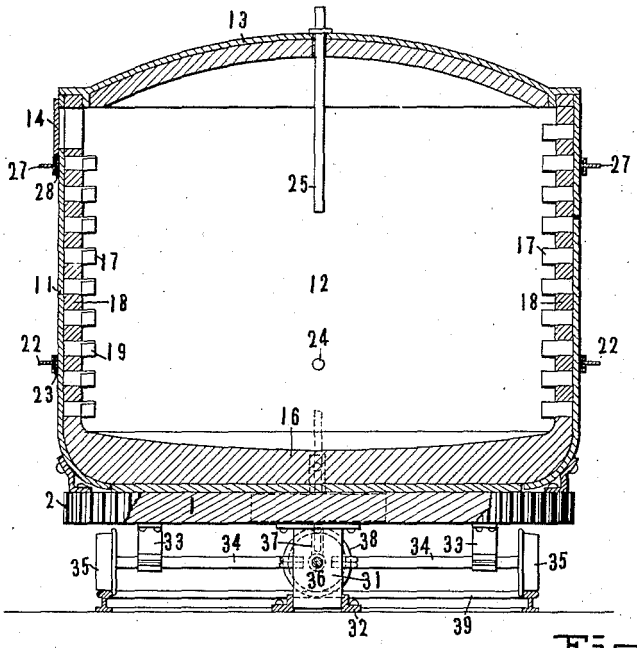
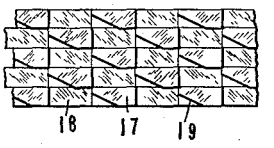


Fig. 3.

Fig. 6.



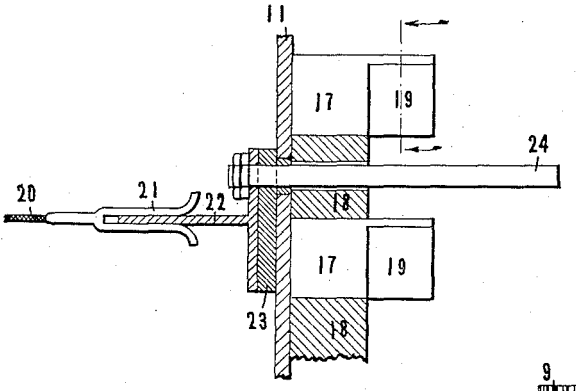


Fig. 4.

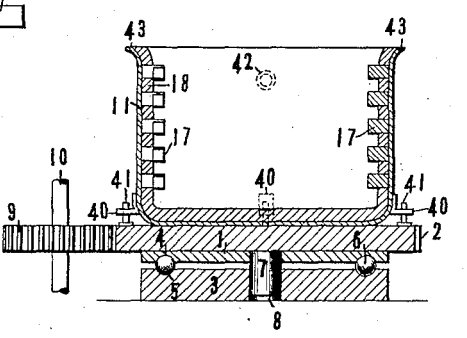


Fig. 7.

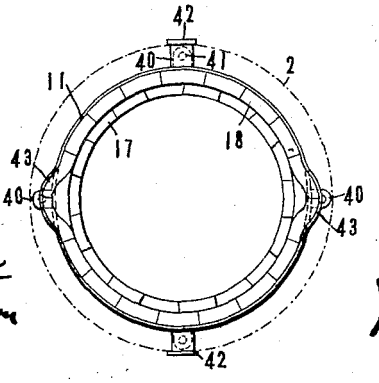


Fig. 8.

WITNESSES

INVENTOR

J. Churchward

BY

ATTORNEYS

UNITED STATES PATENT OFFICE.

JAMES CHURCHWARD, OF MOUNT VERNON, NEW YORK, ASSIGNOR TO CHURCHWARD INTERNATIONAL STEEL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

FURNACE.

1,069,601. Specification of Letters Patent. Patented Aug. 5, 1913.

Application filed April 26, 1911. Serial No. 623,359.

To all whom it may concern:

Be it known that I, JAMES CHURCHWARD, a citizen of the United States, residing at Mount Vernon, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Furnaces, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to furnaces, and with respect to its more specific features, to a rotatable furnace.

One of the objects of the invention is to provide a practical device of the class described adapted to thoroughly mix molten material contained therein.

Another object is to provide an efficient device of the class described adapted to provide a high temperature.

Another object is to provide a device of the class described comprising a simple and compact heating means.

Another object is to provide a device of the class described which shall possess few parts, shall be easy to operate and cheap to manufacture.

Another object is to provide a simple, practical device of the class described comprising efficient means for cooling material.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the following claims.

In the drawings, wherein is represented one of the various possible embodiments of this invention, Figure 1 is a side sectional elevation thereof, omitting a portion of the lining for clearness; Fig. 2 is a plan view thereof showing a portion in section on the line X—X of Fig. 1; Fig. 3 is a side sectional elevation on the line X—X of Fig. 2, omitting a portion of the lining for clearness; Fig. 4 is a detail view of a portion of the heating means; Fig. 5 is a detail view of a portion of the lining of the device; Fig. 6 is a diagrammatic view of a portion of the lining; Fig. 7 is a side sectional elevation of a ladle for use with the device; and Fig. 8 is a plan view of the ladle.

It is believed that it will tend to a more complete appreciation of some of the important features of the device to call attention to the fact that in the use of devices for the heat treatment of materials it is in many cases highly desirable to secure a thorough blending of the various components making up the material used. For example, in the metallurgical art, in the production of alloys and in the various operations of smelting, refining, etc., it is generally necessary to secure a thoroughly mixed and homogeneous mass. In the addition of materials having a high melting point to a molten bath, there are apt to occur segregations in the mass resulting in an improper blending thereof. If the metal be agitated and the various portions of the mixture be quickly and thoroughly brought into contact with one another, there is little opportunity for these segregations and the result is a more perfect and homogeneous product.

That the invention herein disclosed is eminently fitted to secure homogeneity in molten material and especially metallic admixtures, and possesses many other highly desirable features for general heat treatment of materials, will be apparent by noting the structure and mode of operation of the embodiment shown in the drawings.

Referring now to Fig. 1, 1 represents a table adapted to rotate, which is provided with a toothed periphery 2 and with a fixed support 3. The lower surface of the table is provided with an annular groove 4 and the upper surface of the support is provided with a corresponding annular groove 5. Between the table and its support, and resting in the grooves of each, are balls 6 adapted to serve as ball-bearing members for the table. The table is also provided with a stud 7 adapted to fit into a bearing 8 in the fixed support. Mounted upon the table and attached thereto is the furnace proper. The table is adapted to be rotated by means of a pinion 9 which is mounted on a shaft 10 and is adapted to rotate the furnace about its vertical axis. The shaft may be rotated in any convenient manner, for example, by a motor mounted thereon or by a belt and pulley or other suitable device. The furnace, which is preferably upright, comprises a substantially cylindrical outer shell or casing 11, surrounding a single inner melting or heating chamber 12, and, as shown, may

be conveniently pot-shaped. It is provided with a dome-shaped cover 13 and the cover and heating chamber are both lined with suitable refractory material, preferably adapted to withstand high temperatures. The furnace is provided with a door 14 and a tap 15. The inner periphery of the furnace conforms to that of the outer casing and is substantially cylindrical. The walls, however, of the lower portion of the inner lining converge to form a slanting, trough-shaped portion 16 which gradually increases in depth from one side of the furnace across to the tap 15. As will be noted in the embodiment shown, the trough-like portion is preferably diametrically disposed. In order to stir up the material in the furnace by means independent of the rotation provided by the pinion 9 the continuity of the inner periphery of the furnace is interrupted by projecting bricks 17, preferably of suitable fireclay, which, as shown, are radially disposed about the inner periphery at intervals, being associated with other bricks 18 of similar material laid flat. The bricks may be rounded to conform to the periphery of the outer casing or straight as desired. The length of the bricks in the embodiment shown is greater than the depth and breadth thereof.

As shown more particularly in the detail views of Figs. 4, 5 and 6, the projecting bricks which project beyond the outermost surface of the flat bricks are preferably provided with a beveled surface 19, the bevel extending from a point near the upper edge and about midway of the length of the brick, downwardly and backwardly at a convenient angle, in the embodiment shown approximately 30°. When the bricks are set in operative position, the plane of the beveled surface of each preferably extends in a direction oblique to the direction of rotation of the furnace and is so disposed that the surface deflects the particles of material held in the furnace. According to this construction, when the furnace shown in Fig. 1 is rotated counter-clockwise, the material held therein will contact with the beveled surface of the bricks, and, owing to the obliquity thereof, will be deflected into the lower portion of the furnace. Owing to the fact that the fluid contained in the furnace will not rotate as rapidly as the furnace wall, the fluid will have a motion with respect to this wall. The disposition of the beveled bricks with relation to the position of the flush bricks of the inner lining of the surface, preferably forms, as shown, see Fig. 6, a checker-board design, which may be altered as desired according to the size of the furnace, the various conditions under which it is to be operated, etc. The furnace may be heated in any desired manner, but as shown in this embodiment, it is adapted to be heated by electric current. The current is transmitted to the furnace through the wires 20 which are joined to contact members 21, the contact members being preferably stationary and attached at a point exterior to the furnace. The current passes from these contact members to the lower band 22 which surrounds the lower exterior surface of the cylindrical casing 11, and is insulated therefrom, as shown clearly in Fig. 4, by the band of refractory insulating material 23. The band 22 and the insulating band 23 are attached to the furnace in any suitable manner. The lower band is connected in parallel with positive electrodes 24 disposed in the wall of the furnace and projecting into the heating chamber thereof. The current passes from these electrodes through the material held in the furnace and thence to the two vertical electrodes 25 which project through the cover of the furnace into the heating chamber and are adapted to serve as negative electrodes. The current passes through these negative electrodes to the wires 26 which are connected in parallel with the upper band 27 which surrounds the upper surface of the inclosing casing. This band is also suitably insulated by a band 28 of refractory insulating material similar to that used with the lower band. This upper band contacts with contact members 29 which are fixed at a point exterior to the furnace, and these contact members are in turn attached to wires 30. The contact members associated with the upper and lower bands may be of any convenient design, and the friction clips shown in the drawings may be conveniently replaced by a brush, wheel or similar device adapted to contact with the bands.

The ball-bearing members shown in Fig. 1 may be replaced by a modified construction shown in Fig. 3, where the table 1 is provided with a stud 31 which is adapted to bear in a ring 32 which may be attached to the floor or other means of support. Secured to the under surface of the table by means of brackets 33 are shafts 34 supporting at their outer extremities, wheels 35. Supported by brackets 36 in a similar manner at an angle to the shafts 35 are other shafts 37 having wheels 38 at their outer extremities. The wheels mounted on these shafts are flanged and adapted to travel on a track 39 and thereby provide a rolling bearing surface for the table.

In general practice a ladle like that shown in Fig. 7 is preferably provided. The ladle has substantially the same general structure as the furnace, but contains some additional features, making it adaptable for its particular purpose. Attached to the lower portion of the ladle, as shown in Fig. 7, are perforated lugs 40. In this embodiment, the lugs are disposed like the corners of a square

about the furnace. The perforated lugs are adapted to engage and be held by upright rods 41, which are in turn secured to the upper surface of the rotating table. In order to provide means for transporting the ladle from the furnace to the molds, or elsewhere, the outer casing is provided with trunnions 42 whereby the ladle may be lifted, using a crane, tongs, or other device. In order to facilitate pouring of the molten material from the ladle, spouts 43 are provided in the outer casing, and the inner lining of refractory material conforms thereto. As will be noted, the arrangement of the inner lining is substantially the same as that of the furnace proper, being provided with projecting firebricks, having beveled surfaces, as well as flush bricks. If desired the ladle may be provided with a cover, a door and a tap hole, as has been shown in connection with the furnace.

In operating the device, the material to be subjected to melting or other heat treatment is charged into the interior of the furnace by the door 14 or else, if found to be preferable, by removing the cover 13. After charging, power is applied to the shaft 10 and thereby to the rotatable table 1. Current is supplied to the positive electrodes and the negative electrodes being in proper position to receive the current, the furnace will be heated. The rotation of the furnace tends to force any molten material therein up on the sides thereof, and the projecting firebricks, as previously explained, tend to thrust the material down into the furnace, so that the upper surface of the fluid remains substantially level and the tendency for the fluid to rise on the sides is practically overcome. A path of flow will consequently be established in the furnace which will tend to follow substantially the following course: The particles of material at the outermost boundaries of the mass will tend to proceed downwardly toward the center thereof, from that point will tend to pass in a substantially central path upward, and from thence will tend to proceed toward the outermost boundaries of the mass. This path of travel will effect a thorough and complete agitation of the mass and will consequently provide therefor a thorough blending and incorporation. After incorporation of the various constituents of a given mass of metal which has been subjected to the melting process in the furnace, the material is often too hot to pass directly to the molds or to be subjected to other processes, and it becomes necessary to cool it. This may be conveniently done in the furnace proper by simply turning off the current and allowing the rotation to continue. This rotation will not only tend to cool the metal more rapidly by agitating it, but at the same time will prevent the segregation of the various parts of the mass which often causes difficulty in obtaining a homogeneous product. For many purposes it will be found desirable, however, instead of allowing the furnace to cool, particularly if the latter be of substantial size, to tap material into the ladle and cool it there. By rotating the ladle while cooling, substantially the same results will be accomplished as mentioned with the furnace, and when the material has sufficiently cooled it may be poured, as indicated, directly into the molds, or carried through other processes. The embodiment described provides a highly satisfactory means for agitating the material to be heated, and practically prevents the segregations of material which frequently occur in the formation of alloys and in various other metallurgical and heating processes.

The rotation of the furnace about its vertical axis is a feature of special importance in view of the fact that the material within the furnace is provided with a motion, due in part to that of the furnace proper and in part to the projecting bricks, and a very thorough admixture is consequently obtained. Furthermore, with the construction shown, the source of heat is in continuously intimate contact with the various portions of the material to be heated during the whole period of heating.

It will thus be seen that a simple and practical device is provided wherein the objects of the invention, among others, are achieved.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense. It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an apparatus of the character described, in combination, a furnace comprising a heating chamber adapted to rotate on a vertical axis, said chamber being provided with converging walls forming an inclined discharging trough, and means adapted to rotate said furnace.

2. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to rotate said furnace, and means adapted to prevent substantially the rise of material

along the wall of said furnace, due to the rotation of said furnace.

3. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to rotate said furnace, and means, independent of said rotating means, adapted to agitate material held in said furnace while maintaining the upper surface of said material substantially level.

4. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to rotate said furnace, and a member projecting from the wall of said furnace and adapted to throw downward and thereby agitate material held in said furnace.

5. In an apparatus of the nature disclosed, in combination, an upright furnace provided with a chamber having a lining of fire-resisting material, a part of said lining material projecting into said chamber, and means adapted to rotate said furnace.

6. In an apparatus of the nature disclosed, in combination, a furnace, a stirring member projecting therein, said stirring member being provided with a beveled face, and means adapted to rotate said furnace.

7. In an apparatus of the nature disclosed, in combination, a movable upright furnace provided with a lining of firebricks, certain of said firebricks being provided with a beveled face adapted to depress material in the furnace, and means adapted to rotate said furnace.

8. In an apparatus of the nature disclosed, in combination, a movable furnace adapted to rotate and provided with a substantially cylindrical heating chamber, said heating chamber having a lining of fire-bricks, certain of said firebricks projecting into said chamber, the projecting portion of each fire-brick being beveled, the bricks being set in such a manner that the beveled surface slopes in a direction oblique to the direction of rotation of the furnace, and means adapted to rotate said furnace.

9. In an apparatus of the nature disclosed, in combination, a furnace adapted to rotate and having a substantially cylindrical upright wall providing a heating chamber, a tap in the lower portion of said furnace wall, said furnace being provided with a slanting trough-like bottom wall, said bottom wall sloping toward said tap, and means adapted to rotate said furnace.

10. In an apparatus of the nature disclosed, in combination, a furnace adapted to rotate and having a substantially cylindrical upright wall providing a heating chamber, a tap in the lower portion of said furnace wall, said furnace being provided with a slanting trough-like bottom wall, said bottom wall sloping toward said tap, said chamber being provided with a lining of fire-bricks, certain of said fire-bricks projecting into said chamber, the projecting portion of each fire-brick being beveled, said bricks being set in such a manner that the surface slopes in a direction oblique to the rotation of the furnace, and means adapted to rotate said furnace.

11. In an apparatus of the nature disclosed, in combination, a table adapted to rotate, a furnace removably attached thereto and rotatable therewith, a support for said table, the upper surface of said support being provided with an annular groove, the lower surface of said table being provided with a corresponding annular groove, and a ball bearing member resting in contact with said grooves and serving as a bearing surface between said table and said support.

12. In an apparatus of the nature disclosed, in combination, a substantially upright movable heating chamber, having a fire-resisting lining, comprising fire-bricks, certain of said bricks projecting into said chamber.

13. In an apparatus of the nature disclosed, in combination, an upright heating chamber, and a stirring member projecting therein, said stirring member being provided with a beveled face.

14. In an apparatus of the nature disclosed, in combination, a substantially upright movable heating chamber provided with a lining of firebricks, certain of said fire-bricks being provided with a beveled face and projecting beyond the surface of the lining into the heating chamber.

15. In an apparatus of the nature disclosed, a rotatable furnace provided with a substantially cylindrical heating chamber having a lining of fire-bricks, certain of said fire-bricks projecting into said chamber, the projecting portion of each of said fire-bricks being beveled and said bricks being set in such manner that the beveled surface slopes in a direction oblique to the direction of rotation of the furnace.

16. In an apparatus of the nature disclosed, in combination, a substantially upright movable furnace having a lining comprising a series of firebricks, certain of said bricks being laid flat, certain others of said bricks being laid with a portion projecting beyond the outermost surface of said flat bricks, the projecting portion of said bricks being beveled to a point about midway of the length of said bricks.

17. In an apparatus of the nature disclosed, in combination, a heating chamber having a substantially cylindrical upright wall, and a tap in the lower portion of said wall, said chamber being provided with a slanting bottom, said bottom sloping toward said tap, said heating chamber being provided with a lining of fire-brick, certain of said fire-bricks projecting into said chamber, the projecting portion of each of said fire-bricks being beveled in such a

manner that the surface slopes downwardly from the upper edge thereof at a point about midway of one of the longer sides of said brick.

18. In an apparatus of the nature disclosed, in combination, an upright furnace having a substantially cylindrical exterior periphery, an upper band attached to and surrounding the upper portion of said periphery and a lower band attached to and surrounding the lower portion of said periphery, a plurality of contact members adapted to contact with said bands, one of said contact members being adapted to supply an electric current to one of said bands and another of said contact members being adapted to conduct a current from another of said bands, one of said bands being attached to a horizontal electrode, and the other of said bands being attached to a vertical electrode, and means adapted to rotate said furnace.

19. In an apparatus of the nature disclosed, in combination, a rotatable furnace having a substantially cylindrical surface, an upper band surrounding the upper portion of said surface connected to a vertical negative electrode, a lower band surrounding the lower portion of said surface connected to a positive electrode, said bands being attached to said furnace and adapted to rotate therewith, a plurality of contact members adapted to make a continuous contact with said bands, one of said contact members being adapted to transmit a current to said lower band and thence to said positive electrode, another of said contact members being adapted to conduct a current passing from said negative electrode through said upper band, and means adapted to rotate said furnace.

20. In an apparatus of the nature disclosed, in combination, a table adapted to rotate, a furnace attached thereto and rotatable therewith, a track, rotative members associated with said table and coacting with said track, said members being adapted to provide a bearing surface for said table upon rotation, and means adapted to rotate said table.

21. In an apparatus of the nature disclosed, in combination, a furnace adapted to rotate, having a substantially cylindrical heating chamber, a tap in the side wall of said heating chamber, said furnace being provided with a slanting trough-like bottom wall, said bottom wall sloping toward and joining said tap, and means adapted to rotate said furnace.

22. In an apparatus of the nature disclosed, in combination, a table adapted to rotate, a furnace removably attached thereto, and means adapted to rotate said table.

23. In an apparatus of the nature disclosed, in combination, a table adapted to rotate, and a furnace removably mounted thereon.

24. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to move said furnace, and means adapted to prevent substantially the rise of material on the sides of the furnace.

25. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to move said furnace, and means adapted to prevent substantially the rise of material on the side of the furnace comprising a member adapted to deflect material downward.

26. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to supply electric current to said furnace, and means adapted to rotate said furnace.

27. In an apparatus of the nature disclosed, in combination, a furnace, electrodes projecting into said furnace, and means adapted to rotate said furnace.

28. In an apparatus of the nature disclosed, in combination, a furnace having a heating chamber, electrodes projecting into said heating chamber in the upper portion thereof, electrodes projecting into said chamber in the lower portion thereof, means to supply current to said electrodes, and means adapted to rotate said furnace.

29. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on an upright axis, and means whereby the rise of material at the sides of the receptacle due to rotation is substantially prevented.

30. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle, means adapted to heat said receptacle comprising electrodes spaced in the receptacle, a source of electric energy, and means adapted to connect the electrodes to said source of energy as the receptacle rotates.

31. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle, and a trough stationary relative to the receptacle adapted to discharge the contents of the receptacle.

32. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on an upright axis, means whereby the rise of material at the sides of the receptacle due to rotation is substantially prevented, means adapted to heat said receptacle comprising electrodes spaced in the receptacle, a source of electric energy, and means adapted to connect the electrodes to said source of energy as the receptacle rotates.

33. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on an up

right axis, means whereby the rise of material at the sides of the receptacle due to rotation is substantially prevented, means adapted to heat said receptacle comprising electrodes spaced in the receptacle, a source of electric energy, means adapted to connect the electrodes to said source of energy as the receptacle rotates, and a trough stationary relative to the receptacle adapted to discharge the contents of the receptacle.

34. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on an upright axis, a trough stationary relative to said receptacle adapted to discharge the contents of the receptacle, and means whereby the rise of material at the sides of the pot due to rotation is substantially prevented.

35. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle, means adapted to heat said receptacle comprising electrodes spaced in the receptacle, a source of electric energy, means adapted to connect the electrodes to the source of energy as the receptacle rotates, and a trough stationary relatively to the receptacle adapted to discharge the contents of the receptacle.

36. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on an upright axis, and means whereby the rise of material at the sides of the receptacle is substantially prevented, comprising elements in the receptacle having surfaces inclined to the plane of rotation.

37. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on an upright axis, and means whereby the rise of material at the sides of the receptacle is substantially prevented, comprising elements projecting from the walls of the receptacle and having surfaces inclined to the plane of rotation.

38. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on an upright axis, and means whereby the rise of material at the sides of the receptacle is substantially prevented, comprising elements projecting from the walls of the receptacle and having surfaces so inclined to the plane of rotation as to deflect the material downwardly.

39. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on an upright axis, and means whereby the rise of material at the sides of the receptacle is substantially prevented, comprising elements projecting from the walls of the receptacle in different horizontal planes and having surfaces inclined to the plane of rotation so as to direct material downwardly.

40. In an apparatus of the nature disclosed, in combination, a furnace, a plurality of sources of heat disposed in the wall of said furnace, and means adapted to rotate said furnace.

41. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to supply electric current to said furnace, and means adapted to rotate said furnace.

42. In an apparatus of the nature disclosed, in combination, a furnace, and means adapted to supply an electric current to said furnace, comprising a band associated with said furnace and a member adapted to move with respect to said furnace and to supply current to said band.

43. In an apparatus of the nature disclosed, in combination, a furnace, and means adapted to supply an electric current to said furnace, comprising an upper band and a lower band, said bands being connected to electrodes and a contact member adapted to contact with said bands and to supply current thereto, said contact member being adapted to traverse said bands.

44. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to supply an electric current to said furnace, comprising a band associated with said furnace and a member adapted to contact with said band and furnish electric current thereto, and means adapted to rotate said furnace.

45. In an apparatus of the nature disclosed, in combination, a furnace, means adapted to supply electric current to said furnace, comprising a plurality of bands and sliding contact members adapted to coact therewith and to furnish current thereto, one of said bands being connected to a positive electrode and another of said bands being connected to a negative electrode, and means adapted to rotate said furnace.

46. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle, said receptacle having in its bottom a recess adapted to agitate material.

47. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle, said receptacle having in its bottom an inclined recess adapted to discharge the contents of the receptacle.

48. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle on a vertical axis, means whereby the rise of material at the sides of the receptacle is resisted, comprising elements projecting from the walls of the receptacle and having surfaces inclined to the plane of rotation so as to deflect material downwardly, electrodes spaced in the receptacle, a source of elec-

tric energy, a fixed contact member, and a contact member movable with the receptacle and adapted to contact said fixed member.

49. In an apparatus of the character described, in combination, a receptacle, means adapted to rotate said receptacle, means whereby the rise of material at the sides of the receptacle is substantially prevented, and means adapted to heat said receptacle.

50. In an apparatus of the character described, in combination, a receptacle rotatable about a vertical axis, and means for electrically heating the charge in the interior of the receptacle during rotation.

In testimony whereof I affix my signature, in the presence of two witnesses.

JAMES CHURCHWARD.

Witnesses:
J. THOMSON,
L. A. WATSON.