No. 759,357. PATENTED MAY 10, 1904.

T. A. EDISON.

APPARATUS FOR BURNING PORTLAND CEMENT CLINKER, &c.

APPLICATION FILED APR. 19, 1900.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1

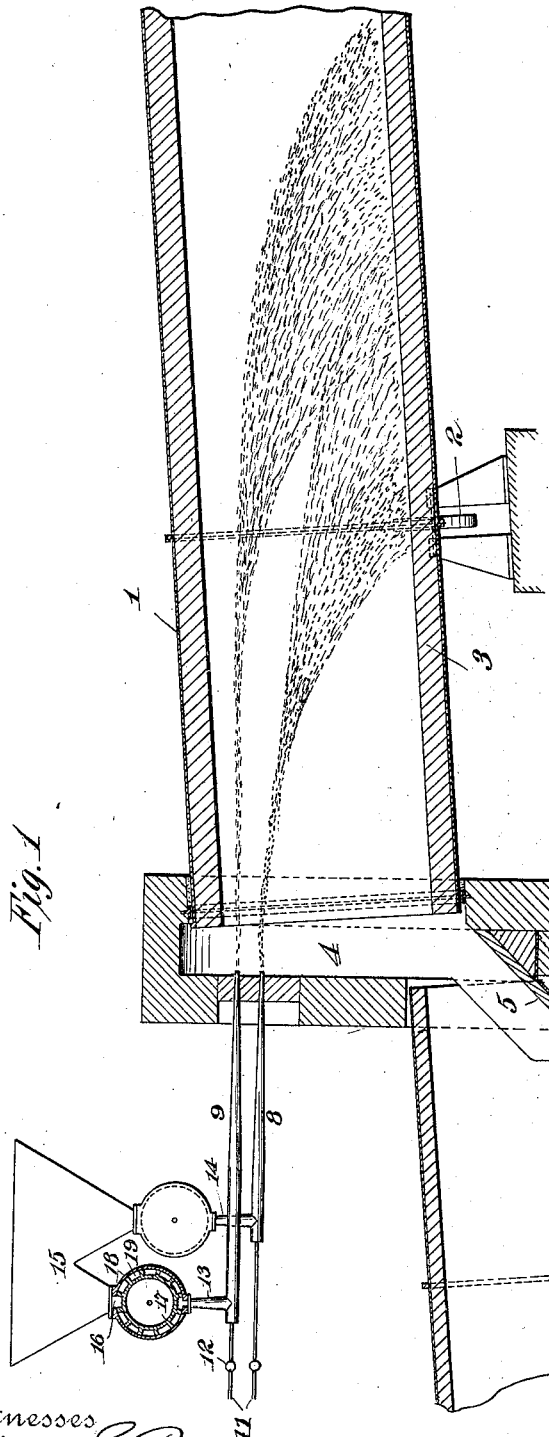
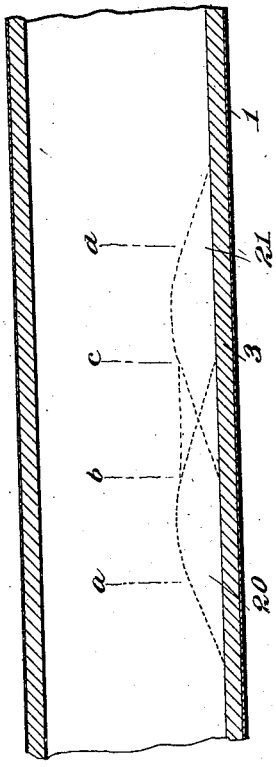


Fig. 2



Witnesses
Archibald S. Reese
Jno. R. Taylor

Inventor
Thomas A. Edison
By his Attorneys
Dyer Edmonds & Dyer

No. 759,357. PATENTED MAY 10, 1904.

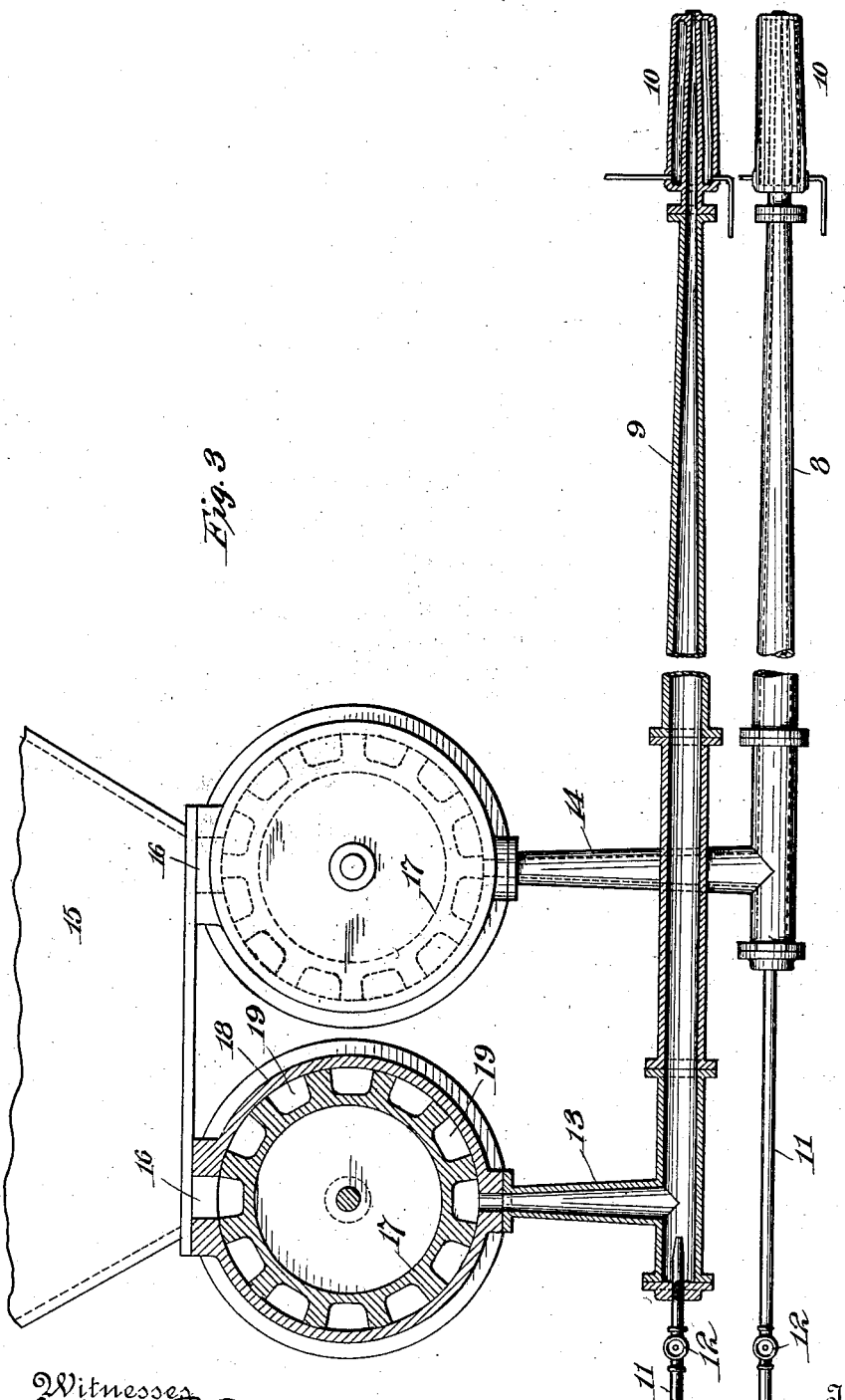
T. A. EDISON.

APPARATUS FOR BURNING PORTLAND CEMENT CLINKER, &c.

APPLICATION FILED APR. 19, 1900.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3



Witnesses
Archibald G. Ryer
Jno. R. Taylor

Inventor
Thomas A. Edison
By his Attorneys
Ryer, Snowden & Ryer

No. 759,357. Patented May 10, 1904.

UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

APPARATUS FOR BURNING PORTLAND-CEMENT CLINKER, &c.

SPECIFICATION forming part of Letters Patent No. 759,357, dated May 10, 1904.

Application filed April 19, 1900. Serial No. 13,406. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, (whose post-office address is said Llewellyn Park, Essex county, New Jersey,) have invented certain new and useful Apparatus for Burning Portland-Cement Clinker and other Materials, (Case. No, 1,033,) of which the following is a specification.

My present invention relates to an improved apparatus particularly designed for the burning of Portland-cement clinker in accordance with the method described and claimed by me in an application filed on even date herewith, said method consisting in producing within a rotary-cylinder burner a plurality of combustion zones each derived from the combustion of a stream or column of pulverized coal blown into the burner by compressed air and with respect to which combustion zones the material is caused to travel slowly by the rotation of the slightly-inclined burner. By thus creating within a rotary-cylinder burner a plurality of combustion zones I am enabled, as stated in said application, to burn much greater quantities of coal in the same burner without raising the temperature at any point therein above that necessary to secure effective clinkering, and since the area of clinkering temperature is thereby very greatly increased increased quantities of material can be burned in a single burner. By arranging the point of maximum temperature of one combustion zone sufficiently close to the point of maximum temperature of the adjacent combustion zone as to secure between such points a temperature sufficiently high to effect a clinkering of the material, the proportional clinkering area is much greater than is at the present time possible where only a single combustion zone is employed derived from the combustion of a single stream of pulverized coal.

The object of my present invention is to provide an effective apparatus for the carrying out of my improved method.

Broadly stated, my present invention comprises, in combination with a rotary-cylinder burner, a plurality of nozzles supplied with compressed air and each adapted to force within the burner a stream or column of pulverized coal, whereby a plurality of combustion zones will be created within the burner; and the invention preferably consists in the employment of means for so controlling the air-pressure supplied to the several nozzles that the powdered coal will be blown into the burner and so distributed therein as to cause the several combustion zones to overlap, whereby the temperature derived from the combined effect of adjacent zones will be sufficiently high as to effect the clinkering of the material.

My present invention is preferably carried out in connection with a rotary-cylinder burner having regenerative devices by which the air which enters the burner at its exit end to supply the additional oxygen required to effect complete combustion of the fuel will be caused to travel in contact with the clinkered material after it makes its exit from the burner, thereby serving to cool the latter and absorbing heat therefrom.

In order that the invention may be better understood, attention is directed to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a diagrammatic view illustrating the lower part of a cylindrical burner of the type described in my last-mentioned application, showing the employment of two nozzles for directing pulverized fuel within the cylinder; Fig. 2, a diagrammatic view illustrating graphically the two zones of combustion of the nozzles shown in Fig. 1 and representing the increase in the area of the zone of high heat or of clinkering temperature, which may be secured by causing the combustion zones to overlap; and Fig. 3, an enlarged sectional view, partly in elevation, showing effective devices for supplying powdered coal to the two nozzles.

In all of the above views corresponding parts are represented by the same characters of reference.

1 represents the burning-chamber of a cylindrical burner, supported on rollers 2 and provided with a fire-brick lining 3, which may be longitudinally corrugated. The exit or lower end of the burner opens into a chamber

4, provided with a chute 5, by which the burned material will be directed into a cooling-cylinder 6, as I describe in my last-mentioned application, the latter cylinder being inclined, as shown, and carried on rollers 7.

8 and 9 represent two nozzles, each provided with a water-jacket 10 at its rear end to prevent overheating, and opening into the rear ends of each of said nozzles is a pipe 11 for supplying compressed air thereto, each of said pipes being provided with a valve 12 for controlling the air-supply. By regulating the valves 12 for the several nozzles it will be understood that the amount of air entering the same may be regulated to provide for blowing the pulverized fuel to the desired extent within the cylinder. Leading into the nozzles 8 and 9 are fuel-pipes 13 and 14, respectively, by which coal or other fuel in pulverized or powdered condition may be introduced into the nozzles, so as to be blown by the compressed air into the cylindrical burner. In order to supply coal to the nozzles, I illustrate a hopper 15, to which the powdered coal is fed in any suitable way and having outlets 16 16 therefrom. Each of the fuel-pipes 13 and 14 is provided with a rotary feed 17, mounted in a casing 18, as shown, said feed comprising a rotating drum having a series of pockets 19 in its periphery. Obviously a given quantity of fuel will be received in each of these pockets as they pass successively beneath the exit-openings 16 of the hopper and be discharged by gravity into the fuel-pipe 13 or 14, as the case may be, as the pockets successively pass the upper ends of said pipes. The feeds for both fuel-pipes are rotated at the same speed by any suitable mechanism; but said feeds are proportioned, as shown, so that while one of them is discharging fuel into one of the nozzles the other feed will occupy an intermediate position. In this way the feed of fuel to the cylinder is more uniform than would be the case if fuel were simultaneously deposited in both nozzles followed by a simultaneous cessation of feed therefrom.

In the burning of Portland-cement material with an apparatus like that described I carry out my improved method as follows: The cylindrical burner 1 is rotated in the usual way, and the cooling-cylinder 6 is also rotated. Compressed air is supplied to the nozzle 9 through its air-pipe, say, at a pressure of fifty pounds per square inch, and compressed air is supplied to the nozzle 8 through its supply-pipe at a lower pressure. The desired air-pressure within the nozzles 8 and 9 can, it will be obvious, be secured by proper regulation or throttling of the valves 12. The hopper 15 being supplied with pulverized coal, the rotary feeds supply the nozzles 8 and 9 with a proper amount of fuel, which by the compressed air will be blown with a velocity depending upon the air-pressure into the cylinder, the fuel spreading more or less as its velocity diminishes. In the assumed case the nozzle 9, owing to the higher air-pressure therein, will project its stream or column of pulverized fuel into the cylinder farther than the nozzle 8. Combustion is started by igniting the streams of pulverized coal, and the proper amount of air necessary to effect complete combustion will be supplied by the draft passing into the cylinder through the cooling-cylinder 6. The representation of the streams or columns of pulverized fuel in Fig. 1 is purely diagrammatic, since in practice complete combustion will take place before the latter can fall to the bottom of the cylinder, as shown. Obviously the areas within the cylinder substantially coincident with the ends of each stream of burning pulverized coal will be the combustion zones. Thus, referring to Fig. 2, the line 20 may be taken to represent graphically the combustion zone derived from the burning stream of pulverized coal supplied by the nozzle 8, while the line 21 may be taken to represent graphically the corresponding combustion zone of the nozzle 9. If a single nozzle such as 8 were used, that portion of the area of the combustion zone represented by the line 20 which extends between the vertical lines *a* and *b* may be assumed to be the clinkering zone of the nozzle 8, or, in other words, so much of the heated area derived from the combustion of the pulverized coal supplied by the nozzle 8 as will secure the clinkering effect on the material. Therefore it will be seen that if a single nozzle were used the material would be clinkered or properly burned only during its passage lengthwise of the cylinder to an extent corresponding to the distance between the lines *a* and *b*, the temperature of the zone 20 at the right of the line *b* and at the left of the line *a* being insufficient to effect a clinkering action. Owing, therefore, to the relatively contracted area of clinkering temperature secured in a heated zone derived from a single nozzle, it becomes possible to pass only a relatively small quantity of the material through the apparatus. If an attempt were made to pass a greater amount of material through the burner by using an increased quantity of pulverized coal in a single nozzle, the maximum temperature of the single zone would be raised so high as to overburn the material and to injure the lining of the burner, since the material, even if of larger volume, would not materially reduce the temperature of the heated zone. By employing, however, a plurality of nozzles, so that a plurality of combustion zones will be secured within the cylindrical burner, the maximum temperature of each of said zones will not be so high as to overburn the material or to injure the lining of the burner. Thus it will be seen that when two nozzles are employed the combustion zone derived from the combustion of the stream or column of pulver-

ized fuel from the nozzle 9 will between the lines *c* and *d* provide for a zone of clinkering temperature. Assuming the air-pressure supplied to the two nozzles to be so widely different as to separate the combustion zones sufficiently as not to influence each other, it will be seen that by doubling the amount of coal supplied to the burner twice the material can be passed through the burner to be effectively clinkered without danger of over or under burning. A greater saving, however, is secured when the air-pressures applied within the several nozzles are so modified as to cause the combustion zone derived from the combustion of coal supplied by one nozzle to, so to speak, overlap upon the combustion zone derived from the other nozzle, as indicated in Fig. 2. When this is done, it will be found that the heat derived from two adjacent combustion zones between the lines *b* and *c* will be sufficient to effect the desired clinkering operation. When the nozzles are thus arranged, it will be seen that by doubling the quantity of coal supplied to the cylindrical burner the clinkering zone will be increased approximately three hundred per cent., and it becomes possible therefore to pass the material through the burner three times as fast with two nozzles as is possible with one or to pass three times the bulk of the material at the same speed with two nozzles as is possible with one. As the material after being clinkered passes down the chute 5 into the cooling-cylinder 6, the cold air entering said cylinder will absorb heat from the material to cool the latter, whereby such air will enter the burning-cylinder in a heated condition.

By employing a rotary feed of the type described it will be observed that an effective air seal is provided preventing leakage of the compressed air from the nozzle up through the fuel-pipes, so that the fuel will fall by gravity through the fuel-pipes and will not be subjected to any updraft therein, as would be the case if the feed was of a character to leak air. Obviously by regulating the speed of the feeds the amount of fuel supplied to the nozzles can be adjusted.

Although the nozzles 8 and 9 may be of the same length, it is preferable to make the nozzle 9, having the higher air-pressure, longer than the nozzle 8, for the reason that owing to the greater velocity of the air in the nozzle 9 increased opportunity should be offered for the air to overcome the inertia of the particles dropping into the nozzle through the fuel-pipe 13. Preferably, therefore, the nozzle having the higher air-pressure should be made long enough to allow the particles to acquire the velocity of the air at the time they are projected from the nozzle.

Instead of using my improved apparatus for the clinkering of cement materials, it will be obvious that it may be carried out in connection with the burning or roasting of other materials—as, for instance, in the roasting of ores.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. In apparatus for burning Portland-cement clinker and other materials, the combination with a rotary-cylinder burner to which the material is supplied and through which it is caused to travel, of means for producing within said burner a series of combustion zones, lengthwise of the cylinder, substantially as set forth.

2. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner to which the material is supplied and through which it is caused to travel, of means for producing within said burner a series of combustion zones lengthwise of the cylinder, said combustion zones being caused to overlap, substantially as set forth.

3. In apparatus for burning cement clinker and other materials, the combination with a rotary cylinder forming a combustion-chamber through which the material is caused to progress, of a plurality of nozzles supplied with compressed air and powdered fuel, whereby a plurality of streams of fuel will be blown into the combustion-chamber to provide for a plurality of combustion zones with respect to which the material moves, and means for adjusting the air supplied to said nozzles to distribute the fuel in a plurality of zones lengthwise of the cylinder, substantially as set forth.

4. In apparatus for burning cement clinker and other materials, the combination with a combustion-chamber in which the material is caused to progress, of two nozzles projecting longitudinally within the chamber, one of said nozzles being longer than the other, means for supplying compressed air and powdered fuel to said nozzles, whereby a plurality of streams of fuel will be blown into the combustion-chamber to provide for a plurality of combustion zones therein with respect to which the material moves, and means for adjusting the air supplied to said nozzles to provide for a greater velocity of the air in the longer nozzle, substantially as set forth.

5. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner to which the material is supplied and through which it is caused to travel, of a plurality of nozzles supplied with compressed air and powdered fuel for producing within said burner a series of combustion zones lengthwise of the cylinder, substantially as set forth.

6. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner to which the material is supplied and through which it is caused to travel, of a plurality of nozzles supplied with compressed air and powdered fuel for produc-

ing within said burner a series of combustion zones lengthwise of the cylinder, and means for adjusting the air supplied to said nozzles to provide for the overlapping of said combustion zones, substantially as set forth.

7. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner through which the material is caused to travel, of a plurality of nozzles, compressed-air-supply pipes for said nozzles, and means for supplying powdered fuel successively to said nozzles, substantially as set forth.

8. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner through which the material is caused to travel, of a plurality of nozzles, compressed-air-supply pipes for said nozzles, means for supplying powdered fuel successively to said nozzles, and means for regulating the air-supply for said nozzles, substantially as set forth.

9. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner with respect to which the material travels, of a plurality of nozzles projecting longitudinally with respect to the burner, compressed-air-supply pipes for said nozzles, a fuel-pipe leading into each of said nozzles, and a rotary feed for successively supplying pulverized coal to said fuel-pipes, substantially as set forth.

10. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner with respect to which the material is caused to travel, of a plurality of nozzles projecting longitudinally with respect to the burner, compressed-air-supply pipes for said nozzles, a fuel-pipe entering each of said nozzles, a hopper to which pulverized coal is supplied, and a rotary feed interposed between said hopper and each of said fuel-pipes, substantially as set forth.

11. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner with respect to which the material is caused to travel, of a plurality of nozzles projecting longitudinally with respect to the burner, compressed-air-supply pipes for said nozzles, a fuel-pipe entering each of said nozzles, a hopper to which pulverized coal is supplied, and a rotary feed interposed between said hopper and each of said fuel-pipes, said rotary feed being provided with a plurality of pockets in its periphery, substantially as set forth.

12. In apparatus for burning cement clinker and other materials, the combination with a rotary-cylinder burner with respect to which the material is caused to travel, of a plurality of nozzles projecting longitudinally with respect to the burner, compressed-air-supply pipes for said nozzles, a fuel-pipe entering each of said nozzles, a hopper to which pulverized coal is supplied, and a rotary feed interposed between said hopper and each of said fuel-pipes, said rotary feed being provided with a plurality of pockets in its periphery, the pockets in the several feeds being arranged successively, whereby the fuel will be successively supplied to said nozzle, substantially as set forth.

This specification signed and witnessed this 10th day of April, 1900.

THOS. A. EDISON.

Witnesses:
J. F. RANDOLPH,
J. A. BOEHME.