UNITED STATES PATENT OFFICE.

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METHOD OF BURNING CEMENT-MAKING MATERIALS.

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To all whom it may concern:

Be it known that I, JAMES M. WILLCOX, of Philadelphia, in the State of Pennsylvania, have invented a new and useful Improvement in the Method of Burning Cement-Making Materials, of which the following is a specification.

My invention is for the purpose of improving the burning of cement-making materials in a kiln or chamber, and thereby the quality of the cement produced; and the objects to be more immediately effected for that purpose are to ignite the fuel rapidly, to burn quickly, to distribute the intense heat evenly and thoroughly, to compensate for any deficiency of heat due to the use of ordinary fuels or any other cause, and to regulate the heat of the kiln uniformly. All these objects are effected much more perfectly by means of my invention than by the ordinary method of burning in hydraulic-cement kilns; and my invention may be stated in a general way to consist in the employment in the burning of cement-making materials, in conjunction with the coal or coke ordinarily associated with such materials in a kiln or chamber, of flaming gas or spray as a carrier of fire, or burner ancillary or auxiliary to the ordinary denser fuel. Any highly-combustible gas will answer my purpose, if forced in a burning stream into the contents of the kiln; but I prefer a current of burning oily or tarry or similar spray, for the reasons that it is not so quickly spent, nor its heat so narrowly localized, and I do not claim the use of either except as an auxiliary or ancillary burner. In practical use I prefer Parson's steam-blower and Parson's tar-burner, patented February 6, 1877, and June 15, 1877, as the best known apparatus for injecting the burning spray or gas.

In illustration of the value of my invention I instance the manufacture of the "Portland" or highest grade of hydraulic cement according to the best method in present use. The cement-making materials are apportioned and reduced to powder in a crude or semi-crude state, mixed with a combustible binder of tar, pitch, or other resinous substance, then pressed or molded into lumps or blocks, and finally laid in the kiln in strata between alternate layers of coal or coke. The kiln, when thus charged, is lighted at the bottom and the fire struggles through the compact mass, slowly reducing it layer after layer to a condition which fits it for grinding into finished cement. In this operation, as the fire slowly ascends, the resinous binder of the layers approached by it softens, volatilizes, and mostly goes off in vapor before the living fire reaches it to ignite it and burn it *in situ* as fuel. This is a very material loss of the most valuable of all fuels, since the binder is so distributed as to be in contact with every molecule of the material, and its burning *in situ* produces a clinker in which the elementary cement constituents form the most perfect union. This burning *in situ* I effect by my process, and so improve the quality of the cement as well as quicken and cheapen its production.

The gas or flame in practice I prefer to introduce first high up in the kiln by injecting it into and throughout the upper layers through a door or opening a moderate distance below the top of the charge. The current of fire soon ignites the whole of the upper part of the charge and drives off by intense heat through the chimney the heavy carbonic-acid gas produced by the decomposition of the large proportion of carbonate of lime in the mixture; but for the intense heat of the upper strata this gas would lag in the kiln and badly choke the slow ignition of the ordinary burning process. Moreover, the proper clinkering of the upper strata is thus assured—an effect seldom produced in any other way. This covering of the upper portion of the charge with a large actively-burning mass of materials induces a strong draft upward through the grate at the bottom in such a way that when the fire is afterward applied to the bottom of the contents it rapidly rises and widens out throughout the entire contents. In this way the binder is nearly all burned *in situ*, and what portion of it volatilizes is burned in the upper incandescent layers, scarcely any escaping as waste vapor. The slippery softening of the balls or blocks held together by it is so far diminished that the interstices are not materially closed under the great superincumbent weight of the charge, and the draft therefore but little impeded. The entire charge burning at the

same time throughout is subject to a much higher heat than if burned in successive stages, and is therefore better and more uniformly brought to the properly-clinkered point.

The lighting of the kiln near the top first, and subsequently at the bottom, brings about the best results; but without departure from my invention the kiln may be lighted at the bottom simultaneously with or a short time before its lighting at the top, the latter operation still acting to produce upon the lower burning and the general burning of the kiln the special effects hereinbefore mentioned—namely, the more rapid expulsion of the carbonic-acid gas of the kiln and the improvement in the draft of the entire kiln, as well as the more efficient and rapid reduction of the charge; nor am I restricted in my invention to those cases only where the materials to be reduced or changed by heat are associated with a combustible binder, although the invention has special advantages and is of special value in such cases. I may apply it to great advantage in the ordinary manufacture wherein a combustible binder is not used, whether the cement to be produced be of a natural or of a Portland character. I have practically ascertained that when my process of injecting one or more streams of flaming gas or spray into the bottom of a kiln charged in the ordinary way has been employed I have effected a great saving in quantity and cost of fuel and a great saving of time in the burning process, and when I have applied my invention and process in such a way as to first thoroughly light the upper strata by directing the flame through them in various directions, and then to light the lower strata at the bottom of the kiln, I have been able to still further reduce the cost of fuel, to improve the cement by burning the binder more efficiently *in situ*, and to reduce the time of burning out the entire kiln to about half the time required to burn it out in the regular way heretofore practiced, thus vastly economizing and improving the manufacturing process and product of a cement-works and nearly doubling its reducing capacity.

Having described my invention and the best way now known to me of carrying the same into effect, what I claim, and desire to secure by Letters Patent is—

In the manufacture of cement, the method hereinbefore described of burning or reducing the cement-making materials in a kiln or chamber by subjecting the same to the simultaneous action both of the usual solid fuels previously mixed with the cement-making materials and forming a portion of the charge and of burning jets of gas, fluids, or spray which are auxiliary and ancillary to the solid fuels and are applied to the upper strata of the charge in the kiln before or at about the time the lower strata of the same charge are lighted, substantially as and for the purposes hereinbefore set forth.

JAMES M. WILLCOX.

Witnesses:
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W. H. GODWIN.