Feb. 6, 1923. 1,444,209.

R. D. PIKE.

ORE ROASTING FURNACE.

FILED JAN. 18, 1921. 2 SHEETS—SHEET 1.

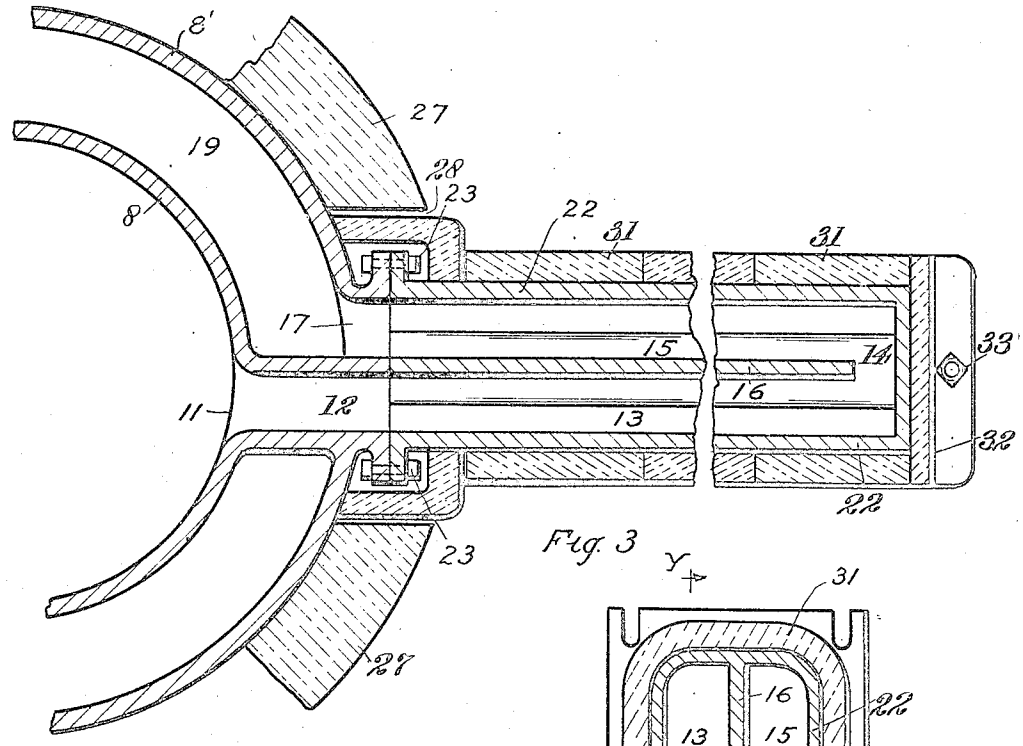


Fig. 3

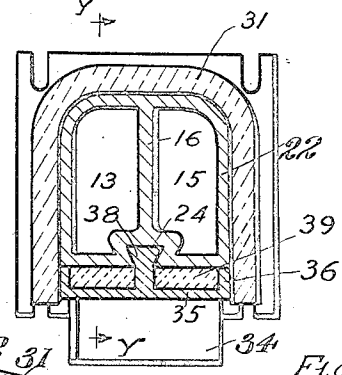


Fig. 2

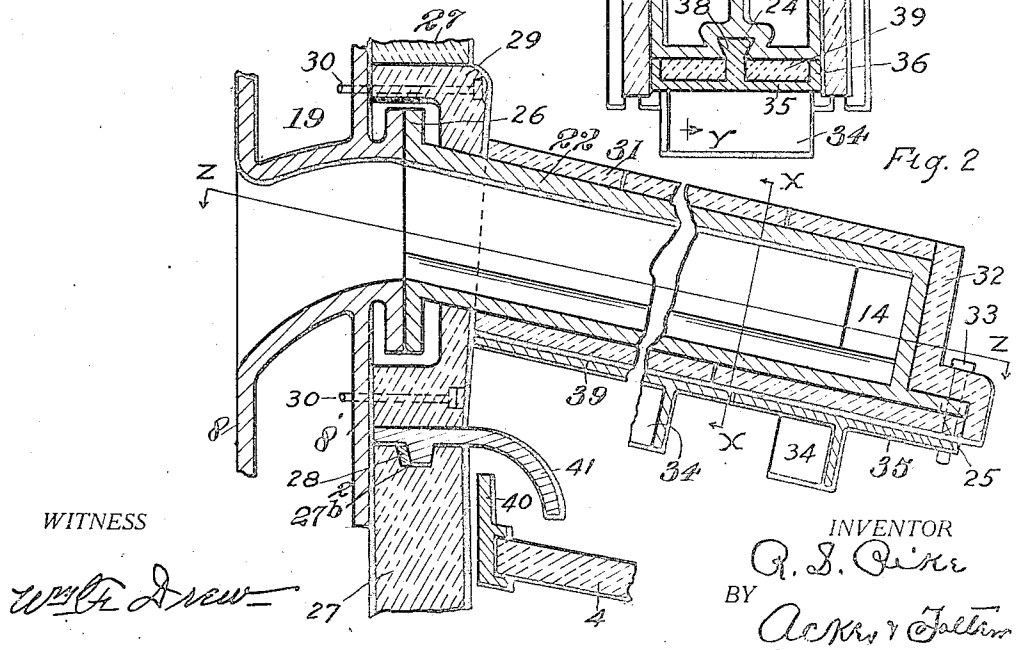


Fig. 1

WITNESS

Wm. A. Drew

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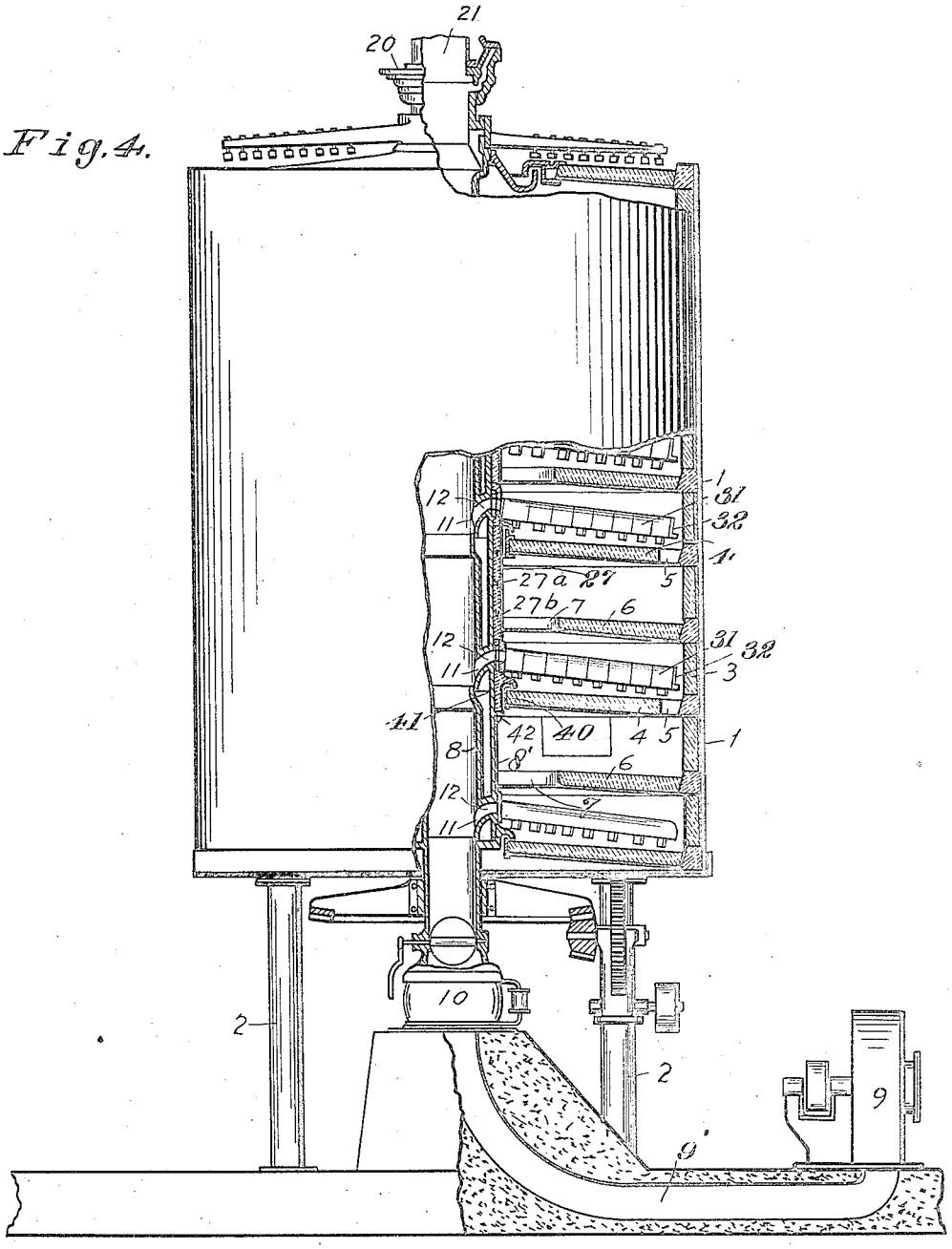
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Fig. 4.



WITNESS

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Patented Feb. 6, 1923. 1,444,209

UNITED STATES PATENT OFFICE.

ROBERT D. PIKE, OF SAN FRANCISCO, CALIFORNIA.

ORE-ROASTING FURNACE.

Application filed January 18, 1921. Serial No. 438,118.

To all whom it may concern:

Be it known that I, ROBERT D. PIKE, a citizen of the United States, residing at the city and county of San Francisco and State of California, have invented certain new and useful Improvements in Ore-Roasting Furnaces, of which the following is a specification.

The hereinafter described invention relates more particularly to the internal construction of the working parts of an ore roasting furnace of that type largely used for the roasting of copper and similar ores, and more particularly to that type of roaster in which air is used as a cooling medium for the rabbling mechanism, although it is not so restricted; and the apparatus embodying the invention is adapted for the economical calcination or roasting of such material as calcite, wherein the required temperature for calcination ranges from 1800 degrees to 2000 degrees Fahrenheit, and which is a working range beyond the pratical working of furnaces as at present constructed, although the furnace of the present invention is useful for economic calcination of magnesite and similar substances having a calcining temperature of approximately 1500 degrees Fahrenheit, in which case considerable of the value is due to the fact that the construction of the apparatus permits of the use of small quantities of air for cooling, resulting in greater thermal efficiency of the furnace.

The invention resides more particularly in the protecting of the metal parts in the hot zone of the furnace; as, for instance, the rabble arms, in such a manner as to provide against injury to the said arms due to the intense heat in the hotter zone of the furnace, and in the present case the said arms are protected by fire clay, or other suitable refractory and insulating material, such as, for example, molded calcined diatomaceous earth, which material is molded into suitable shape so as to cover what otherwise would be exposed metallic parts, whereby the temperature of the metallic surfaces with any given furnace temperature is greatly reduced, because of the so called temperature gradient through the fireclay or other refractory insulating material with which the metal is protected. Such parts of the rabble mechanism, as for example the rabble teeth, which for mechanical reasons must present metallic surfaces to the charge being treated within the furnace, are made from any suitable alloy highly resistant to the action of heat; as, for example, an alloy of chromium and nickel. Any suitably constructed furnace structure capable for the practical treatment of the material to be handled may be utilized in connection with the present invention, and in the present drawings is illustrated a preferred constructed furnace for the embodiment of the invention therein, and wherein:—

Figure 1 is a broken longitudinal sectional view taken through one of the protected rabble arms and the central rotating column of the apparatus disclosing the seal between one of the hearths of the furnace and between the rabble arm and the central rotating column, the said view being taken on the sectional line Y—Y Figure 2 of the drawings and viewed in the direction of the arrows appearing thereon.

Figure 2 is a cross sectional view taken on the line X—X Figure 1 of the drawings, and viewed in the direction of the arrow, the protecting pieces at the base of the rabble arm being removed.

Figure 3 is a horizontal sectional top plan view taken on the line Z—Z Figure 1 of the drawings and viewed in the direction of the arrows.

Figure 4 is a broken part sectional view disclosing the invention as applied to a typical mechanical ore roasting furnace, said view illustrating the general arrangement and disposition of the protected rabble arms, and the protected central rotating column associated therewith in the central or hot zone of the furnace.

In the drawings, reference being had more particularly to Figure 4 thereof, the numeral 1 is used to designate the outside shell of a suitably constructed mechanical ore roasting furnace, which is supported or sustained by means of the supporting base columns 2, the said shell structure being interiorly protected with a refractory lining 3. The said shell is provided interiorly with a series of circularly disposed hearths 4 and 6, Figure 4 of the drawings, the hearths being in superposed relation, over which hearths the material under treatment moves as advanced through the apparatus, the material on the hearths 4 moving outwardly and dropping therefrom through the cut-outs 5 thereof onto the hearths 6, while the material received onto the hearths 6 from

the hearths 4 moves inwardly and drops therefrom through the annular opening 7 thereof. Any suitable means, not shown, may be used for firing the furnace. The 2nd, 3rd, 4th, 5th and 6th hearths from the bottom of the apparatus are situated within the zone of maximum temperature.

Within the furnace shell is arranged a vertically disposed central rotating column or hollow shaft, which is composed essentially of two parts, an inner cylindrical member 8 and an outer cylindrical member 8′, the latter enclosing within itself the former, and providing an annular space between the two members. With the inner member 8 of the rotating central column or shaft connects an air supply pipe 9′, the connection between the said pipe and the rotating column or shaft being through the medium of a running joint 10. Air is admitted through the connection 9′ into the member 8 by means of a suction fan 9 suitably connected therewith for the forcing of air through the pipe 9′ into the member 8, the air thus forced into the member 8 escaping therefrom through the lateral outlet openings 11, Figures 3 and 4 of the drawings, each of which openings communicates through a suitable passage 12 with one of the longitudinal passages 13 in each of the rabble arms. The air thus admitted within the hollow rabble arms moves the length thereof and passes through the end passage 14 for return travel through a parallel passage 15, the passages 13 and 15 being formed by the centrally disposed longitudinal partition wall 16, Figures 2 and 3 of the drawings. The air thus circulating through the passages of the rabble arms escapes therefrom through an opening 17 formed in the rotating central column 8′ adjacent each of the rabble arms, and passes therethrough into the annular space 19 formed by the two spaced members 8 and 8′ of the said rotating column or shaft, and passing upwardly within said annular space, leaves the furnace through the running joint 20 and the stationary pipe 21, Figure 4 of the drawings.

By this arrangement there is provided for an active circulation of air, which is maintained throughout the centrally disposed rotating column or shaft and each of the rabble arms connected therewith and carried thereby.

Each rabble arm 22 is securely fastened to the vertically disposed central rotating column by the attached bolts 23, Figure 3 of the drawings, so as to make an air tight joint between the passages 13 and 15 of the rabble arms and the openings 11 and 17 respectively of the said shaft. Each rabble arm 22 has formed in the bottom wall member thereof a longitudinally disposed V-shaped slot or channel 24, Figure 3 of the drawings, and, at its outer extremity, each rabble arm is provided with an outwardly projected lip 25, Figure 1 of the drawings, and on its inner end each of said arms is provided with suitable bolt flanges 26, through which extend the securing bolts 23.

To protect the central rotating column against the intense heat of the furnace within the zone of highest temperature, the same is covered with a fireclay lining composed of pieces 27, Figures 1, 3 and 4 of the drawings, each of which pieces is provided on its bottom edge with a male joint 27^a, and on its upper edge with a female joint 27^b, so that the pieces interlock one with the other for the making of a tight joint. In laying up the tile pieces, their position against the central column is secured by means of a metal hoop 28 which rests within the female joint 27^b, and extends entirely around the tile pieces, and answers as a binding hoop for securing or holding each layer of the built up tiles in position; it being understood that there is a hoop for each circumferentially disposed layer of the built up tiles, the position of said hoop being disclosed by Figure 1 of the drawings. The entire structure of the built up tiles surrounding and protecting the central column is supported on a circumferentially disposed outwardly projecting shelf 42, formed integral with the supporting column, Figure 4 of the drawings. A rectangular shaped opening 28′ is formed or left in the fireclay protecting wall for the central column adjacent each of the openings 11 and 17 of the rotating column in order that the rabble arms may be properly positioned and secured in place without taking off or removing any of the fireclay protecting wall pieces 27, the said opening being closed up after the rabble arm has been secured in place by means of a split plug 29, which is preferably made of fireclay, and which is held in place by means of the bolts 30, Figures 1 and 3 of the drawings.

Each rabble arm is protected by means of a suitable covering composed of heat withstanding material, such as calcined diatomaceous earth or fireclay. This covering is made up of a plurality of sections 31, Figures 1, 3 and 4 of the drawings, each shaped to conform to that of the rabble arm, and covering the upper portion thereof. These pieces are of U-shaped form, Figure 2 of the drawings, and the side walls thereof extend downwardly over the said walls of the rabble arms and project approximately one inch below the lower face of the rabble arms. The length of each piece 31 is such that a given number of said pieces are just sufficient to cover the entire length of the rabble arm and they are held in place by means of an end piece 32 which is adapted to rest on the lip 25 of the rabble arm, and is

held in place relative thereto by means of the securing bolt 33; it being understood that the securing piece 32 is formed of material similar to that from which the covering pieces 31 are formed.

Each rabble arm is provided with a series of downwardly extended rabble teeth 34, which are of suitable design and preferably formed of an alloy such as nickel and chromium, so as to be resistant to the high temperature within the furnace. The rabble teeth are formed integral with the holding plate 35, which is provided with the upwardly projecting side flanges 36, and the upwardly projecting wedge-shaped central longitudinally disposed projection 38, which wedge-shaped projection is adapted to slide within the V-shaped recess or channel 24 of the rabble arm, Figure 2 of the drawings, and thus serves to secure the position of the rabble teeth in proper relation with the rabble arm. There is interposed between the holding plate 35 for the rabble teeth and the bottom wall surface of the rabble arm a filler piece 39 formed of fireclay or other suitable refractory and insulating material, and which is held in place by means of the end pieces 32 for the rabble arm cover.

It will be observed from the foregoing that all parts of the central rotating column and of the rabble arms located within the hot zone of the furnace are protected from the intensity of the heat by a covering of refractory and insulating material, of such a character as will resist the action of the high temperature to which such parts are ordinarily exposed, and retard the action of the heat to such an extent that the metal of the rabble arms themselves and of the central column does not become overheated. The rabble teeth 34 alone are exposed to the action of the heat, but, as before stated, these are made of an alloy which is highly resistant to the action of high temperatures.

To prevent material and gases passing between the hearths 4 over which the material moves outwardly and the rotating central shaft or column, suitable seals are provided, each of which consists of the metal curbing 40 secured to the inner edge of the hearths, Figures 1 and 4 of the drawings, so as to leave only a small clearance space relative to the central column, and a curved member 41 which is secured to, and outwardly projects from the insulated covering of the central shaft or column so as to overhang the curbing 40. These seal members are preferably formed from nickel-chrome alloy, or any alloy or metal resistant to the action of high temperature.

By the use of the described invention, relating as it does to the manner of protecting the parts usually exposed to the high temperature within the zone of calcination, or in the hot zone of mechanical roasting furnaces, I am enabled to carry the temperature in the hot zone several hundred degrees higher than is possible with the furnaces as at present constructed, and, therefore, the furnace lends itself to and permits of the economical calcination and roasting of materials which cannot be treated in furnaces of this character as ordinarily constructed. The arrangement of detachably connecting the rabble arms permits of the same being quickly removed and the placing thereof relative to the rotating column, without disturbing its protected lining. Protective linings have heretofore been applied to the central rotating column of a furnace, but in such furnaces the rabble arms pass through the column and are fastened from the inside. Such construction necessitates that there be working room for a man inside of the central column, which results in a large column with great heat surface for radiation, and, as a consequence reduces the effective hearth area of the furnace. The present invention enables the construction of a furnace wherein is employed or utilized a small central column with rabble arms attached to the outside thereof, and at the same time provides protective covering for all the surfaces of the central column within the hot zone of the furnace, and equally so provides protective covering for the rabble arms, thereby preserving these parts from the high temperature, reducing the loss of heat by conduction through their surfaces, and provides for an increased effective hearth area for a furnace of given capacity.

I do not wish to be understood as limiting or restricting the invention to the detailed constructed working parts, but on the contrary wish to be understood as claiming the invention as broadly as the state of the art will permit.

While air has been described as the cooling medium employed for circulation through the rabble arms, any other suitable cooling medium—as for instance water or steam may be utilized for such purpose.

Having thus described by invention, what I claim as new and desire to secure by Letters Patent of the United States is:—

1. An apparatus for the described purpose, the same comprising an outer stationary shell, a vertical rotary shaft centrally disposed within said shell, a plurality of spaced horizontally disposed hearths arranged within the shell, each hearth provided with outlets for the escape of material therefrom, a series of hollow rabble arms secured and carried by the rotary shaft, means for causing a circulation of a cooling medium through said rabble arms, and a covering of refractory and insulating material for each of said rabble arms.

2. In an apparatus for the described purpose, the combination with the hollow vertically disposed rotary shaft thereof, a plurality of horizontally disposed hollow rabble arms detachably secured to and carried by said shaft, means for causing a circulation of a cooling medium through said arms, and a covering of refractory and insulating material removably held to the rabble arms.

3. In an apparatus for the described purpose, the combination with a centrally disposed hollow rotary shaft composed of two spaced concentric members, a series of hollow rabble arms detachably secured to and carried by said shaft, a plurality of openings in the shaft adjacent each of the rabble arms, means for admitting a cooling medium to the shaft and causing the circulation thereof through the rabble arms, and a covering of refractory and insulating material removably held to the rabble arms.

4. In an apparatus for the described purpose, the combination with a centrally disposed hollow rotary shaft composed of the spaced concentric members, a series of hollow rabble arms divided interiorly into parallel connected inlet and outlet circulating passages detachably connected to the rotary shaft, outlet and inlet passages adjacent each of the rabble arms, one extended from the interior of the shaft and communicating with the inlet passage of the arms and the other extended from the annular space between the shaft member and communicating with the outlet passage of the arms, means for causing a circulation of a cooling medium through said rabble arms, and a covering of refractory and insulating material removably held to the rabble arms.

5. In an apparatus for the described purpose, the combination with a centrally disposed hollow rotary shaft composed of spaced concentric members, a series of hollow rabble arms detachably secured to and carried by said shaft, means for causing a circulation of a cooling medium through the shaft and rabble arms, a built up lining of refractory and insulating lining surrounding the shaft for a portion of its length, and a covering of refractory and insulating material removably held to each of the rabble arms.

6. In an apparatus for the described purpose, the combination with a hollow rabble arm provided with an inlet and an outlet communicating passage, a covering for said arm consisting of a series of sections of refractory and insulating material detachably secured thereto, and a plurality of depending rabble teeth removably held to the rabble arm.

7. A rabble arm for furnaces of the described class, provided interiorly with an inlet and an outlet communicating passages, and a longitudinally disposed interlocking channel formed in the bottom wall thereof, a covering of refractory and insulating material removably held to the rabble arm, a rabble tooth plate provided with an interlocking tongue for engagement with the channel of the arm, a series of rabble teeth depending from said plate, and means for holding the plate and the protecting covering to the rabble arm.

8. A hollow rabble arm for furnaces of the described class provided interiorly with parallel disposed communicating inlet and outlet passages and exteriorly with a longitudinally disposed interlocking channel in the bottom wall thereof, a covering of refractory and insulating material removably held to the rabble arm, a rabble tooth plate provided with an interlocking tongue in locked engagement with said channel of the arm, a series of rabble teeth depending from said plate, and a lining of refractory and insulating material interposed between the rabble tooth plate and the bottom of the rabble arm.

9. In an apparatus for the described purpose, the combination with a stationary furnace shell, of a plurality of spaced horizontally disposed hearths arranged therein, a rotary shaft composed of concentric spaced members extended through said shell centrally thereof and provided with outlet and inlet openings, a series of hollow rabble arms detachably held to the central shaft, each formed interiorly with parallel communicating inlet and outlet passages which register respectively with outlet and inlet openings formed in the central shaft adjacent the position for each rabble arm, a series of rabble teeth removably held to the rabble arms, means for detachably securing the rabble arms to the central rotating shaft, a built up lining of refractory and insulating material surrounding the said shaft, and means for causing a circulation of a cooling medium through the shaft and rabble arms, and a covering of refractory and insulating material for the rabble arms.

10. In an apparatus for the described purpose, the combination with a stationary furnace shell, of a centrally disposed hollow rotary shaft extended through said shell, a removable built up lining composed of refractory and insulating material surrounding said shaft and provided with cut-outs adjacent the points for attachment of rabble arms thereto, and plugs for closing said cut-outs in the lining after the attachment of the rabble arms to the shaft.

11. In an apparatus for the described purpose, the combination with a stationary furnace shell, of a series of horizontally disposed hearths arranged therein in superposed relation and each provided with discharge outlets, a hollow shaft composed of spaced concentric members extended through

and centrally disposed relative to the shell and provided with outlet and inlet openings at intervals throughout its length, a protecting lining surrounding said shaft and provided with cut-outs adjacent said outlet and inlet openings of the shaft, a series of hollow rabble arms provided with longitudinally disposed communicating inlet and outlet passages, means for attaching the arms to the exterior wall of the shaft with their inlet and outlet passages in registry with the outlet and inlet openings of the shaft respectively, plugs for closing the cut-outs of the lining after the attachment of the rabble arms to the shaft, and a protecting covering of refractory and insulating lining for the rabble arms.

In testimony whereof I have signed my name to this specification.

ROBERT D. PIKE.