UNITED STATES PATENT OFFICE.

HENRY J. WILLIAMS, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE COAL TREATING CO., OF PHŒNIX, ARIZONA TERRITORY, AND BOSTON, MASSACHUSETTS, A CORPORATION OF ARIZONA TERRITORY.

PROCESS FOR CONTROLLING THE COMBUSTION OF FUEL.

No. 896,875. Specification of Letters Patent. Patented Aug. 25, 1908.

Application filed June 10, 1908. Serial No. 437,721.

To all whom it may concern:

Be it known that I, HENRY J. WILLIAMS, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Processes for Controlling the Combustion of Fuel; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a process for controlling the combustion of fuel, and has for its object the provision of a cheap and certain method for facilitating the combustion of coal and at the same time preventing the production of smoke.

In the application of Newell W. Bloss, Serial No. 433,234, filed May 16, 1908, there is disclosed a process for accomplishing the above purposes wherein catalytic agents are used, and especially salts of the alkali group in thin films; sodium nitrate being preferred. From a series of practical tests carried out by myself, I have discovered that salts of the alkaline earths are even more efficient for this purpose than salts of the alkali metals; especially calcium chlorid $CaCl_2$, which is probably immediately converted into calcium oxid CaO, after the fuel is ignited.

Therefore, my invention consists in coating the fuel, preferably coal, with a thin film of a salt of the alkaline earths, then igniting the fuel and permitting it to generate a combustible gas, which in turn ignites and produces a flame much longer than is produced under the same conditions when the fuel is not so treated.

In carrying out my process I preferably employ a salt which is soluble in water, and coat the fuel with a water solution of the same by either a sprinkling or a dipping process, preferably the latter. After the coal, or other fuel, is thoroughly coated with this solution and allowed to drain, it is then placed upon a fire kindled in the ordinary way. As soon as the water is driven off and a temperature of about 1000° F. in the fire is reached, blue flames begin to appear which at first gradually increase, and then rapidly grow longer as the temperature rises, until at a temperature in the neighborhood of 1800° F., there exists splendid long flames very greatly exceeding in volume and length any flames that could possibly be produced under like conditions if the coal were not coated with the solution mentioned, or its equivalent. In fact, I have repeatedly produced flames under the above conditions which were 36 inches long, or longer, when under the same conditions the same coal untreated failed to produce flames longer than four inches. Still other tests were even more pronounced in favor of the treated fuel. I have, also, tried solutions of calcium chlorid, $CaCl_2$, of various strengths, ranging from one part of $CaCl_2$ salt to 600 parts of water to one part of salt to 10 parts of water, with the most satisfactory results; and these experiments seem to show that a solution of about one part of salt in about 50 parts of water would be the most desirable from a commercial standpoint, owing to the fact that the flames with such a solution are thoroughly satisfactory; and a solution containing one part of salt in 10 parts of water does not give flames five times as great in volume; and therefore the chemicals consumed in the 1–50 solution are sufficient and about five times as cheap as in the 1–10 solution. Not only are the flames from the treated fuel very much longer than from the untreated fuel, but there appears to be substantially perfect combustion, and therefore practically no smoke is given off. Under proper conditions no smoke at all can be seen to be emitted.

Another advantage of great importance lies in the fact, that if low grade fuel including coal which is difficult to ignite, such as the well known graphitic coal of Rhode Island, be treated by my process it becomes readily ignitible, and behaves in the fire like free burning coal. In fact, the long flames given off seem to penetrate the coal mass and to cause an even ignition all over the grate, which could not be the case under like conditions with untreated coal.

I am unable to account for the remarkable results above outlined, because the chemistry of combustion in furnaces together with the reactions that take place therein are so little understood; but it is probable that said results are due to a catalytic action of some kind. That is to say, it is possible when the calcium chlorid $CaCl_2$, is subjected to a high temperature in the presence of carbon and water vapor, that the chlorin goes off, the

calcium remains, and the oxygen of the air causes the coal to be covered with an exceedingly thin film of CaO. The red hot carbon being protected from the air by this film of calcium oxid reduces it, and forms carbon monoxid gas CO, which leaves the system; whereupon the reduced calcium again takes up oxygen from the air and the process is repeated indefinitely. The carbon monoxid given off, of course, ignites and burns to CO_2, thereby liberating great heat, while those portions of the fuel not covered by the film burn directly to CO_2 and liberate sufficient heat among the particles of coal themselves to keep up the combustion, as well as the catalytic action.

The behavior of the fuel with a given film of salt will vary with the furnace, the draft and other conditions, just as in the cases of ordinary fires; and therefore while the above solution of one part of salt in fifty of water, is commercially the best for the conditions under which it was tried, yet it might not be most economical under wholly different conditions. In all cases, however, only a relatively thin film is necessary, and it often takes some little time after the treated coal is put on the fire before any useful or surprising results begin to appear, although I have under favorable conditions produced such results in about ten minutes or less.

While I prefer to use water soluble salts to obtain the coating, of course, other salts could be used, so long as the individual lumps are coated with a thin film. Nor is it necessary that all the fuel be so coated. It suffices if a substantial portion on the fire has been treated; but, of course, the flames in that case may not be so large.

After the solution has been drained from the lumps, a very small quantity of it remains sticking thereto; and after the water has been driven from this small quantity by the heat of the fire, an exceedingly small quantity of the chemical remains on the coal, forming a film which must be almost infinitesimally thin.

Of course, I do not limit myself to the above theory of operation nor to any other theory, since so little is definitely known on this subject; but the facts above can best be explained by the various catalytic theories found in modern chemistries, and I believe one or more of them to offer the most satisfactory explanation of the remarkable results achieved in practice.

What I claim is:—

1. The process of facilitating the combustion of fuel, which consists in coating the same with a thin film of a salt of the alkaline earth metals; then igniting said fuel and permitting said film, when the fuel is burned, to cause carbon to be withdrawn from said fuel and to be set free in the form of a combustible gas, substantially as described.

2. The process of facilitating the combustion of fuel, which consists in coating the same with a thin film from a solution of a salt of the alkaline earth metals; igniting said fuel and permitting said film to cause carbon to be withdrawn from said fuel and set free in the form of a combustible gas, substantially as described.

3. The process of facilitating the combustion of fuel, which consists in treating said fuel with a solution of calcium chlorid, allowing said fuel to drain, and then igniting said fuel, substantially as described.

4. The process of facilitating the combustion of fuel, which consists in treating said fuel with a dilute water solution of calcium chlorid, leaving thereon a thin film, and then igniting said fuel, substantially as described.

5. The process of controlling the combustion of fuel, which consists in immersing said fuel in a dilute water solution of calcium chlorid; draining said fuel and then igniting it, substantially as described.

6. The process of controlling the combustion of fuel, which consists in immersing the same in a solution of the proportions of about one part of calcium chlorid to fifty parts of water; allowing the fuel to drain and then igniting the same, substantially as described.

In testimony whereof, I affix my signature, in presence of two witnesses.

HENRY J. WILLIAMS.

Witnesses:
JOHN H. ROBINSON,
JAMES W. DENNIS.