

UNITED STATES PATENT OFFICE.

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PROCESS FOR CONTROLLING THE COMBUSTION OF FUEL.

No. 896,876.

Specification of Letters Patent.

Patented Aug. 25, 1908.

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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. And in my other pending application No. 437,721, filed June 10, 1908, I have disclosed a process for controlling the combustion of fuel and for preventing smoke which employs thin films of salts of the alkaline earths, especially those of calcium. From a series of further experiments carried on by myself, I have now discovered that salts of the practically non-volatile metals in the form of thin films applied to the fuel will accomplish the same qualitative results; and especially water soluble salts of copper, iron, manganese, aluminum, chromium, nickel, cobalt, tin and even gold and platinum.

Therefore, my invention consists in coating the fuel, preferably coal, with a thin film of a salt of these metals, 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 exist flames very greatly exceeding in volume and length any flames that could be produced under like conditions if the coal were not coated with one of the solutions mentioned, or its equivalent.

In some trials recently made by me, the coal used was the well known graphitic Rhode Island coal which is so difficult to ignite; and I used in successive trials solutions of ferric chlorid, Fe_2Cl_6 , of manganous chlorid, MnCl_2 , and ammonio-cupric chlorid, $\text{CuCl}_2 + 2(\text{NHCl}) + 2\text{H}_2\text{O}$. The proportion of salt used in each case for each solution was one part of salt to twenty parts of water. In each case there occurred a vivid livening of the fire with a development of flames many times longer than could be produced under like conditions with the untreated coal, and these flames were observed for a considerable length of time, say 40 minutes in each case; and they undoubtedly would have been observed for longer times had the conditions of the trials permitted. In each case, also, the treated red hot lumps, when removed from the fire, showed a zone of blue flame emitted from each lump, and visible over its whole surface. I, also, made tests of the action of solutions of chromic acid, CrO_3 , and aluminic chlorid Al_2Cl_6 , with the above Rhode Island coal, and found these salts to act in the same general way as the above, both in producing longer flames than was possible with the untreated coal under like conditions, and in producing a zone of blue flame around the ignited surfaces of the red hot lumps. The only rational explanation of this remarkable action, exemplified in these tests, as well as the tests set forth in the applications above, to my mind, is to be found in one or more of the theories of catalytic action. In brief, it seems certain to me that each of the salts above, are in the presence of air and at the high temperatures to which they are subjected, converted into an oxid of the metal, and this oxid is continually reduced by the red hot carbon on one side of the thin film coating the coal, and continually reformed by the oxygen of the

air on the other side; while the carbon mon-
 oxid thus formed by the reduction leaves
 the system to be further ignited beyond the
 region of the red hot coal. Of course, this
 5 reduction of the metallic oxids will only take
 place above a certain temperature, and un-
 less the fire is kept at this temperature the
 catalytic action will cease. It is evident
 that every portion of all the surfaces of all
 10 the lumps cannot be expected to be coated
 with a thin film of oxid; and it seems entirely
 reasonable that any portions not so coated
 should receive more oxygen from the air, and
 burn to carbon di-oxid, CO_2 , and therefore
 15 liberate sufficient heat to keep the tempera-
 ture up to the point necessary to bring into
 play the catalytic actions above mentioned.
 Of course, it would follow from such a theory
 that some salts would act better as catalyzers
 20 than others; and such is confirmed by experi-
 ment; for some of the salts in the tests above
 mentioned seemed to produce better results
 than others. It is, also, possible that the
 oxids of those metals which form fusible sili-
 25 cates with the greatest difficulty are the ones
 which are the most likely to remain in the
 furnace the longest time, as well as to be the
 most active in producing CO gas; for the
 reason that oxids which would form fusible
 30 slags in the presence of red hot carbon, of
 course, would not so readily suffer reduction
 and thereby produce carbon monoxid; and
 furthermore, such slags would be sure to col-
 lect through the action of their own high
 35 surface tension, into films on the fuel too
 thick to act catalytically. It seems evident,
 therefore, that salts of copper, iron, alumi-
 num, chromium, manganese, nickel, cobalt,
 tin, gold and platinum, would act qualita-
 40 tively the same.

My present invention accordingly com-
 prises the application to the fuel of thin films
 from solutions of the salts of those regular
 metals which are characterized by the fact,
 45 that under ordinary furnace temperatures,
 they will remain in the furnace without sub-
 stantial volatilization; and which are of such
 a nature that they will not readily become
 inactive catalytically through permanent
 50 fluxing with impurities in the fuel, at the or-
 dinary temperatures of furnaces.

Of course, I do not limit myself to the
 catalytic theory, nor to any particular theory,
 for the reason that the chemistry of these re-
 55 markable results, as well as the whole chem-
 istry relating to the reactions that actually
 take place in a furnace, is so little under-
 stood at the present time; but nevertheless,

I believe one or more of the catalytic theories
 to be found in the more advanced modern 60
 chemistries constitute the only rational ex-
 planation of these results that at present is
 known.

What I claim is:—

1. The process of facilitating the combus- 65
 tion of fuel, which consists in coating the
 same with a thin film from a solution of a
 salt of a metal practically non-volatilizable
 in the furnace; then igniting said fuel and
 permitting said film, when the fuel is burned, 70
 to cause carbon to be withdrawn from said
 fuel and to be set free in the form of a com-
 bustible gas, substantially as described.

2. The process of facilitating the combus- 75
 tion of fuel, which consists in coating the
 same with a solution of a salt of a metal prac-
 tically non-volatilizable in the furnace; ig-
 niting said fuel and permitting the film thus
 formed to act catalytically to cause carbon
 to be withdrawn from said fuel and set free in 80
 the form of a combustible gas, substantially
 as described.

3. The process of facilitating the combus-
 tion of fuel, which consists in coating said
 fuel with a thin film from a solution of a salt 85
 of a metal, which film at the ordinary tem-
 peratures of the furnace in the presence of
 carbon is practically non-volatilizable, nor
 readily form a fusible slag with the impuri-
 ties of the fuel; allowing said fuel to drain, 90
 and then igniting said fuel, substantially as
 described.

4. The process of facilitating the combus-
 tion of fuel, which consists in treating said
 fuel with a dilute water solution of a salt of 95
 the copper-iron group of metals, leaving
 thereon a thin film, and then igniting said
 fuel, substantially as described.

5. The process of controlling the combus-
 tion of fuel, which consists in immersing said 100
 fuel in a dilute water solution of copper;
 draining said fuel and then igniting it, sub-
 stantially as described.

6. The process of controlling the combus-
 tion of fuel, which consists in immersing the 105
 same in a solution of the proportions of about
 one part of copper salt to twenty parts of wa-
 ter; allowing the fuel to drain and then ig-
 niting the same, substantially as described.

In testimony whereof, I affix my signa- 110
 ture, in presence of two witnesses.

HENRY J. WILLIAMS.

Witnesses:

WARREN B. WHEELER,
 STILLMAN SHAW.