

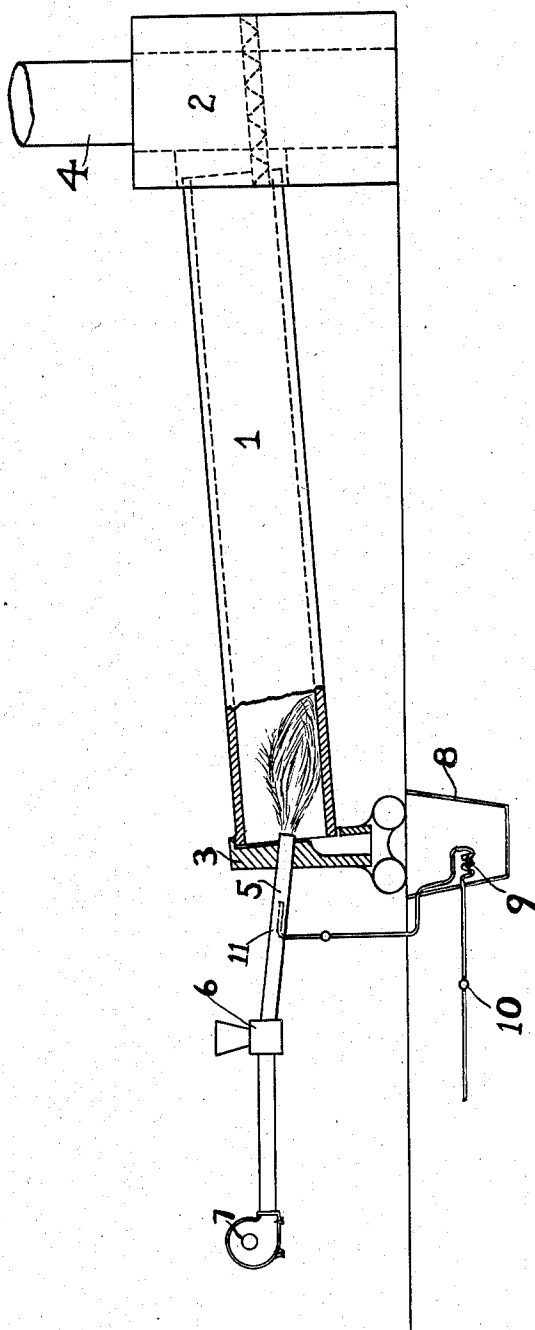
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H. L. DOHERTY.

PROCESS OF BURNING CEMENT AND APPARATUS THEREFOR.

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WITNESSES:

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HENRY L. DOHERTY, OF MADISON, WISCONSIN.

PROCESS OF BURNING CEMENT AND APPARATUS THEREFOR.

No. 846,555.

Specification of Letters Patent.

Patented March 12, 1907.

Application filed April 7, 1906. Serial No. 310,561.

To all whom it may concern:

Be it known that I, HENRY L. DOHERTY, a citizen of the United States, and a resident of Madison, in the county of Dane and State of Wisconsin, have invented certain new and useful Processes of Burning Cement and Apparatus Therefor, of which the following is a specification.

The present process relates to burning cement-clinker in inclined rotary kilns by means of a tempered impinging flame of powdered fuel.

In the practice of the art of cement-burning it has heretofore been customary to perform the operation of clinkering with a flame produced by the burning of powdered fuel with ordinary air. With such a flame it has been found necessary to take extreme precaution to prevent the flame from striking or impinging upon either the material or the walls of the kiln. Such methods are not economical, for the reason that the removal of the flame to a point distant from the place of utilization of the heat makes it necessary to rely on radiation alone for the transference of heat to the material.

The present invention has for its object the production of a flame which can be brought in contact or in proximity to the material or even the walls of the kiln without any deleterious effects.

A further object is the introduction into the flame of a catalytic body—namely, steam or water-vapor—for the purpose of assisting in the formation of clinker.

It has been previously proposed to make use of steam or water-vapor in the burning of cement; but all such proposals have been suggested, so far as I am advised, in connection with the use of an axial flame or of a flame which is substantially parallel to the axis of the kiln. Under such circumstances little or no catalytic action is manifest, as the water-vapor has no opportunity to come in contact with the material and thereby perform useful work. In the operation of clinkering cement a number of reactions of a complex nature occur, and, in fact, the exact character of all the reactions which go on at this stage is far from clear. Investigations show that steam or water-vapor has a peculiar action on silica at the time of transfor-

mation into silicates, and, on the whole, steam appears to have a beneficial action in accelerating the combination of silica with lime, aluminium, and iron, provided the temperature of the flame is carefully regulated, is fairly uniform, and is not excessively high. In burning powdered coal with ordinary air, containing approximately twenty-one per cent. of oxygen, a very high flame temperature is reached. The heat, however, is much localized and for that reason is not adapted to burning cement-clinker uniformly. Mitigation of the effect of such localized combustion and excessively-high temperatures is in part secured by the use of a non-impinging flame. By my invention, however, uniform and less-localized combustion is attained, which makes possible the use of an impinging flame and permits of the effective use of a catalyzer.

My process consists in the addition to the air used to support combustion of a predetermined modicum of steam or water-vapor or other vapor having equivalent properties.

In the accompanying drawing, which illustrates (part in elevation and part in section) an inclined rotary kiln, I have shown means for carrying out the above-mentioned process.

Referring to said drawing, 1 is a rotary open-ended barrel entering a housing or dust-chamber 2 at its upper end and inclosed by a hood 3 at the lower end. A stack 4 is provided for the removal of the products of combustion. Connected with the hood by means of the single pipe 5 is a coal-feeding mechanism 6, to which air is supplied by the blower 7.

8 is a clinker-pit into which the hot clinker from the kiln 1 falls. In this clinker-pit is placed a coil of pipe 9, to the inlet 10 of which water is supplied. The outlet 11 of said coil terminates in the blast-pipe 5. The raw material is entered into the upper part of the kiln in the usual manner and passed downwardly along the barrel of the kiln upon rotating the latter. The flame produced by the ignited blast of coal and air entering through the pipe 5 is so directed that the material is bathed in burning and incandescent gases. Water is entered through 10 into the coil 9 and is converted into vapor or steam

by the heat of the discharged clinker, which collects in 8. Steam thus generated discharges into the pipe 5 and mixes with the coal and air. The amount of steam introduced is regulated by a suitable cock. The effect of the steam is to lower the flame temperature, and the amount introduced is obviously dependent upon the flame temperature desired. One to three per cent. is usually sufficient in the burning of Portland cement made from silicate rock. The amount of sulfur in the fuel should be taken into consideration in determining the quantity of steam to be used. A high content of sulfur in coal usually calls for a slightly larger quantity of steam over that above mentioned. The steam required may be generated in other ways—as, for instance, by means of a steam-boiler placed in the stack 4. The quantity of steam may be varied intermittently or periodically, if desired, and in case of the formation of incrustations of clinker on the walls of the kiln it is desirable for a short time to considerably increase the proportion of steam or to suddenly and frequently vary the quantity until the “ring” is dislodged. In burning cement with ordinary air no means are at hand for the efficient removal of rings, and it is necessary under former practice to stop the kiln and remove the incrustations by manual effort. My invention aids in the removal of rings, so that stoppages are less frequent.

It is a well-known fact that water-vapor exerts a beneficial action in the calcination of limestone. The raw mix for ordinary Portland cement contains about thirty per cent. of carbon dioxid. The presence of the additional amount of steam other than that coming from the fuel results in an improved calcination of the limestone. The lime is freed more easily from the carbon dioxid with which it is combined in an atmosphere containing a substantial amount of water-vapor.

I do not limit myself in the production of an impinging and catalyzing flame in this manner solely to the use of steam, as I may under certain circumstances use products of combustion in conjunction with steam for this purpose.

I am aware that the use of the stack-gases for the regulation of flame temperature is not new, and I do not lay claim to the use of air and products of combustion without the addition of steam.

What I claim is—

1. The process of burning cement-clinker in rotary kilns which consists in directly impinging on an advancing stream of cement material in such kilns a tempered flame of burning fuel carried by a jet of commingled air and steam, the relative proportion of

steam in such jet being so regulated as to confine the temperature produced within the upper and lower limits of safe clinkering temperature.

2. The process of burning cement-clinker which consists in directly impinging on a traveling stream of cement material a tempered flame of burning fuel carried by an aeriform jet containing a modicum of steam, the proportion of steam in such jet being regulated to confine the temperature produced within the upper and lower limits of safe clinkering temperatures.

3. The process of burning cement-clinker in rotary kilns which consists in directly impinging on an advancing stream of cement material in such kilns a tempered flame of burning fuel carried by an aeriform jet containing a modicum of steam, the proportion of steam in such jet being regulated to confine the temperature produced within the upper and lower limits of safe clinkering temperatures, and from time to time slightly modifying said proportion within said limits to obviate ring formation.

4. The process of burning cement-clinker which consists in impinging on an advancing stream of cement materials a tempered flame of powdered coal carried by an air-jet containing sufficient water-vapor to temper and confine the temperature produced within the upper and lower limits of safe clinkering temperatures.

5. The process of burning cement-clinker in rotary kilns which consists in directly impinging on an advancing stream of cement materials in such kilns a tempered flame of powdered coal carried by an air-jet containing sufficient water-vapor to temper and confine the temperature produced within the upper and lower limits of safe clinkering temperatures, and in periodically varying such proportion within such limits to obviate ring formation.

6. A cement-clinker apparatus comprising a rotary inclined kiln, means for feeding raw material thereto and removing finished clinker therefrom, and flame-producing means therefor comprising a burner arranged to direct a flame into direct impingement upon material advancing therethrough, a feeding device furnishing said burner with powdered fuel, air-supplying means for transporting said fuel to and through the burner into impingement upon the material and means for furnishing to said air a modicum of steam.

7. A cement-clinker apparatus comprising a rotary inclined kiln, means for feeding raw material thereto and removing finished clinker therefrom, and flame-producing means therefor comprising a burner arranged to direct a flame into direct impingement upon material advancing therethrough, a feed device

furnishing said burner with powdered fuel,
air-supplying means for transporting said
fuel to and through the burner, and a water-
vaporizing device located in proximity to the
5 clinker-removing means and having a pipe
connection with said flame-producing means
whereby undue heat of the impinging flame
may be tempered.

Signed at New York, in the county of New
York and State of New York, this 16th day of 10
March, A. D. 1906.

HENRY L. DOHERTY.

Witnesses:

FLETCHER P. SCOFIELD,
FRED. I. SMITH.