

# UNITED STATES PATENT OFFICE.

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## METHOD OF BURNING POWDERED COAL.

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Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, LOUIS S. HUGHES, a citizen of the United States of America, residing in Joplin, county of Jasper, and State of Missouri, have invented a certain new and useful Improvement in Methods of Burning Powdered Coal, of which the following is a true and exact description.

It has long been recognized that the use of powdered coal as a fuel possesses certain important advantages. Among these may be mentioned the following: It insures a very perfect combustion so that the combustion of a given quantity of powdered coal furnishes a materially greater amount of heat than would be obtained by burning the same coal in the ordinary lumpy condition. In burning powdered coal, the amount of fuel supplied to the combustion chamber can be nicely regulated with ease to meet the heat demands. By powdering it, finely divided coal, which cannot well be burned on ordinary grates is rendered available for use. Notwithstanding these advantages, the use of powdered coal as a fuel has not become general. The principal reason for this is the fact that in burning the coal an ashy residue is produced which is deposited in the form of a glassy or vitreous coating on the walls of the furnace chamber from which it cannot be readily removed, and in some cases this coating actually attacks the furnace walls. In the case of steam generators, such as locomotive boilers, this adherent coating is, of course, practically prohibitory of the use of powdered coal, since the coating formed on the metallic portion of the boiler tubes, grate bars or other metal surfaces, in contact with the furnace gases, not only greatly diminishes the heat transferred to the heater, but impairs the durability and strength of the boiler.

The object of my invention is to provide a way of burning powdered coal without the production of a residue which will adhere to the walls of the furnace chamber in objectionable amounts. This object I accomplish by burning the coal in the presence of some basic material which acts on the ashy residue of the coal to prevent its fusion into an adherent clinker.

The ashy residue of coal comprises an incombustible silicious component which consists of one or more fusible silicates or mixtures of silica and certain basic materials which unite on the combustion of coal to

form fusible silicates or a mixture of fusible silicates and fusible silicate forming materials. I have found that if I burn the powdered coal in the presence of certain basic materials, the fusibility of the otherwise easily fusible silicious component is greatly reduced or entirely done away with. If fusion occurs, the presence of a sufficient amount of basic material which I employ, prevents the formation of the objectionable glassy or vitreous adherent clinker which would otherwise be formed. The fusible silicate residue which may be formed in the presence of the basic material added by me is in the nature of a silicate or silicates, into the composition of which the added basic material enters and which silicates are not of a glassy, vitreous adherent character. The basic materials which I prefer to employ are oxids of calcium and magnesium and admixtures thereof, or preferably, in practice, carbonates of calcium and magnesium, such as calcite and other common varieties of limestone, dolomite, magnesite etc. These carbonates readily break down under the furnace heat and yield the desired infusible oxids. Other substances than those enumerated above possess the desired refractory and basic properties and I do not mean to exclude their use in carrying out my invention by my enumeration of certain common, easily obtainable substances which I have found to be satisfactory.

I believe the correct explanation of the results obtained by my invention is as follows: In the combustion of the coal, the silicious, or other components which would, but for the presence of the basic material I employ, form the injurious fusible residue, are set free in a state of ultimate division, and the chemical combinations which result in the ash formation occur after the components are released and while they are in a nascent condition. When the basic, or base containing material is mixed with burning coal, it is decomposed and the basic components then in a nascent condition unite with the nascent ash forming constituents of the coal to form compounds which are practically infusible, and of a non-glassy character. Whether or not the foregoing is the true explanation, the results obtained by the use of my invention are highly advantageous.

The amount of the basic material which I mix with the burning coal is slightly in



excess of the quantity which unites or may unite with the silicious components to form non-vitreous non-adherent fusible silicates. The minimum amount of basic material to be employed varies largely in different cases; some coals containing much higher percentages of silicious components than others. This is especially true as my invention may be satisfactorily employed in burning all the common varieties of coal including lignite. Generally speaking, the weight of basic material to be added is of the same order as the weight of the ash forming constituents of the coal, for instance, if calcium carbonate is the base containing material employed, its weight should be approximately equal to the weight of the ash forming constituents of the coal. It will be understood, of course, that the exact amount of basic material to be added to obtain the best results is dependent upon its character and the character as well as the amount of the ash forming constituents of the coal. For instance, the weight of calcium oxid necessary, if it be the basic material employed, is but little more than half that of the weight of calcium carbonate necessary with the same amount of coal, and the weight of the amount of magnesia necessary would be less than that of the calcium oxid. Some excess of basic material over the quantity theoretically necessary is not harmful, though much excess is objectionable.

It will be understood by those skilled in the art that in speaking herein of burning powdered coal in the presence of powdered basic material, I mean not merely that the fuel and basic material are finely subdivided, but also that the combustion takes place with the coal and basic material floating in the air or gas supporting combustion and not with the fuel burning in a mass supported on a grate, or the like, as in the usual method of burning solid fuel.

The coal and basic material may be fed into the furnace in any suitable manner, for instance, a powdered mixture of coal and

basic material may be fed in by an air jet or jets or coal may be fed in by one jet or set of jets and the basic material by another jet or set of jets. Instead of air jets, any other suitable means may be employed for feeding the coal and basic material into the furnace, so that combustion takes place with the fuel and basic material suspended in the gaseous medium supporting combustion.

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

1. The process of burning powdered coal, which consists in mixing with the coal a powdered substance, or substances, which unite with the silicates or silica in the coal to form a non-adherent residue.

2. The process which consists in burning powdered coal in the presence of a powdered substance which unites with the incombustible ingredients of the coal to form a non-adherent residue.

3. The process which consists in feeding into a combustion chamber powdered coal and a powdered basic material of a character and in an amount sufficient to unite with the mineral acid components of the coal ash to form a non-adherent clinker.

4. The process which consists in feeding into a combustion chamber powdered coal and powdered calcium carbonate in amount sufficient to make the resultant ash highly basic.

5. The process which consists in feeding into a combustion chamber powdered coal and powdered limestone in amount sufficient to make the resultant ash highly basic.

6. The process which consists in feeding into the combustion chamber powdered coal and a difficultly fusible basic material slightly in excess of that necessary to unite with the silicious component of the coal.

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Witnesses:

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