J. ZELLWEGER.

ANNULAR ORE ROASTING KILN.

APPLICATION FILED JAN. 14, 1910.

976,769.

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FIG. 1

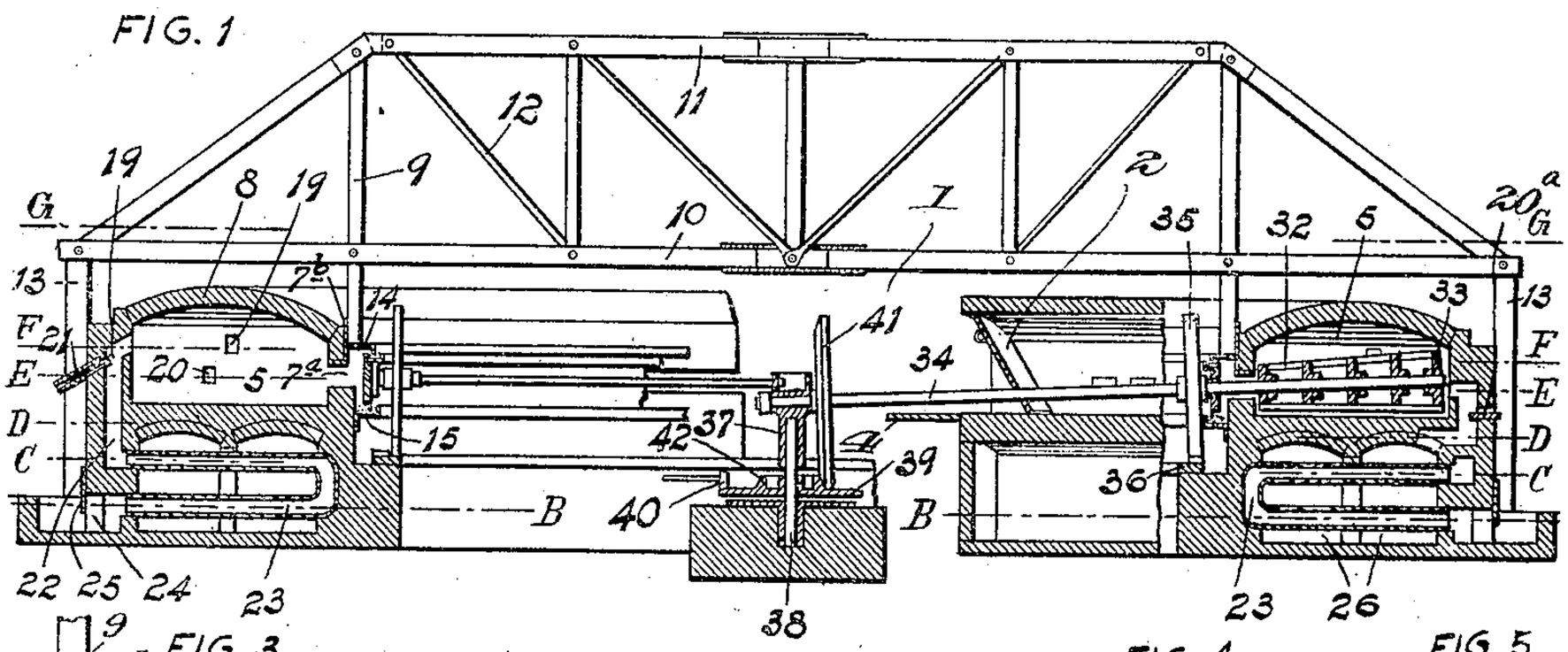

FIG. 3.

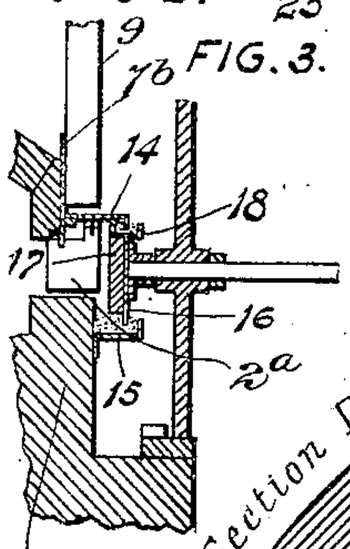

FIG. 2.

FIG. 4.

FIG. 5.

WITNESSES

Wm. Janus.

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JOHN ZELLWEGER, OF ST. LOUIS, MISSOURI.

ANNULAR ORE-ROASTING KILN.

976,769. Specification of Letters Patent. Patented Nov. 22, 1910.

Application filed January 14, 1910. Serial No. 538,142.

To all whom it may concern:

Be it known that I, JOHN ZELLWEGER, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Annular Ore-Roasting Kilns, 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, reference being had to the accompanying drawings, forming part of this specification.

In the drawings: Figure 1 is a vertical sectional view of my improved kiln. Fig. 2 is a horizontal sectional view taken respectively on lines B—C—D—E—F and G Fig. 1. Fig. 3 is a detailed sectional view illustrating the sand seal. Fig. 4 is a horizontal sectional view through one of the stirrers. Fig. 5 is a cross sectional view through a stirrer.

This invention relates to a new and useful improvement in a roasting kiln of the annular type, the object being to construct such a kiln that the ores to be roasted will be economically and expeditiously treated, the eliminated gases being utilized if desired for by-products purposes.

Other objects of the invention are: (1) to provide a kiln chamber which can be kept at proper temperature with the least consumption of fuel by closing the chamber and excluding cool air, by introducing air under pressure of a hot air column; (2) to utilize the same heat repeatedly by recuperating heat from the fire gases; (3) to use warm air for oxidizing the charge by introducing it through the recuperator and fire ports; (4) to omit the use of metal parts in the kiln chamber, (5) to provide for the separation of sulfur gases from the products of combustion; (6) to provide means for varying the temperature in the several zones of the hearth, whereby the ore may be locally heated to different degrees.

The principal features of my present invention are: the construction of the kiln proper; the arrangement of the ports therein; and the construction of the stirrers and their operating mechanism.

The kiln.—The kiln proper provides an annular chamber, there being a segmental section of the kiln removed as at 1 for the purpose of charging and discharging the ore. 2 is an iron door hinged near its upper edge and closing the entrance to said chamber. This door is preferably inclined as indicated by the arrow in Fig. 2.

3 is an iron door pivoted at its upper end for closing the discharge end of the chamber. This door opens outwardly and preferably stands vertical in its closed position.

4 is a loading platform at the entrance end of the chamber.

The kiln proper consists of a hearth portion 5, and outer side wall 6, an inner side wall 7, and an arched roof 8. The inner side wall 7 is provided with a circumferentially disposed slot 7^a throughout its length, the upper wall of which slot is formed in whole or in part by metal facing plates 7^b. These facing plates support the over hanging inner edge of the arched roof, and are connected to vertical posts 9 of an overhead trussed structure of which 10 is the bottom chord, 11 the top chord and 12 the diagonals. At the ends of the kiln chamber the slot is closed by means of small doors placed in line with the large doors 2 and 3. These small doors hang from the upper part of the inner wall. These small doors are shown at 2^a, Fig. 3, and preferably hang from the inner wall, and reach from the inside of the inner wall to near the sealing ring, so as to close the slot space as shown in Fig. 3. The ends of the various radially disposed arms of this trussed structure are supported by the buck-staves 13, which extend upwardly above the outer side walls 6 which they support. There may be as many radially disposed trussed extensions as is necessary to support the inner edge of the arched roof. In the accompanying drawing I have contemplated the use of twelve such arms.

14 is a hood plate having a downwardly extending flange at its inner edge and 15 is a Z-shaped plate having an upwardly extending flange, as shown in Fig. 3. Plate 14 is arranged above the slot 7^a, and plate 15 below said slot, the wall 7 forming the outer wall for a trough in which loose dry sand or other refractory sealing material may be placed and retained.

16 is an annular sealing plate faced on the side toward the slot 7^a with fire brick lining 17. The upper end of this plate carries a ring-shaped channel 18, whose flanges are presented upwardly and which forms a continuous trough for containing a refractory

sealing material such as sand, for coöperating with the marginal depending flange of plate 14, which extends down into the sand and prevents the entrance of air through the slot. The lower edge of plate 16 by extending into the sand in the trough 15 also forms a seal to prevent the entrance of air at this point.

The flues.—The outer wall 6 of the kiln is solid and supports the outer half of the arched roof. In this outer wall are the inlet ports 19 for the fire gases which enter at an angle near the roof. The outlet ports 20 for the products of the combustion and sulfur gases are arranged near the hearth.

21 is a pipe leading from gas or oil supply and discharging into the fire port 19, preferably at an angle as shown in Fig. 1.

22 is an air supply duct arranged in the under wall 6 and which is connected to a pipe 23 having a return bend, and extending across the chimney flue under the hearth of the kiln. Pipe 23 communicates at its lower end with a chamber 24 opening to the exterior, the size of which opening is regulated by a damper plate 25. The outlet ducts 20 are also preferably provided with dampers 20[a] (Fig. 1) for regulating the escape of the sulfur gases or products of combustion from the chamber. These outlet ports communicate with a chimney flue 26, arranged under the hearth, and in which flue are arranged the iron pipes 23 for heating the air for supporting combustion of the oil or gas in the burners described. The flame entering the chamber at an upward incline follows the curved roof to the opposite side wall where it is deflected downward onto the hearth and spreads out, flowing to the outlet ports which lead to the chimney.

The roasting process may be divided into three periods:

1. The green ore is heated partly by fire gases from above, but principally by the oxidation of its sulfur and metal contents. This period yields the most concentrated sulfur gases.

2. The partially roasted ore, which produces little heat must be heated principally by fire gas, it, therefore, yields strongly diluted gases.

3. The nearly roasted ore develops practically no heat, and must be highly heated by fire gases to complete the process. This period yields only the fire gases which should not be mingled with the sulfur gases, if the latter are to be neutralized or utilized in the manufacture of sulfuric acid.

In case the sulfur gases are not to be utilized all the gases are made to flow over the hearth to the receiving end of the kiln, and are there conveyed through the last few outlet ports into the chimney flue under the hearth. There they flow in an opposite direction, or toward the chimney port at the discharge end of the kiln, on their way they heat the many iron pipes laid crosswise through the chimney flue, and which serve to supply the heated air to support combustion in the kiln chamber. The air in passing through these pipes 23 becomes heated and returns some of the heat into the kiln chamber, thereby not only saving a considerable amount of heat, but producing better combustion of the fuel, and more rapid oxidation of the ore.

In case the sulfur gases are to be utilized in the production of sulfuric acid, or have to be neutralized to prevent injury to vegetation, they should be diluted as little as possible by fire gases, and for this purpose the fire gases produced near the discharge end of the kiln are to be taken directly into the fire flue (nearest the discharge end of the kiln). These fire gases being still very hot gives a large part of their heat to the pipes 23, furnishing hot air to the burners at this point, and thereby greatly increasing the temperature of the kiln chamber in this region. The fire gases produced in the middle region and receiving end of the kiln together with the sulfur gases are led over the hearth to the outlet ports near the receiving end into the chimney flue, and from there through a duct 29 to the acid plant, or other point of discharge.

If desired the chimney flue may be divided by a partition 30 into two parts, one communicating with the chimney through the flue 31, and the other with the utilization plant through the flue 29. This partition wall, however, is not absolutely necessary, because the gases will follow the path of least resistance, which can be regulated by the chimney draft, or by the exhaust fan suction to the acid plant.

In case it is found that the ore at any point along the hearth is not sufficiently advanced in desulfurization, and it becomes necessary to increase the heat in that zone or region, such an increase in temperature can be effected without the use of extra fuel by temporarily opening some of the outlet ducts whereby a greater flow of the fire gases nearer the hearth is caused at the desired location.

The ore feed.—The green ore is fed onto the hearth plate 4 outside of the sloping door 2, and the roasted ore is discharged through the vertical door 3. The ore is carried over the hearth by a rotating stirrer or stirrers, there being as many of these stirrers used as desired. This stirrer consists of a number of blades 32, said blades preferably being in the form of angle irons as shown in Fig. 5, arranged in notches in disk-plates 33. These blades are preferably inclined so as to form a conical or tapered stirrer, and the blades are slightly helical as shown in Fig. 2. The stirrer as a whole is supported

upon the end of a shaft 34 the desired distance above the hearth. Shaft 34 passes through the slot 7ª, and through a bearing in the ring plate 16.

35 is a traction gear meshing with a circular cog-track 36. Gear 35 supports the shaft 34 and its carried stirrer and sealing ring at this point. Shaft 34 has its inner end supported in a bearing 37, arranged upon the upper end of a vertical shaft 38. This shaft 38 is provided with a miter gear 39 with which coöperates a driving pinion 40. Endwise movement of the shaft 34 in the bearing 37 is prevented by collars on each side of said bearing. The bearing 37 is intended to rotate independently of the shaft 38.

41 is a miter gear fixed on the shaft 34 and meshing with teeth 42 on the gear 39, to rotate shaft 34.

It is obvious that other means for driving the gear 42, such as a rope drive could be employed in lieu of the gear 39 and pinion 40.

The stirrer blades can be constructed in the manner illustrated in my former Patent No. 627,609, dated June 27, 1899, but in the form of the annular kiln shown they are preferably made of angle bars rigidly attached to the shaft in the form of a cone by spider castings shown. When the stirrer shaft is rotated the motion is transmitted to the gear 35 which then traverses the circular cog-track and causes the shaft 34 to revolve or swing horizontally around the shaft 38. The cantaliver end of the shaft extending through the shield ring and slot into the kiln chamber, causes the shield ring to rotate in front of the slot and swing the rotating stirrer cone horizontally over the hearth. During this motion each of the stirrer blades in the front side of the cone gradually approaches the hearth in a forward motion, and pushes ahead of it any ore which is lying on the hearth. At its lowest position it scrapes the ore from the hearth, and then drags it forwardly and upwardly, leaving it at the top of the ore bed in the same manner described in my aforesaid patent. In order to prevent accumulation of ore near the outer wall of the chamber, the outer end of each stirrer blade is set so as to be slightly ahead of the inner end, when the blade is in its lowest position, and this slight spiral displacement of the blade produces an ore bed of the same depth over the hearth.

My improved stirrer differs from the one disclosed in No. 627,609 referred to, in that the support wheel 35 does not produce rotating motion by being rolled over the cog-track, but only horizontal motion. The rotating motion is transmitted to the shaft and stirrer by the gear wheel 39 near the pivot 38. Wheel 35 is cogged to prevent slipping and to produce positive forward motion.

I claim:

1. An annular ore roasting kiln having doors at each end of the chamber, a slotted side wall, a rotating shield ring arranged in juxtaposition to said side wall, and seals cooperating with said seal ring, a swinging arm which supports the shield ring at its outer end, and gears for rotating said arms.

2. An annular ore roasting kiln having a charging and discharging space, doors at each end of the kiln chamber adjacent said space, a slotted side wall, a rotating shield ring for closing the slot in said side wall, sand shields coöperating with said shield ring, arms extending from the center of the kiln for supporting said shield ring, and supporting wheels on said arms near the shield ring.

3. An annular ore roasting kiln having a slot in its inner wall, a sealing ring for closing said slot, wheels for supporting said ring, and arms on which said wheels are mounted, said arms extending from a central support.

4. An annular ore roasting kiln comprising a hearth portion, an outer wall and inner wall, said inner wall being provided with circumferentially disposed slot throughout its length, a roof portion and over head frame for supporting the inner over head edges of said roof portion, a rotating shield ring for closing said slot, and wheels supported upon radial arms for carrying said shield ring.

5. An annular ore roasting kiln having a continuous slot in its inner wall, a sealing ring arranged adjacent to said slot, sealing means coöperating with said ring, arms extending radially from a central support to support said ring, and arm supporting wheels on the arms near the ring.

6. An annular ore roasting kiln having a slot in its inner wall, supporting means arranged outside of said chamber for supporting said ring, sealing material for coöperating with the upper and lower edges of said sealing ring, arms extending radially from a central support to support said ring, and arm supporting wheels on the arms near the ring.

7. An annular ore roasting kiln having a slot in its inner wall, plates extending outward from its inner wall above and below said slot, said plates having flanges presented toward each other, a sealing ring extending below the flange of the lower plate, arms extending from a central support for supporting said ring, supporting wheels on the arms near the ring and coöperating with refractory sealing material confined by said flanges, and a circular trough carried by said sealing ring and containing refractory sealing material for coöperating with the flange on the said upper plate.

8. An annular ore roasting kiln having a

slot in its inner wall, a sealing ring for closing said slot, said sealing ring being faced with refractory material, sealing means cooperating with the upper and lower edges of said ring, rolling support for said ring, the axle or shaft of one of said rolling supports extending into the kiln chamber and a stirrer arranged thereon.

9. An annular ore roasting kiln having a slot in its inner wall, a sealing ring for closing said slot, and a rolling support for said sealing ring, comprising a circular track plate, wheels rolling on said track plate, and arms radiating from a central support, and constituting axles for said wheels.

10. An annular ore roasting kiln having a slot in its inner wall, a sealing ring for closing said slot, a gear wheel whose axle constitutes one of the supports for said sealing ring, and a circular gear track with which said gear coöperates.

11. A circular ore roasting kiln having an escape flue for the products of combustion arranged under its hearth, pipes traversing said escape flue at right angles to the flow of gases for supplying heated air to an air flue adjacent the down take flue, and leading to the roasting chamber, and down take flues for leading the fire gases from the roasting chamber to the fire flue.

12. An annular ore roasting kiln having fire ports near its roof and outlet ports for the products of combustion near its ore bed, a chimney flue arranged under the hearth, and to which said outlet ports lead, dampers for controlling said outlet ports and pipes traversing said flue for taking air from the exterior, heating it and supplying said heated air to support combustion in the fire ports and kiln chamber.

13. An annular ore roasting kiln having fire ports near its roof and outlet ports for the products of combustion near its ore bed, a chimney flue arranged under the hearth, and to which said outlet ports lead, dampers for controlling said outlet ports and pipes traversing said flue for taking air from the exterior, heating it and supplying said heated air to support combustion in the fire ports and kiln chamber, and dampers for controlling the admission of air to said pipes.

14. An annular ore roasting kiln having a charging and discharging space, a chimney flue under its hearth, ducts leading from said chimney flue at the ends thereof, at the charging and discharging ends of the kiln chamber, fire ports and outlet ports throughout the length of said kiln chamber and means for individually controlling said ports, whereby if the sulfur gases are to be treated or utilized they may be taken from the charging end of the kiln chamber, and the other gases or products of combustion nearer the discharge end of the kiln chamber may be separately removed.

15. An annular ore roasting kiln, the continuity of whose chamber is interrupted, flue or space underneath the roasting chamber substantially coincident in length of said chamber, outlet ports for the products of combustion leading from said chamber into said flue, a conduit leading from the discharge end of the flue, and dampers for controlling said outlet openings whereby products of combustion generated at the discharge end of the chamber may be forced to pass over the bed of ore to the charging end of said chamber before finding an outlet to said flue.

16. An annular ore roasting kiln having an interrupted roasting chamber, a flue arranged under said chamber outlet opening for the products of combustion, and other gases, leading from said chamber to said flue at different points, and a conduit leading from said flue near the charging end of the chamber whereby the gases generated at said charging end may be drawn into said flue and carried off by said conduit.

17. An annular ore roasting kiln having a slot in its inner wall, a shaft extending through said slot, a conical stirrer on the said shaft exteriorly arranged, means for supporting said shaft, said means comprising a cogged wheel of larger diameter than the stirrer, and arranged near the kiln chamber, and having a bearing rotatably mounted on a pivot in the center of the annular kiln, and means for transmitting rotary motion to said shaft.

18. An annular ore roasting kiln having a slot in its inner wall, a shaft extending from the exterior through said slot into the kiln chamber, said shaft being supported by a wheel for imparting horizontal motion thereto, and a stirrer mounted on the said end of the shaft within the kiln chamber, said stirrer comprising blade supports, and blades forming substantially a conical stirrer.

19. An annular ore roasting kiln having, in combination an exteriorly supported rotatable stirrer whose blades are so arranged that an even ore bed is maintained over the hearth, and means for causing the travel and simultaneous rotation of said stirrer.

20. An annular ore roasting kiln having, in combination an exteriorly supported rotatable stirrer whose blades are so arranged that an even ore bed is maintained over the hearth, and is prevented from piling at the outer edge of the hearth, and means for causing the travel and simultaneous rotation of said stirrer.

21. An annular ore roasting kiln having a slot in its inner wall, a sealing ring for closing said slot, a vertical shaft constituting a pivot point about which said sealing ring rotates, a casting carried by said vertical shaft for supporting the inner end of the radially disposed shafts, whose outer ends

support said sealing ring, supporting wheels arranged on said shaft near said sealing ring, and a circular track plate on which said supporting wheels run.

22. An annular ore roasting kiln having a slot in its inner wall, a sealing ring for closing said slot, a vertical shaft constituting a pivot point about which said sealing ring rotates, a casting carried by said vertical shaft for supporting the inner end of the radially disposed shafts, whose outer ends support said sealing ring, supporting wheels arranged on said shaft near said sealing ring, and a circular track plate on which said support wheels run, one or more of said radially disposed shafts passing through the slot into the kiln chamber, and a stirrer thereon and arranged in the kiln chamber.

23. In an annular ore roasting kiln, the combination of a traveling stirrer, whose periphery has a differential speed, and means for continuously rotating said traveling stirrer.

24. In an annular ore roasting kiln, the combination of a horizontally movable conical stirrer, and means for continuously rotating said stirrer.

25. An annular ore roasting kiln in combination with a traveling stirrer whose periphery has a differential speed to prevent piling of ore at the outer edge of the hearth.

26. An annular ore roasting kiln in combination with a rotatable stirrer, and a supporting wheel for said stirrer, whose periphery travels at a different rate of speed from that of the periphery of said stirrer, whereby the stirring blades are caused to drag in their rotary movement.

In testimony whereof I hereunto affix my signature in the presence of two witnesses, this 12th day of January, 1910.

JOHN ZELLWEGER.

Witnesses:
F. R. Cornwall,
M. P. Smith.