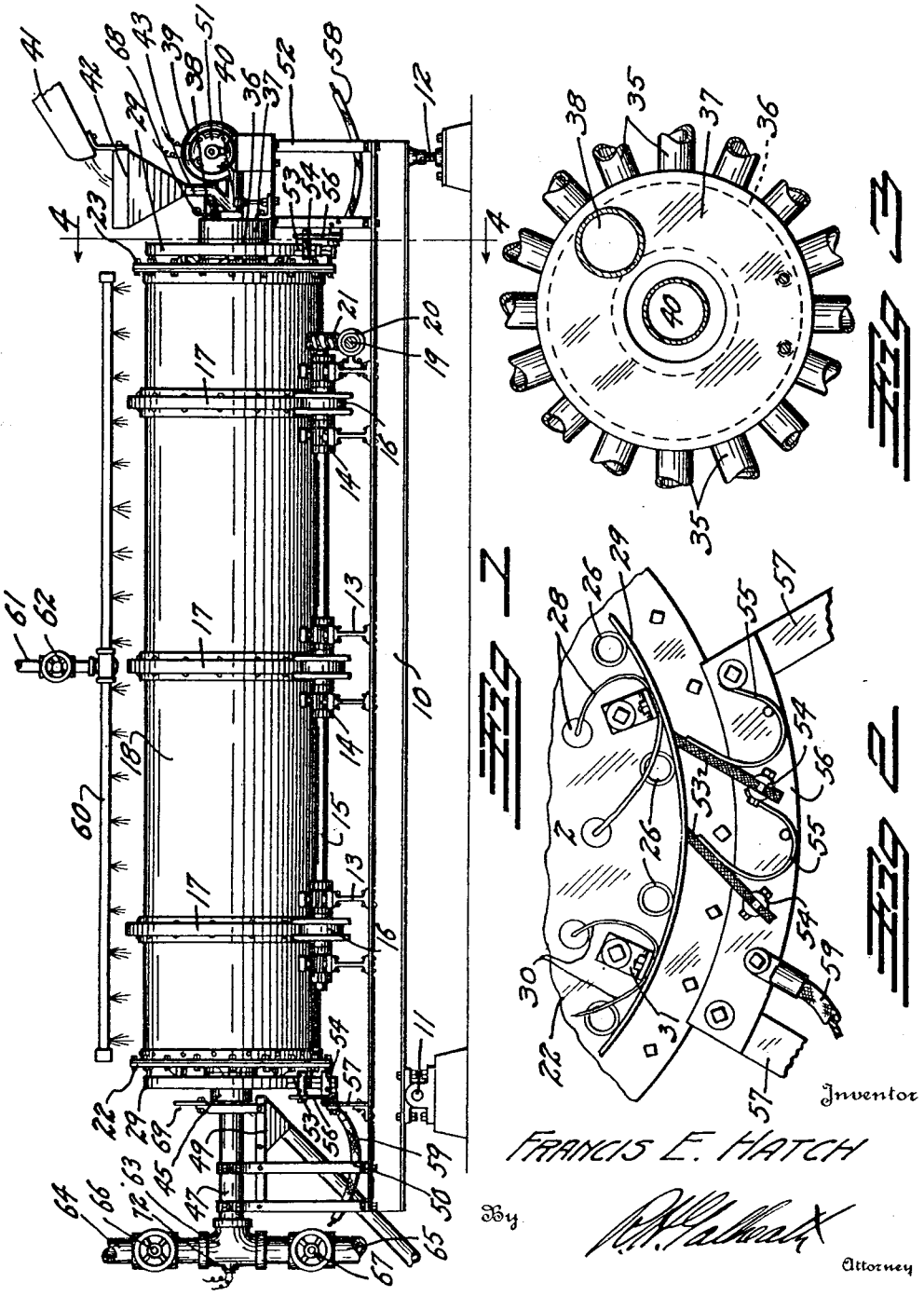
April 10, 1928. 1,665,546

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ELECTRIC FURNACE FOR TREATING ORES, SHALES, ETC

Filed Sept. 4. 1926 3 Sheets-Sheet 1



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ELECTRIC FURNACE FOR TREATING ORES, SHALES, ETC

Filed Sept. 4. 1926 3 Sheets-Sheet 2

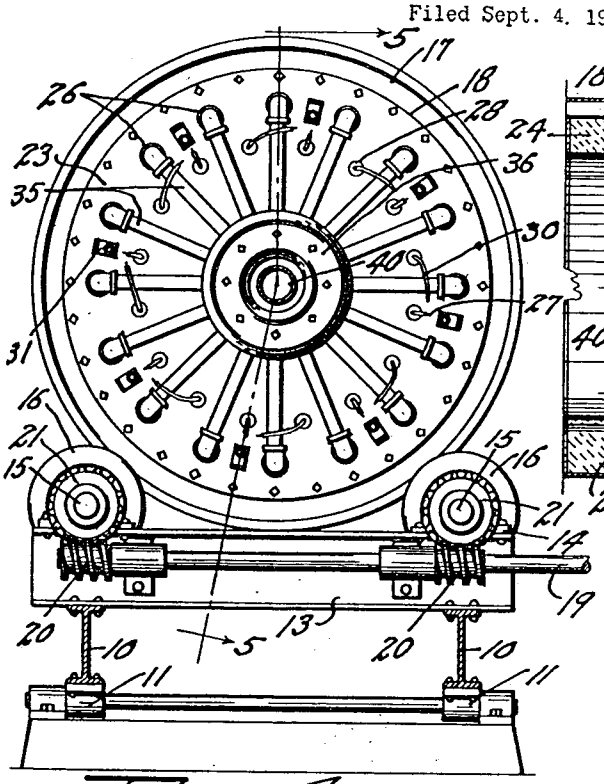


Fig 4

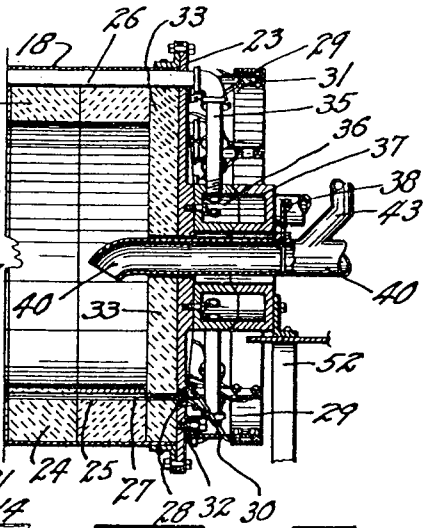


Fig 5

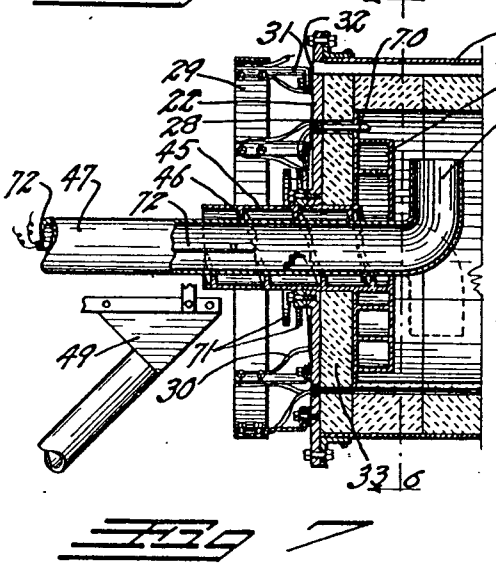


Fig 7

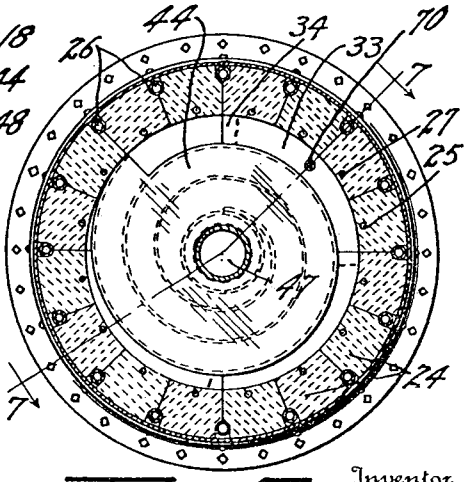


Fig 6

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ELECTRIC FURNACE FOR TREATING ORES, SHALES, ETC

Filed Sept. 4, 1926 3 Sheets-Sheet 3

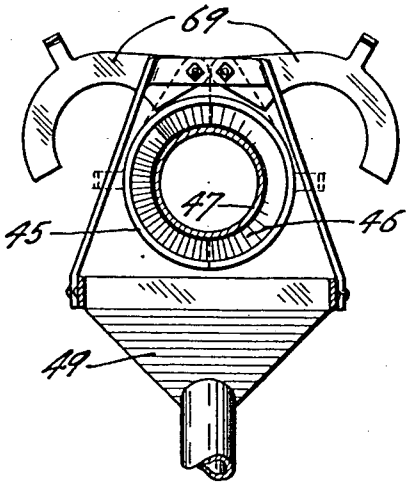


Fig 6

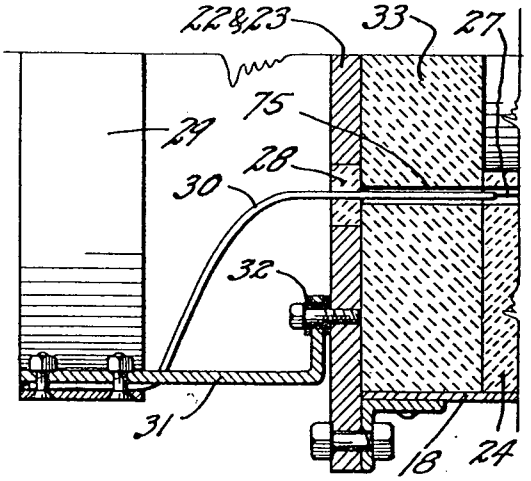


Fig 9

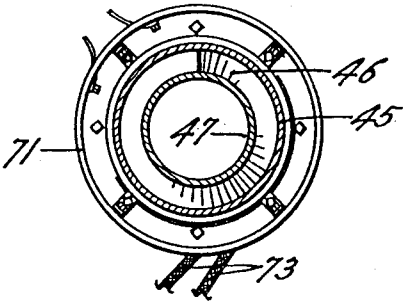


Fig 10

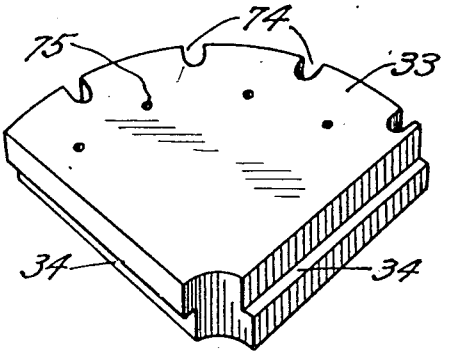


Fig 11

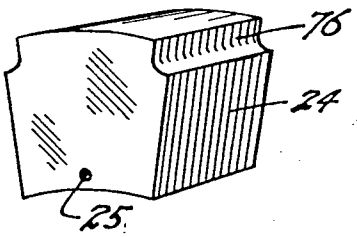


Fig 12

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Patented Apr. 10, 1928. 1,665,546

UNITED STATES PATENT OFFICE.

FRANCIS E. HATCH, OF DENVER, COLORADO.

ELECTRIC FURNACE FOR TREATING ORES, SHALES, ETC.

Application filed September 4, 1926. Serial No. 133,715.

This invention relates to an electrically heated furnace, and, while primarily designed for the heating and reduction of ores, it will also find useful application in many other fields, such as distilling oil shales, etc., where a very accurate control of temperature is desirable.

The principal object of the invention is to provide a furnace of this character which will be more efficient and practical in operation than the ones illustrated in my prior patents, to wit, Nos. 640,283, issued January 2, 1900; 741,333, issued October 13, 1903; and 946,727, issued January 18, 1910. The present invention has, of course, all of the objects and advantages provided by the apparatus illustrated in said prior patents in addition to the advantages brought about by the improvements incorporated herein.

Another object of the invention is to prevent heat losses and provide a more uniform and quicker heating result from a minimum amount of electricity.

Still another object is to introduce the ore or other material being treated into the furnace combined with heated air, said air being heated from the waste heat of the furnace.

A further object is to provide means for separately removing the gases and solid material continuously from one extremity of the furnace.

A still further object resides in the novel and efficient electrical heating element employed in the furnace.

Other objects and advantages reside in the detail construction of the invention, which is designed for simplicity, economy, and efficiency. These will become more apparent from the following description.

In the following detailed description of the invention reference is had to the accompanying drawings which form a part hereof. Like numerals refer to like parts in all views of the drawings and throughout the description.

In the drawings:

Fig. 1 is a side elevation of the complete invention.

Fig. 2 is an enlarged fragmentary elevation of the discharge end of the furnace, illustrating in detail the electrical collector rings.

Fig. 3 is a detail end view of the air collector.

Fig. 4 is a vertical cross section, taken on the line 4—4, Fig. 1. In this view the cap of the air collector is removed.

Fig. 5 is a detail longitudinal section through the feed end, taken on the line 5—5, Fig. 4.

Fig. 6 is a detail cross section through the furnace, taken on the line 6—6, Fig. 7.

Fig. 7 is a detail longitudinal section through the discharge end of the furnace.

Fig. 8 is a detail view of a gate which may be employed on the discharge of the furnace.

Fig. 9 is an enlarged detail section through one of the furnace heads.

Fig. 10 is a detail view of the pyrometer collecting rings.

Figs. 11 and 12 are perspective views of the fire bricks employed in the furnace.

The furnace proper comprises a cylinder or drum 18, which is supported on a main frame 10. The frame 10 is hingedly supported at 11 and provided with elevation adjusting screws 12, by means of which the horizontal angle of the furnace may be changed at will and comprises longitudinal beams which carry a series of lateral beams 13. Bearings 14 are supported on the lateral beams 13 and carry two parallel shafts 15 along each side of the frame 10. Keyed to the shafts 15 are flanged supporting rolls 16, which are engaged by annular tracks 17 which surround and are secured to the furnace drum 18. The drum 18 is rotated from any suitable source of power through the medium of a countershaft 19, which acts through worms 20 and worm wheels 21 to rotate the shafts 15.

The drum 18 is closed at one extremity by means of a discharge head 22 and at the other extremity by an intake head 23, and is lined throughout its interior with bricks 24 of fire clay or other suitable fire resisting, refractory, insulating material. The bricks 24 are sector-shaped and are cemented into the drum 18 in a continuous cylinder. Each brick contains a longitudinal passage 25 centrally located near its interior face adapted to contain the heating element, and has cut-away corners in its exterior face to form passages for air pipes 26 adjacent the inner face of the drum 18. The heating elements, designated by the numeral 27, comprise a wire or strip of electrical resistance metal, such as a nickel chromium alloy or the like.

The extremities of the element 27 are conducted through bushed openings 28 in the

discharge and intake heads 22 and 23 and terminate in annular collector rings 29, supported from each extremity of the drum 18. This places the heating elements "in parallel" between the collector rings so that the failure of one or more elements will not effect the remaining elements. The portion of the heating elements on the exterior of the heads is passed through copper tubes 30 to increase the electrical carrying capacity at this point and prevent heating of the element on the exterior of the drum. The collector rings 29 are supported from the drum on brackets 31 which are electrically insulated at 32 from the heads.

The inner face of each of the heads is provided with a fire clay lining, as at 33. Each of these linings consist of four segment shaped bricks joined with an overlapping joint, as indicated at 34. The air pipes 26 extend throughout the length of the drum 18 and open to the atmosphere through the discharge head 22 (as shown in Figs. 2 and 9) and to radially arranged pipes 35 exteriorly of the intake head 23.

The pipes 35 all communicate with a hot air collector 36 secured concentrically of the intake head 23 so as to rotate with the drum. The hot air collector 36 is closed by means of an annular, stationary cap 37, through which a hot air intake pipe 38 communicates to a blower 39. The blower 39 discharges through a stationary blower pipe 40 which passes through the hot air collector 36, the intake head 23, and the lining 33 at the intake end of the drum.

The material to be treated in the furnace is introduced at 41 into a hopper 42 which communicates through a pipe 43 with the blower pipe 40. At this discharge end of the furnace a spiral scoop 44 is placed on the interior of the fire brick lining 33. The scoop 44 is carried on the extremity of and communicates with a sleeve 45 which contains an internal scroll conveyor 46. The scoop 44 and scroll conveyor 46 are secured to the head 22 and rotate with the drum 18 about a stationary gas discharge vent 47 which passes concentrically through the scroll 46 and terminates in an upwardly turned extremity 48 on the interior of the drum 18. The scroll 46 discharges into a suitable discharge hopper 49.

The hopper 49 and the vent 47 are supported from the frame 10 on a suitable supporting frame 50. The blower 39, with its driving motor 51, the feed hopper 42 and the hot air collector cap 37 are all rigidly supported on a frame 52 from the main frame 10.

A series of brushes 53 contact with each of the collector rings 29 at each extremity of the drum 18. The brushes 53 are carried in rotatable posts 54 and are forced against the collector rings by means of suitable springs 55. The brush posts 54 are supported on bus bars 56. The bus bar 56 at the discharge end of the furnace is carried on a stationary frame 57 from the main frame 10. The bus bar 56 at the intake end is supported from the frame 52.

In operation electric current is fed from any suitable source to the bus bars 56 through conductors 58 and 59 controlled by a suitable rheostat (not shown). From the bus bars the current flows through the brushes 53 to the collector rings 29 and from thence to each of the heating elements 27 throughout the periphery of the drum. The material to be treated flows from the feed hopper 42 into the blower pipe 40 and is projected by the blast of hot air from the blower into the interior of the furnace. This air is heated in the pipes 26 which are placed adjacent the inner face of the drum 18 to absorb the heat which is transmitted through the fire brick lining.

The pipes 26 serve a double purpose in that they act as a cooling medium to prevent radiation of the heat from the drum and as a heating medium for heating the air that is introduced into the drum for oxidation purposes.

One of the uses of the furnace is for reducing sulphide ores. In this use the oxygen of the heated air will combine with the sulphur of the ore in the furnace, under the influence of the heat therein, forming sulphur dioxide which will flow from the gas vent pipe 47, either to be discharged into the atmosphere or converted into other products, such as sulphuric acid. The metal from the ore will gradually travel toward the discharge head 22 where it will be raised by the scoop 44 to the sleeve 45, thence by the scroll conveyor 46 through the sleeve 45 to the receiving hopper 49 from whence it will be carried to other parts of the plant.

The drum 18 can be inclined by means of the screw 12 to any desired angle so as to cause the material to travel through the drum at any desired speed, for naturally the greater the angle of the drum the more rapidly the material will spiral therethrough.

To prevent undue heating of the drum, I provide a sprayer pipe 60 fed from a supply pipe 61 controlled by a valve 62. The sprayer pipe 60 constantly sprays in the exterior of the drum with cold water to prevent its overheating. The action of the cooling water also serves to confine the heat to the drum interior, thereby reducing the amount of electric current necessary and increasing the temperature of the air in the pipes 26. It is preferred to terminate the discharge vent 47 in a T 63 from which lead, a flue 64 and a discharge pipe 65 controlled by means of valves 66 and 67 respectively.

In some uses, such as in the distillation of oil shales or in refining zinc ores, it is desir-

able to exclude air from the drum 18. This may be accomplished by means of a gate 68 in the blower pipe 40 and gate 69 arranged to close the discharge end of the sleeve 45. The gate 69 is illustrated in detail in Fig. 8. The gate 68 may comprise a cut-off slide in the blower pipe.

In using the apparatus on zinc sulphide ores, the drum 18 is charged with the desired amount of ore and the gate 69 is closed to prevent ore from leaving the drum. The drum 18 is now heated to the proper temperature to oxidize the sulphur which is allowed to flow as sulphur dioxide through the flue 64, the valve 67 being closed. After the sulphur has been eliminated from the ore, the gate 68 is closed to prevent further entrance of air and the valve 67 is opened. The temperature is now raised to the volatilizing point for the zinc. The zinc then flows as a vapor through the discharge pipe 65, the valve 66 being now closed, to suitable condensing apparatus. To determine the proper temperatures for the various steps of the process a pyrometer tube 70 is carried projecting through the discharge head 22. This pyrometer tube of course rotates with the drum so that provision must be made for conducting its current to suitable indicating devices. This is accomplished by connecting the electrical terminals of the pyrometer tube to a pair of commutator rings 71 on the head from whence the current may be conducted by suitable brushes 73. (See Fig. 10). This pyrometer tube gives an indication of the temperature of the solid material in the drum. To obtain an indication of temperature of the gases, a second pyrometer tube 72 is inserted through the T 63 into the vent 47.

Various gases, of course, have various weights and will stratify at different elevations. In the drum 18 a separation of these gases or vapors may be made by rotating the vent 47 in its supports so that the turned extremity 48 will take from the drum at different elevations. Should it be desired to remove the very lightest gases or vapors the vent will be in the position of Fig. 7; for the heaviest gases it will be in the broken line position of this view.

In Fig. 11 I have illustrated in detail one of the segment shaped quarters of the head lining 33, illustrating the overlapping joint 34, perforations 75 for the heating elements, and notches 74 for the pipes 26.

In Fig. 12 I have illustrated in detail one of the fire bricks 24 illustrating at 76 the cut-away corners for the pipe 26. The bushed openings 28 are hermetically sealed by means of a mixture of fire clay cement. This electrically insulates the heating elements and hermetically seals the passages 25 so that oxidation of the heating elements is prevented.

While a specific form of the improvement has been described and illustrated herein, it is desired to be understood that the same may be varied, within the scope of the appended claims, without departing from the spirit of the invention.

Having thus described the invention, what I claim and desire secured by Letters Patent is:—

1. In an electric furnace comprising a horizontally disposed drum; a lining of refractory material in said drum; heads adapted to close the extremities of said drum; pipes communicating through said heads and extending throughout said drum through said lining; a collector carried at one extremity of said drum and connected with said pipes; and means for causing a current of air to flow through said pipes and said collector.

2. An electrically heated furnace comprising a vertically pivoted frame; positively traveling rollers carried by said frame; a cylinder carried by said rollers and adapted to be rotated thereby; heads in said cylinder arranged to rotate therewith; a concentric air passage through one of said heads; means for forcing air through said passage; a second passage adapted to conduct solid material into said air passage; a concentric vent pipe adapted to pass through the other of said heads; and means for internally heating said cylinder.

3. An electrically heated furnace comprising a vertically pivoted frame; positively traveling rollers carried by said frame; a cylinder carried by said rollers and adapted to be rotated thereby; heads in said cylinder arranged to rotate therewith; a concentric air passage through one of said heads; means for forcing air through said passage; a second passage adapted to conduct solid material into said air passage; a concentric vent pipe adapted to pass through the other of said heads; means for internally heating said cylinder; a series of longitudinally extending, interior pipes in said cylinder communicating with the exterior at one extremity thereof; a collector carried at the other extremity of said cylinder in communication with said pipes; a cap for said collector carried by said frame; and a passage communicating between said cap and said means for forcing air.

4. In a rotatable drum type furnace, having a metallic cylindrical shell lined with refractory material; grooves in said material extending throughout the length of said drum adjacent said shell; pipes carried in said grooves and extending to the exterior of said shell at each extremity; radial pipes connecting the extremities of said first pipes with a common collector concentrically arranged with relation to said shell; and means connected with said collector for

causing a current of air to flow through all of said pipes.

5. In a rotatable drum type furnace, having a metallic cylindrical shell lined with refractory material; grooves in said material extending throughout the length of said drum adjacent said shell; pipes carried in said grooves and extending to the exterior of said shell at each extremity; radial pipes connecting the extremities of said first pipes with a common collector concentrically arranged with relation to said shell; and means connected with said collector for causing a current of air to flow through all of said pipes, said refractory lining being formed of longitudinal rows of blocks, said blocks each having their exterior edges indented to form, when in place, said grooves.

6. In an electric furnace comprising a horizontally disposed rotatable drum; a lining of refractory material in said drum; heads adapted to close the extremities of said drum; pipes communicating through said heads and extending throughout said drum through said lining; a collector carried at one extremity of said drum and connected with said pipes, said collector having an open face; a cap mounted so as to remain stationary and close said open face; and means for drawing air through said cap.

7. In an electric furnace comprising a horizontally disposed rotatable drum; a lining of refractory material in said drum; heads adapted to close the extremities of said drum; pipes communicating through said heads and extending throughout said drum through said lining; a collector carried at one extremity of said drum and connected with said pipes, said collector having an open face; a cap mounted so as to remain stationary and close said open face; a concentric passage through both said cap and said collector, and closed to the latter, communicating with the interior of said drum; and means for drawing air from said collector and forcing it through said concentric passage.

8. In an electric furnace comprising a horizontally disposed rotatable drum; a lining of refractory material in said drum; heads adapted to close the extremities of said drum; pipes communicating through said heads and extending throughout said drum through said lining; a collector carried at one extremity of said drum and connected with said pipes, said collector having an open face; a cap mounted so as to remain stationary and close said open face; a concentric passage through both said cap and said collector, and closed to the latter, communicating with the interior of said drum; means for drawing air from said collector and forcing it through said concentric passage; and a second passage communicating with said concentric passage and adapted to supply foreign material to said latter passage.

In testimony whereof, I affix my signature.

FRANCIS E. HATCH.