D. BAKER.

ROTARY FURNACE.

APPLICATION FILED JULY 1, 1907.

1,004,340.

Patented Sept. 26, 1911.

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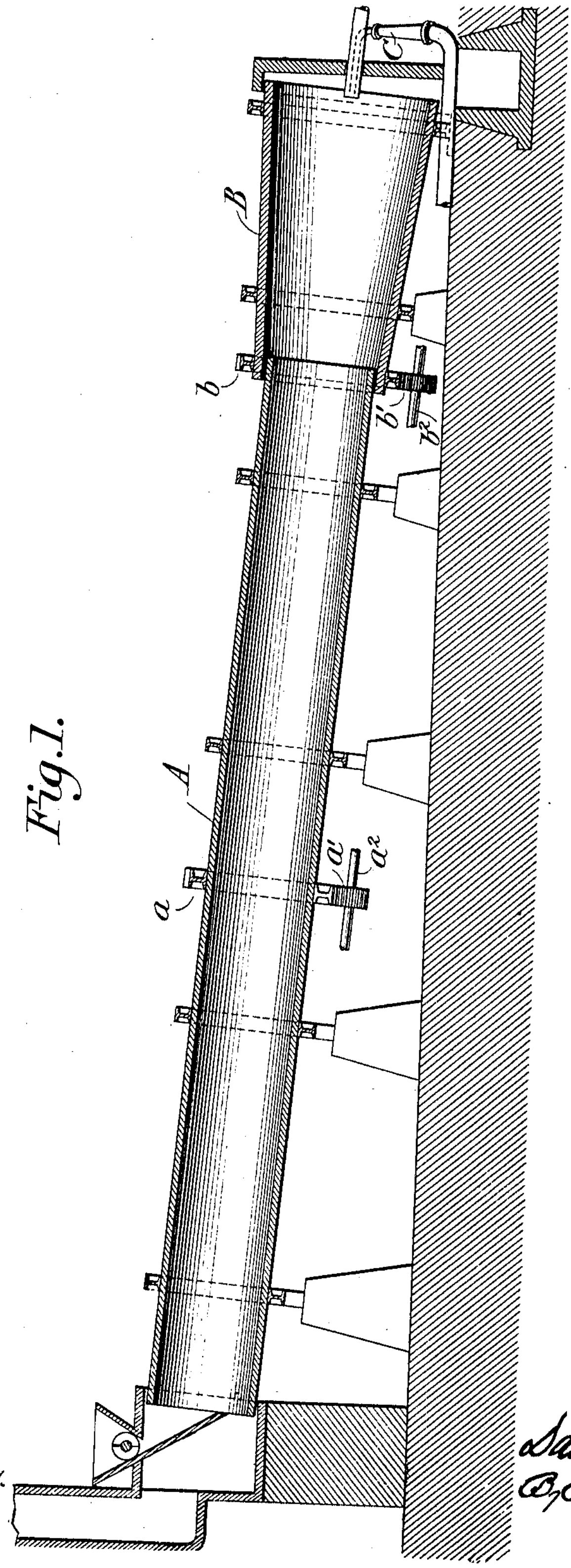

Witnesses

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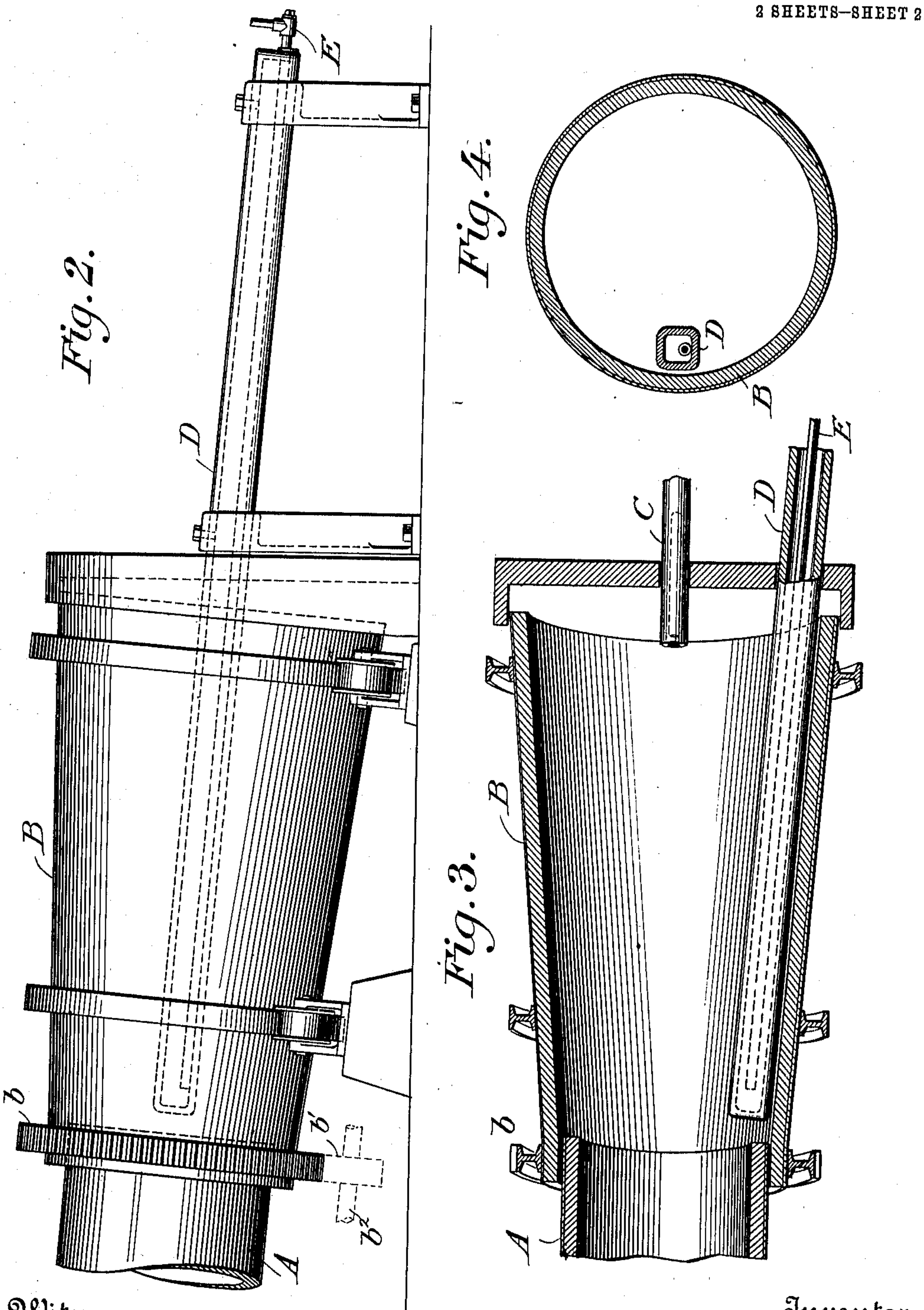

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UNITED STATES PATENT OFFICE.

DAVID BAKER, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY FURNACE.

1,004,340. Specification of Letters Patent. Patented Sept. 26, 1911.

Application filed July 1, 1907. Serial No. 381,584.

To all whom it may concern:

Be it known that I, DAVID BAKER, of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented a new and useful Improvement in Rotary Furnaces, of which the following is a specification.

This invention relates to rotary furnaces designed more particularly for desulfurizing and nodulizing fine iron ores for smelting purposes. Furnaces of this general type embody a rotating cylinder sustained at an inclination downward, so that the ore fed into the upper end of the cylinder will travel toward its discharge end, the ore in its passage through the cylinder being subjected to heat from a flame injected into the discharge end of the same.

The invention consists primarily in constructing the furnace in two sections, in one of which the desulfurization takes place, and in the other of which the sintering or nodulizing of the ore takes place, the relation, form and construction of these parts being such that the ore will travel at relatively low speed, and be subjected to a relatively low degree of heat in the part of the furnace where it is desulfurized, but will travel at a higher speed, and be subjected to a comparatively higher degree of heat in the part of the furnace where the sintering or nodulizing process is carried on.

The invention consists also in combining with a rotary furnace, a scraping or cleaning device of improved form, designed to dislodge from the interior of the furnace any fused material adhering to the same, thereby preventing the clogging of the furnace, and maintaining its internal surface clean, and in a condition most favorable for effective action.

In the accompanying drawings:—Figure 1 is a vertical longitudinal sectional elevation through my improved furnace. Fig. 2 is a side elevation of the discharge end of the same showing the cleaning or scraping device applied thereto. Fig. 3 is a horizontal section on the line 3—3 of Fig. 2. Fig. 4 is a transverse vertical section on the line 4—4 of Fig. 2.

Referring to the drawings:—My improved furnace comprises a long rotary main cylindrical portion A, sustained at a slight inclination from the horizontal so as to incline downward to its discharge end, and a relatively short rotary section B, in the form of a hollow truncated cone with its smaller end encircling the discharge end of the cylindrical portion, so that the ore passing from this cylindrical portion will be received in the conical end section, and by it discharged to the outside. The conical section B is so sustained relatively to the main cylindrical portion A, that their longitudinal axes will coincide, the result being that while the lower portion of the conical section will form a continuation of the lower portion of the cylindrical section, it will extend at a greater inclination downward, with the result that the travel of the ore through the conical section will be materially greater in speed than its travel through the main cylindrical portion. In order to accentuate this effect and properly control the relative speeds at which the ore shall travel through the two sections of the furnace, I propose to rotate the cylindrical portion A at relatively low speed, and the conical section B at comparatively high speed. For this purpose, the cylindrical portion A is provided on its exterior with an annular rack a, engaged by a driving pinion a' on a driving shaft a^2, receiving motion from any suitable source. Likewise the conical section B is provided with an annular rack b engaged by a driving pinion b' on a shaft b^2 receiving motion from any suitable source. I have found that satisfactory results may be secured if the driving pinion for the cylindrical portion of the furnace, rotates at one revolution per minute, and the driving pinion for the conical section, at four revolutions per minute, the annular racks being of the same diameter and containing the same number of teeth, and the driving pinions being of the same size. Of course these proportions and relations of the parts may be varied within reasonable limits, the essention requirement being that the ore in its passage through the main cylindrical portion of the furnace, will travel materially slower than when passing through the conical section.

The heating flame is introduced into the discharge end of the conical section through injector pipe C, and flows toward the receiving end of the main section, the highest heat being thus developed in the conical section, whence the effect gradually decreases as the receiving end of the furnace is approached. The slowly traveling and tumbling ore in the cylindrical portion is thus subjected to a moderate degree of gradually increasing heat, sufficient to effect the desulfurizing of the ore, so that by the time the conical section is reached, the sulfur is thoroughly eliminated, and the ore is ready to become fused or nodulated in the sintering process. This process takes place mainly, if not wholly, within the rapidly rotating conical section, where the heat is most intense, and as the ore in its quick passage through this conical section in the immediate vicinity of the flame, is rapidly tumbled about, it quickly forms into nodules which are discharged from the end of the cone.

From the foregoing description it will be seen that the ore is subjected to a continuous process or treatment, involving a desulfurizing action on the slowly traveling ore and a nodulizing or sintering action on the rapidly moving ore; and I believe myself to be the first to treat ore in this manner. It will be observed also that the roasting or desulfurizing of the ore is extended over a long period at moderate heat of gradually increasing intensity, and that the sintering action is confined to a comparatively short period of time, but at a very high degree of heat within the immediate vicinity of the flame. This treatment of the ore I believe also to be original with me.

In the operation of rotary furnaces, great trouble and annoyance result from the accumulation of the fused material on the walls of the furnace, this accumulation increasing to such extent as to frequently clog up the furnace and interfere with its proper operation. By reason of the great heat which exists in the region where such accumulation takes place, the removal of the concretions is attended with unusual difficulties. In order to overcome this objection, I provide a scraping or cleaning device shown more particularly in Figs. 2, 3 and 4. This device consists of a bar D suitably sustained in a fixed frame at the discharge end of the furnace, in such position that the bar will extend into the revolving section, close to the inner face of the wall thereof. The rotation of the furnace relatively to this bar will carry any adhering matters against it, and they will be thereby dislodged.

The bar is preferably hollow and kept cool so as to withstand the effects of the intense heat, by the circulation therein of a cooling medium. This may be effected by extending within the bar, a pipe E terminating near the inner end of the bar and having its outer end extended at the front and adapted to be connected with a suitable source of cold water supply.

My improved furnace is designed especially for desulfurizing and nodulizing the residues from pyrites burners, which product is a valuable iron ore when desulfurized and nodulized. It is very difficult to treat this material in an ordinary rotary kiln, for when it is desulfurized and reaches the part of the kiln where the nodulizing takes place, the pasty ore adheres to the lining of the kiln and soon chokes up the furnace. It is a very expensive undertaking to remove this internal "scaffold" or "ring" in the kiln, and as the nodulizing zone is only to stick the ore together, the nodulizing action should be as short as possible. In other words, when the ore becomes pasty, it should be hurried out of the kiln. It is for this purpose that I drive the lower section of the furnace at a higher rate of speed than the upper section; and it is for this purpose that the upper section is longer than the lower section; and further, it is for this purpose that the lower section is conical so as to cause the material to flow quickly therethrough.

I believe myself to be the first to form a furnace in which there is a comparatively long upper hollow section and a comparatively short lower section, forming a continuation of the upper one, the latter revolving at a lower speed than the former. I believe myself to be the first also to form the furnace of two sections arranged end to end and inclined downwardly and in which the lower section revolves at a higher rate of speed than the upper one. And I believe myself to be the first also to combine with a hollow upper section, a conical lower section forming a continuation thereof, the latter being driven at a higher rate of speed than the other section.

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

1. A furnace for desulfurizing and nodulizing fine ores comprising, in combination, an upper long downwardly inclined hollow section and a lower comparatively short hollow section, said sections being arranged end to end, means for rotating the upper section to cause the material therein to travel slowly toward its lower end, means for rotating the lower section at a higher speed to cause the desulfurized ore to travel more rapidly in its passage through said lower section, and means for introducing the heating medium into the lower portion of the furnace; whereby the desulfurized ore will be subjected to the high degree of heat for a comparatively short time.

2. In a furnace, the combination of an upper downwardly inclined hollow section, a lower hollow conical section with its smaller end in position to receive the ore flowing from the end of the upper section, means for rotating said sections at different relative speeds, the conical section at a higher rate than the other one, and means for introducing the heating medium into the conical section.

3. A furnace for desulfurizing and nodulizing fine ores comprising, in combination, two downwardly inclined hollow sections arranged end to end, means for rotating the upper section at such speed that the ore will travel slowly toward its lower end, and means for rotating the lower section at a higher speed to cause the desulfurized ore to pass rapidly therethrough, and means for introducing the heating medium into the lower section; whereby the ore will pass slowly through the upper section, where the desulfurizing action takes place, and will pass more rapidly through the lower section, where the nodulizing action takes place, and where the desulfurized ore will be subjected to the high degree of heat for a comparatively short period of time.

4. In a furnace, the combination of a main downwardly inclined hollow cylindrical section A, a hollow conical section B with its smaller end in position to receive the ore flowing from the end of the main section, means for rotating said sections at different relative speeds, and means for introducing the heating medium into the discharge end of the conical section.

5. In a furnace, the combination of a main hollow cylindrical section A inclined downwardly from its receiving end, a hollow conical section B with its smaller end in position to receive the ore from the lower end of the section A, said sections having their axes in alinement, means for rotating said sections, the conical section at greater speed than the cylindrical section, and means for introducing the heating medium into the discharge end of the conical section.

6. In a furnace, the combination of a main hollow cylindrical section inclined downwardly from its receiving end, a comparatively short section in the form of a hollow truncated cone having its smaller end surrounding the lower end of the cylindrical section, means for rotating said sections, the short section at higher speed than the other one, and means for introducing a heating flame into the discharge end of the short section.

7. In a furnace, and in combination with a hollow rotating section, a relatively fixed cleaning bar extending into the said section adjacent its interior surface, and means for cooling said bar.

8. In a furnace and in combination with a rotary hollow section, a relatively fixed hollow cleaning bar extending into said section adjacent its inner surface, and means for introducing a cooling medium into said bar.

9. In a furnace, and in combination with a rotary hollow section, a relatively fixed cleaning bar containing an interior cavity and extending into said hollow section parallel with its under side, and means for circulating a cooling medium in the interior cavity of the bar.

10. The combination of a kiln, with a scraping bar therein, one of said parts being revoluble relatively to the other, whereby materials adhering to the interior of said kiln are detached.

11. The combination of a rotary kiln, with a scraping device therein, and means for holding said device in the path of revolution of material adhering to the lining of said kiln whereby said material is detached by its impact against said device, substantially as specified.

12. The combination of a rotary kiln and means for heating it, with a rigid scraping device having means for protecting it from destruction by the heat applied to said kiln, and means for holding said device in the path of revolution of material adhering to the lining of said kiln whereby said material is detached by its impact against said device, substantially as specified.

13. The combination of an inclined rotary kiln, means for introducing materials at the higher end thereof, means for introducing flame at the lower end thereof, a scraping bar extending through the lower end of said kiln to a termination therein, and means adjacent to the lower end of said kiln for supporting said bar.

14. The combination of a rotary kiln, means for heating said kiln, a scraping bar disposed in said kiln so as to detach adhering material rotating therewith, means for supporting said bar and means for protecting said bar from the heating effects.

15. The combination of a rotary kiln, a hood for closing an end thereof and means for introducing a flame into said kiln, with a water cooled scraping bar movably supported in an opening in said hood and adapted to detach materials adhering to the interior of said kiln.

16. The combination of a rotary kiln, with a scraping bar disposed therein, whereby material adhering to the interior of said kiln is detached by the rotary action thereof, and means for supporting said bar so that it can be moved longitudinally.

In testimony whereof I hereunto set my hand this 20th day of June, 1907, in the presence of two attesting witnesses.

DAVID BAKER.

Witnesses:
LOUISE B. MORRIS,
LILLIAN M. HUDNUT.