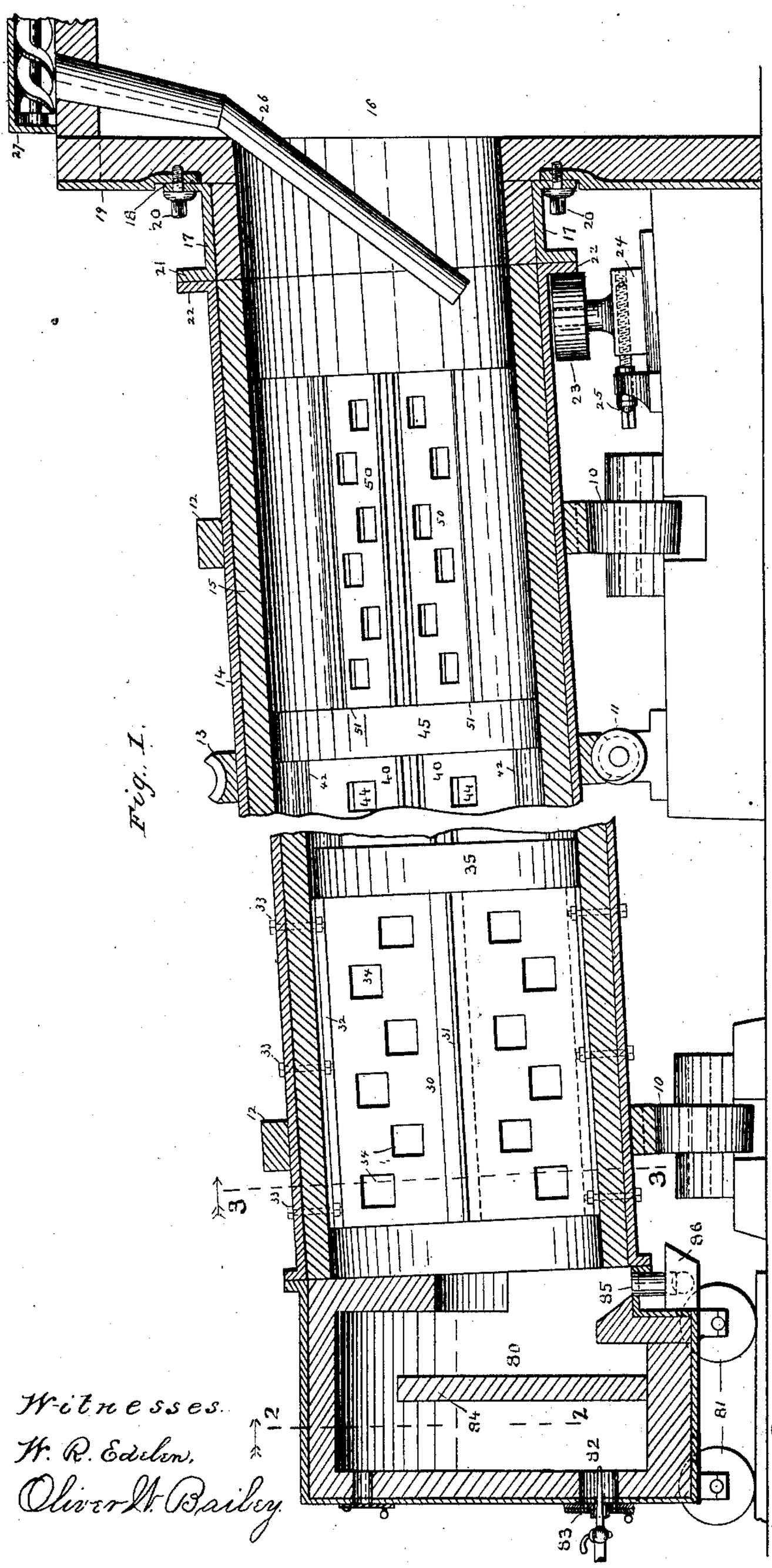
No. 711,338. Patented Oct. 14, 1902.

P. NAEF.

REVOLVING FURNACE FOR ROASTING ORES.

(Application filed Apr. 7, 1894.)

(No Model.) 3 Sheets—Sheet 1.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

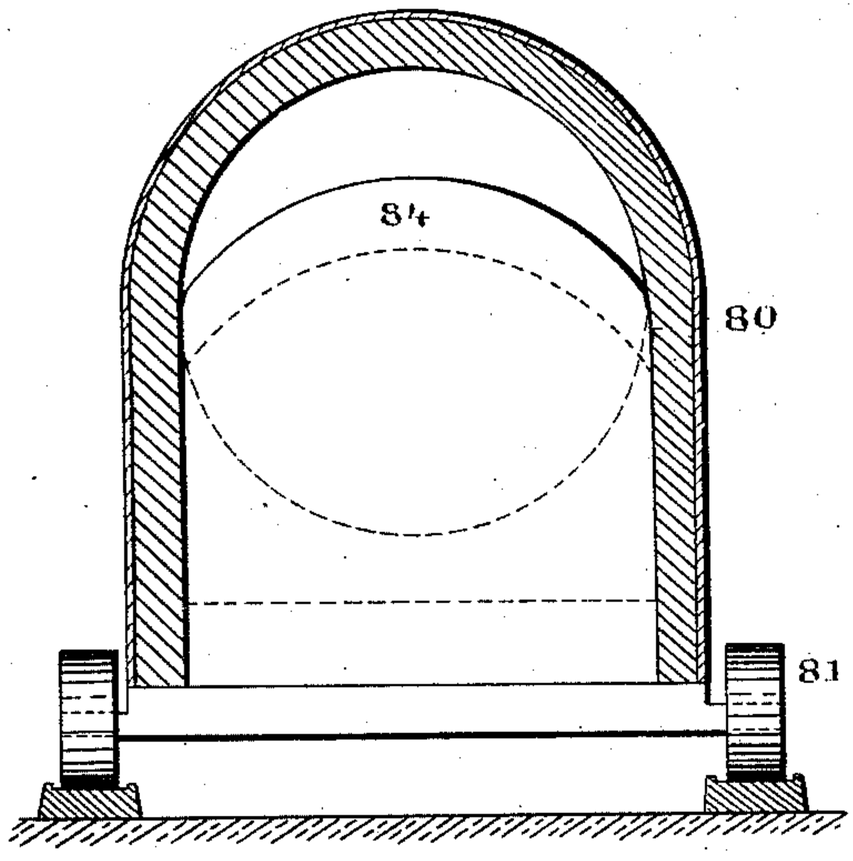


Fig. 3.

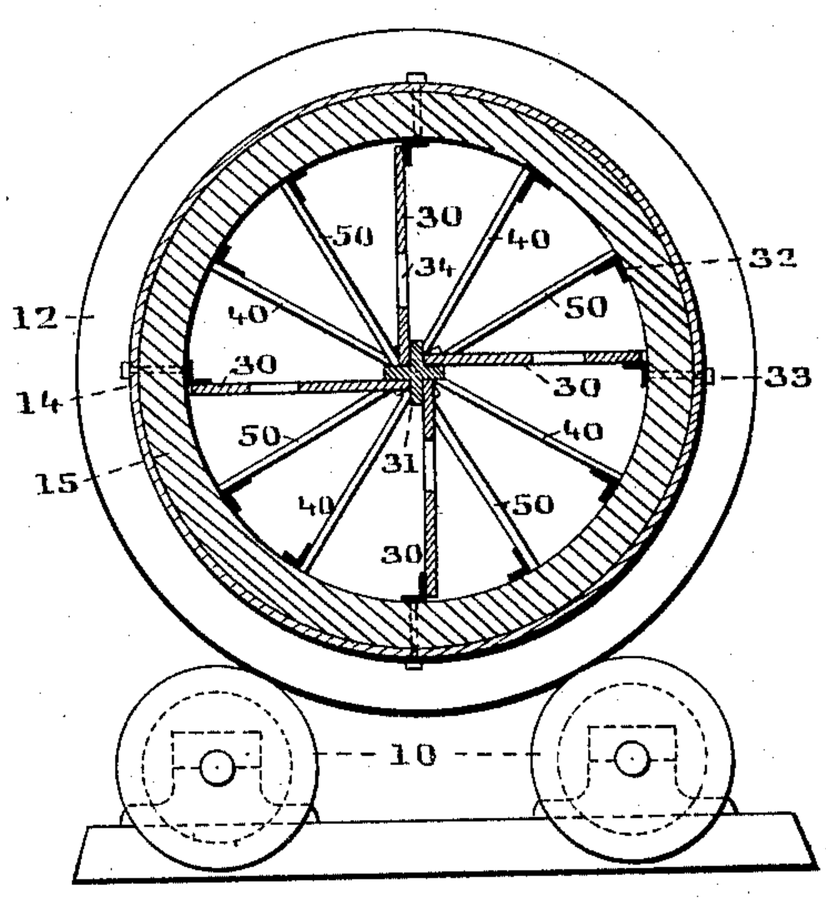


Fig. 5.

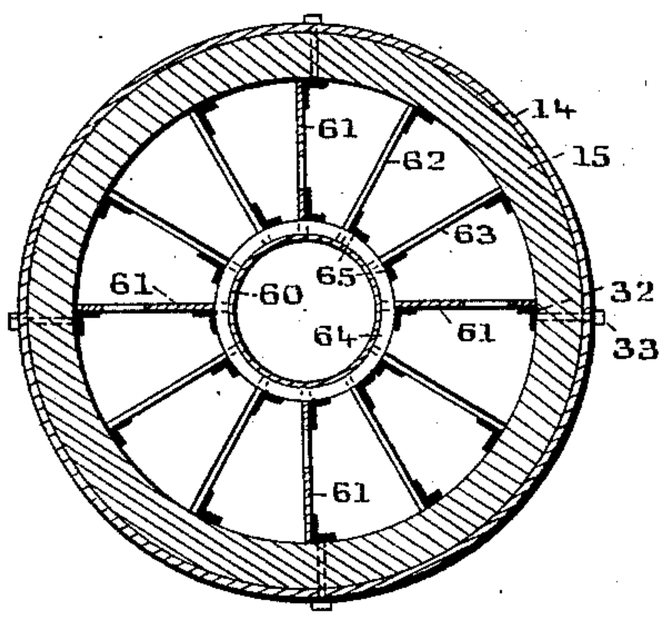
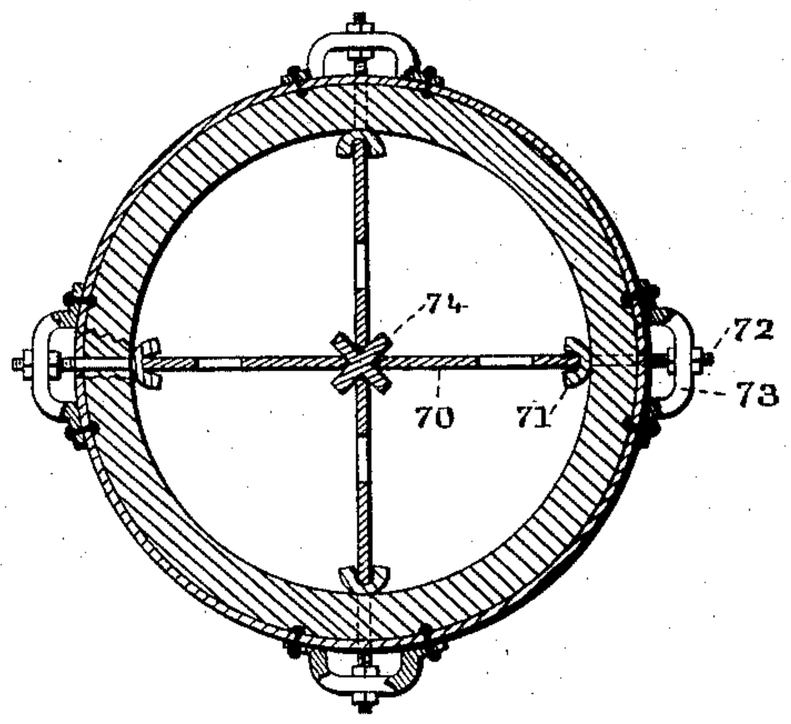


Fig. 4.



Witnesses.
W. R. Edelen.
Oliver W. Bailey.

Inventor,
Paul Naef,
By Story B. Lord,
his Attorney.

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Fig. 7.

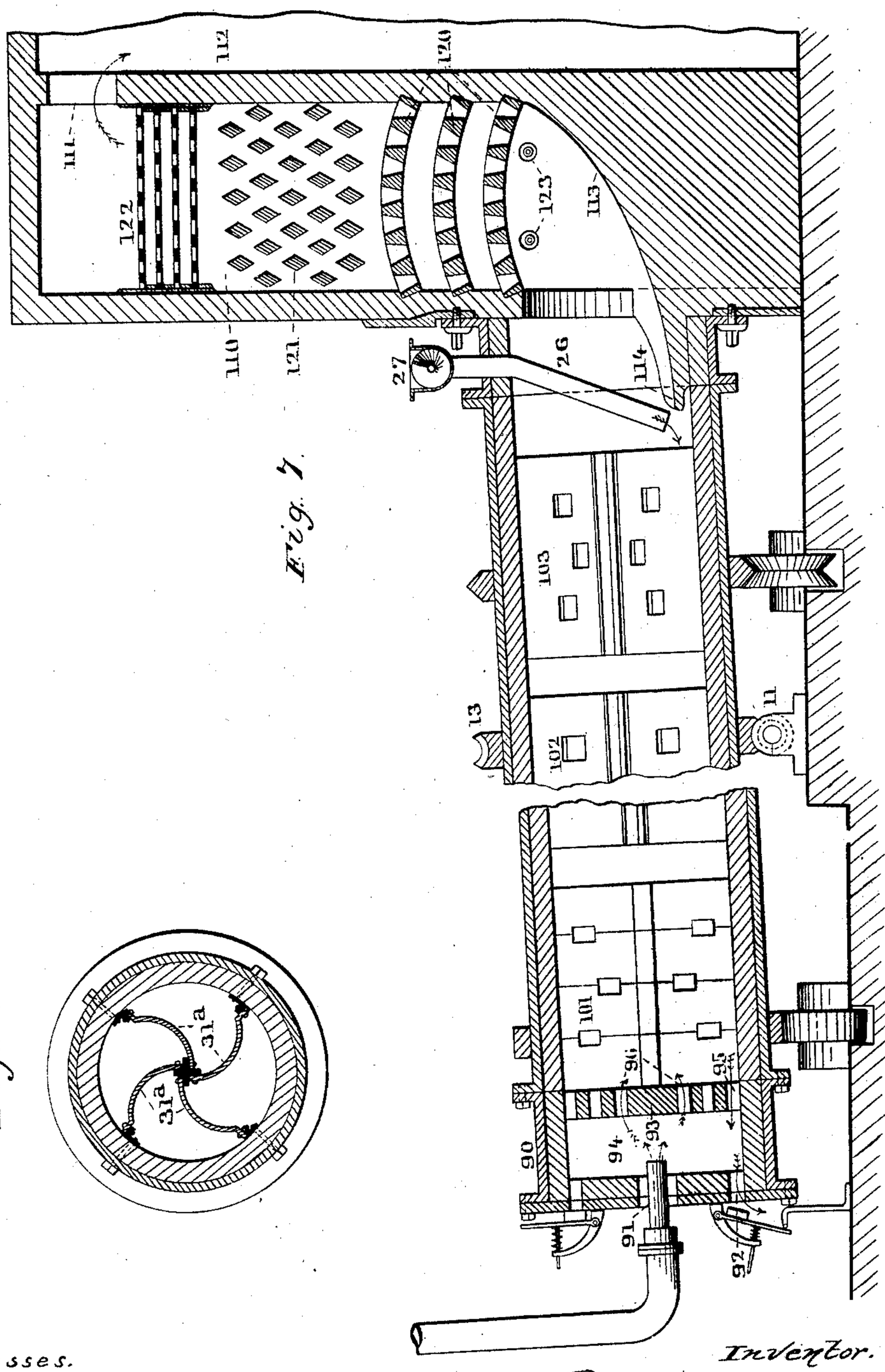

Fig. 6.

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UNITED STATES PATENT OFFICE.

PAUL NAEF, OF NEW YORK, N. Y.

REVOLVING FURNACE FOR ROASTING ORES.

SPECIFICATION forming part of Letters Patent No. 711,338, dated October 14, 1902.

Application filed April 7, 1894. Serial No. 506,701. (No model.)

To all whom it may concern:

Be it known that I, PAUL NAEF, a citizen of Switzerland, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Revolving Furnaces for Roasting Ores; and I do hereby declare the following to be a full, clear, and exact description of the invention, 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, and to figures of reference marked thereon, which form a part of this specification.

The present invention relates to the class of revolving cylinder roasters or driers in which the ore or other material to be roasted or dried is fed continuously into and through a horizontally-inclined cylinder; and the object of the present invention is to provide a revolving roaster which by reason of the intimate contact between the pulverulent material and the air in the cylinder will secure the complete roasting of the ore at a relatively low temperature, and, further, will roast the ore with a minimum amount of atmospheric oxygen, whereby the volume of gas produced is relatively small and the separation of the flue-dust therefrom is simplified.

Another object in view is to provide a cylinder-furnace which shall be economical in its construction and maintenance.

The invention relates to the class of cylinder-roasters in which there are apertured partitions which operate as ore-lifters to elevate the ore and discharge it in oft-repeated showers; and it consists of the novel features hereinafter fully described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of a cylinder roaster or drier embodying the present invention. Fig. 2 is a sectional view taken on the line 2 2 through the fire-box. Fig. 3 is a transverse section of the roasting-cylinder, taken on the line 3 3. Fig. 4 is a transverse sectional view illustrating a modification in the construction of the ore-lifting partitions. Fig. 5 is a transverse sectional view illustrating a modified form of the furnace in which there is provided a central air-inlet pipe for feeding air into the cylinder. Fig. 6 shows the ore-lifting partitions curved or bent to allow for expansion and prevent warping; and Fig. 7 is a longitudinal view of a cylinder-roaster and flue-dust chamber, the cylinder being fitted with a fire-box.

The cylinder is supported in the usual way on friction-rollers 10 and is revolved by a worm-gear 11 or otherwise.

12 12 are the bearing-rings for the friction-rollers, and 13 the rack-circle for worm-gear. In the present case 14 is the iron shell of the cylinder, and 15 the fire-brick lining. The exit flue or chamber 16, which receives the gases from the roasting-cylinder and the flue-dust, is provided with an adjustable cylinder-section 17, against which the feed end of the roasting-cylinder abuts. The adjustable iron flue-cylinder 17 has the base-flange 18 bolted to the face of the wall-plate 19 by the bolts 20 and the flange 21 at the opposite end, against which the steel end flange or ring 22 of the roasting-cylinder abuts. By means of this adjustable flue-cylinder 17 a true presentation of the flange 21 is easily secured and maintained. The joint between the cylinder-section 17 and its supporting-wall is easily sealed by luting, if necessary, when the adjustment has been made.

To take up the thrust of the cylinder and hold it against the face of the exit-flue, there is a roller 23, carried by an adjustable block 24, which block slides on an inclined bed parallel with the axis of the cylinder. This roller bears against the flange 22, and by means of the screw 25 it is adjusted so as to preserve a sufficiently-tight joint between the flange-plates 21 and 22.

A pipe for delivering the ore into the cylinder is shown at 26 and the end of a screw conveyer for the ore at 27.

We come now to the special feature of the invention, the construction and arrangement of the apertured partitions in the cylinder. These partitions are of iron, dividing the cylinder in cross-section into quadrants or sector-shaped apartments, and they are divided lengthwise of the cylinder into several sections, three being shown in the present case. Beginning at the discharge end of the cylinder the first set of iron partitions are the plates 30, four in number, bolted or riveted at the center of the cylinder to the flanges of a +

iron 31 and bolted or riveted along their outer edges to angle-irons 32, which are supported in position against the brick lining of the cylinder by bolts 33, passing through the same to the outer shell 14. These partition-plates may be curved as illustrated by Fig. 6, 31ª, to allow for the radial expansion and contraction of the plates and to prevent them from warping. The partition-plates 30 have the apertures 34, which alternate in radial position, as shown, so that every other stream of ore falling through the apertures of a plate is near the circumference of the cylinder and the intermediate streams are nearer to the center. The change in position of the apertures of a plate coupled with the different angular presentation of the several series of plates, as hereinafter described, gives a general distribution of the streams of falling ore across the cylinder. This set of apertured partitions extends for a certain distance along the cylinder, in the present case a little less than one-third the length of the cylinder, and then there intervenes a short vacant space 35, when we come to the second series of apertured partitions, or the next series may abut directly against the first set. I prefer to leave the interval between the several sections to allow all the ore to shower from the partitions after it has passed each section before it passes onto the next set. The second set is a duplication of the first except that they are offset thirty degrees in angular position with respect to the first set. The plates are shown at 40, the angle-irons at 42, and the apertures at 44. Following the second series comes the open space 45 and then the third series of partitions, again offset thirty degrees in angular position from the second set, so that the several partitions are equally distributed in angular position spirally-like around the entire circle throughout the greater length of the cylinder, as clearly shown in Fig. 3. The apertured partitions of the third series are shown at 50.

It will be understood that the number of sets of partitions can be varied as desired and the degree of variation in their respective angular positions; but whatever the number may be they are preferably so disposed that taken altogether they are equally distributed around the circle. This arrangement of the partitions in separate sections has the further advantage that any plate or set of plates can be repaired or renewed without interfering with the brick lining or without disturbing the rest of the plates.

Where the roasting-cylinder is made with a central pipe—as, for example, for the heating of the inflowing air prior to its introduction into the roasting-chamber of the cylinder, as described in a prior application made by me—the above-described arrangement of several sets of apertured partitions may be employed. Fig. 5 illustrates such a case. 60 is the central pipe, and 61, 62, and 63 indicate the several sets of apertured partitions riveted to the outer angle-irons. To support the inner edges of the apertured partitions, I encircle the pipe 60 with rings 64, which are spaced at intervals along the central pipe, but are independent of it. Fastened to the series of rings 64 there are angle-irons 65 extending parallel with the central pipe, and the partitions are riveted to these angle-irons 65. In this way the drilling of holes through the pipe 60 is avoided and perfect tightness of the same is insured.

As a further modification of the invention, I illustrate by Fig. 4 an arrangement specially designed for a cast-iron construction to avoid the riveting or bolting of the partitions to angle irons or flanges. Each of the apertured partitions 70 is supported along its outer edge by a channeled or U-shaped bar 71, which extends along the brick lining and is held by bolts 72, that pass through the lining and the outer shell and have screw-threaded ends engaging with stirrups or other supports 73. At the center of the cylinder the partition-plates fit into the angles of a + iron bar 74. This construction allows the several partition-plates to be firmly clamped and held between their respective outer channeled bars 71 and the center iron 74, and any plate can be easily removed by loosening the proper bolts.

If the roaster is to be used for ores which do not need artificial heat, the discharge end is closed with a cover or end piece having an opening for admitting the air and automatically-controlled discharge-openings for the ore; but if external heat is required for the drying or roasting the furnace is fitted with a fire-box 80, as illustrated by Figs. 1 and 2. This fire-box can be arranged for gas, coal, or oil, the illustration showing an arrangement for gas. The fire-box is mounted on rollers 81 for convenience in removing. The gas enters at 82 and the air at 83, and to prevent overheating the gases of combustion have to rise in front of and pass over the bridge-wall 84 and descend before entering the furnace. In cases where the gas from the roaster is to be utilized and where the presence of combustion-gas is deleterious the fire-box is supplied with hot air or other heated gas from Cowper stoves or other hot-air generators.

As before stated, the ore is charged into the furnace through the pipe 26 by means of a mechanical feed. It is discharged through the opening 85 at the back of the fire-box and falls into the tray 86, from which it is taken off by a spout.

Referring now to Fig. 7, the roasting-cylinder is shown fitted with a fire-box 90, bolted as a continuation of the cylinder to the discharge end thereof. The gas or oil pipe 91 is in the center of the head of the fire-box, and the discharge-openings for the ore are shown at 92. An apertured fire-brick wall 93 divides the combustion-chamber 94 of the fire-box section from the roasting-chamber, and the ore passes outward through the openings

95 to the discharge-outlets, while the gases of combustion enter the roasting-chamber through the center holes 96. When the roasting-cylinder is fitted with this fire-box section, the first set of ore-lifting partitions 101 are made of fire-brick, as they are subjected to a high heat, and the second and third sets of partitions 102 and 103 are constructed of iron, as above described.

The fine ore is fed into the roasting-cylinder and falls from a considerable height, and the flue-dust carried out by the current of gas is not so thoroughly roasted as the ore discharged from the furnace. To obviate this, the gas which leaves the roaster passes through the vertical flue-dust chamber 110 and thence through the passage 111 into the flue-dust chamber 112. The latter is of ordinary construction; but the antechamber 110 is a feature of the present case. This chamber is built with an inclined floor 113, sloping at a considerable angle back into the end of the roasting-cylinder, and a lip 114 forms the end of the inclined floor of the dust-chamber and projects over the joint between the revolving cylinder and the stationary flue-face and into the roasting-cylinder. The deposited flue-dust, settling to the bottom of the dust-chamber 110, slides down the inclined floor and is discharged again into the roaster, where it rejoins the ore passing through the same. Spanning the vertical chamber 110 there are a series of apertured arches 120, and instead of these arches or in conjunction therewith the chamber may be fitted with prismatic tiles 121, set staggered and presenting inclined surfaces, down which dust settling thereon will successively fall and between which winding passages are formed for the upward passage of the gases. Across the top of the chamber there may be one or more screens 122, of coarse iron netting or perforated plates, just below the passage 111. The special form and construction of these dust-catching surfaces is not material, so long as they allow the deposited flue-dust to fall back into the furnace, the special feature being a construction which allows as much of the flue-dust as possible to be intercepted and automatically returned to the furnace by gravity and the roasting of the flue-dust carried along by the gases. As the gas passes along the surface of the arches, tiles, or plates the heavier particles of flue-dust are deposited and fall back on the inclined bottom of the chamber, from which they slide or are pushed back into the furnace. The very fine particles of flue-dust which are not deposited are thoroughly roasted by coming in contact with the hot surfaces of the several obstructions offered to the free passage of the gas, and they are finally deposited in the chamber 112 in a well-roasted condition. To increase the heat of the dust collecting and intercepting surfaces in this first flue-dust chamber, there may be one or more oil or gas burners 123 at the bottom of the chamber just below the first apertured arch. By means of these the arches, prismatic tiles, or other devices are made as hot as necessary to effect the complete roasting of the fine dust while in transit through the chamber.

The apparatus is adapted for the drying of any materials which do not materially affect iron, and as the contact between the pulverulent material and the gas is most intimate roasting as well as drying operations can be carried on at very low temperatures.

What I claim as my invention is—

1. A revolving roasting-cylinder having two or more sets of apertured ore-lifting partitions which divide the cylinder into longitudinal compartments, with open spaces across the cylinder between the sets of partitions, the partitions of one set being radially and spirally like offset with respect to those of an adjacent set, substantially as and for the purpose set forth.

2. In a roasting-cylinder, the combination with a series of radial plates, of a central multiple channeled or + iron bar with the angles of which the respective plates engage, and a series of radially-adjustable clamps for the outer edges of the plates, as and for the purpose set forth.

3. A revolving roasting-cylinder having at its discharge end a fire-box section forming a part of and revolving with the cylinder, said fire-box having a heating-burner therefor and an apertured fire-wall between the fire-box section and the roasting-chamber of the cylinder, together with ore-discharge ports and means for automatically opening and closing the same as the cylinder revolves, as and for the purpose set forth.

4. In a roasting-cylinder, the combination with a radial plate, of a grooved bar adapted to engage with the inner edge of the plate, and an outer grooved bar supported by the cylinder-shell and radially adjustable, and engaging with the edge of the plate, as and for the purpose set forth.

5. In a roasting-cylinder, the combination with a radial plate and a central support therefor, of a radially-adjustable grooved bar adapted to engage with the edge of said plate, and having screw-threaded bolts extending through the brick lining and the cylinder-shell, with supports for said bolts carried by the shell, as and for the purpose set forth.

6. A revolving roasting-cylinder having an outer shell, a brick lining, and iron-ore-lifting devices, with radially-adjustable bolts extending from the outer shell through the brick lining to the ore-lifting devices and adjustably supporting the latter independent of the brick lining, whereby the interior fittings can be repaired or renewed without interfering with the lining and central supports for said ore-lifting device, as and for the purpose set forth.

7. The combination with a roasting-cylin-

der, of a flue-dust chamber having a series of horizontally-disposed obstructions extending across the dust-chamber with narrow passages therebetween for the upward flow of gases, and auxiliary burners beneath the said series of obstructions for directly heating the same, as and for the purpose set forth.

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

PAUL NAEF.

Witnesses:
ANDREW J. WHITE,
F. M. LODGE.