

# UNITED STATES PATENT OFFICE.

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## METHOD OF PRODUCING ARTIFICIAL FUEL.

SPECIFICATION forming part of Letters Patent No. 762,718, dated June 14, 1904.

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*To all whom it may concern:*

Be it known that I, GEORGE K. HOLLISTER, Jr., a citizen of the United States, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Method of Producing Artificial Fuel, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved method for producing artificial fuel, the fuel having a high rate of heat units and being in solid or briquet form, practically smokeless and odorless before and while burning, and intended for use in household-furnaces, kitchen and other stoves, boiler-furnaces, and the like, and capable of producing a high heat.

The fuel consists, essentially, of reduced non-coking coal, reduced coking coal, and a binding agent; and the method consists, essentially, in the reduction of a non-coking coal to a state of fine division, reduction of coking coal to a pulverized condition, mixing of the reduced non-coking coal and the reduced coking coal with a binding substance, preferably under application of heat, and finally pressing the mixture into a briquet of any desired shape and size.

In carrying out the invention use is made of a mixture of non-coking coal—such as anthracite culm or slack, certain lignites, carbon, graphite, coke, and the like—and a coking coal in a pulverulent condition, together with a binding agent that will serve to hold the briquets together in ordinary handling; also, that when fed into the furnace said briquets will remain intact until the non-coking coal particles become firmly fixed together by the coke formed from the coking coal during combustion. From experience I have found that oxidation of almost any mineral substance can be readily accomplished by subjecting said material in a pulverulent state to an incandescent temperature when in the presence of sufficient oxygen. It is therefore essential that the coking coal be in a pulverulent condition. The non-coking coal may be somewhat coarser, as when under pressure the softer and finer coal finds its way in between the hard-coal particles, thereby making

a firm and solid briquet, with far less chance of waste than if the briquet was made up of coarse particles alone, which would crumble and break under pressure, rendering the briquet fragile and of poor quality. I therefore take advantage of the coking nature of coking bituminous coal, and from experience find that an excellent smokeless steam coal can be made by a mixture of three-quarters of anthracite culm or screenings with one-quarter of a good coking coal, and a fuel giving a high rate of heat units with a long flame may be produced by combining seventy per cent. of anthracite with thirty per cent. of coking coal and a good stove-coal with seven-eighths of anthracite and one-eighth of a good coking gas-coal. In fact, either of the given proportions will produce for a long time a long flame.

As anthracite culm or screenings contain at least from fifteen to eighteen per cent. of incombustible material, it can readily be seen the advantage of a mixture of anthracite coal and bituminous coal, for most all grades of soft coal (with the exception of brown and lignite) have a high per cent. of fixed carbon with about ten per cent. of ash. Therefore a briquet containing only ten or twenty per cent. of bituminous coal and sufficient alum to allay the smoke from the same makes a very desirable fuel, leaving but little ash and igniting in the same manner as the natural coal.

In practicing my invention with anthracite culm or screenings, lignite coal, and the like I have found it expedient to modify to some extent the materials composing the binder, as more or less may be used, even to altering the method of mixing same as the absorbent qualities of such coal may require, and I do not limit myself to the exact proportions given.

The materials contained in my binder, the proportions, and the method of mixing the same will now be described.

I take of a non-coking coal and a coking coal in either of the proportions given, and in order to form a binder for the amount of material per ton I place in a suitable tank about fifteen gallons of water, which may be salt



river-water, dissolving in same fifteen pounds of sal-soda or other caustic alkali, alkaline earth or ammonia in the proportion of alkaline strength of the sal-soda crystal, adding  
 5 thereto seventy pounds of whiting as free from sand and other foreign substances as possible, or I may use in place of whiting common clay or clay containing alum in the natural state or river-silt taken from the  
 10 river-bottom or of marshes, and these materials are mixed well so as to make a thick fluid. Then I add seventy-five pounds of resin or pitch or conifer resin or its resin-pitch or resin and pitch in a fine state and stir  
 15 the mass until said resin has settled down into the solution. I then add two pounds of alum, which may be chrome-alum either in powder or in crystal. This mixture is placed over the fire, or a suitable steam-tank may be used,  
 20 and in a short time the mixture will thicken into a semifluid state, keeping the fluid during the process of cooking, as it were, in a state of agitation. The fluid is allowed or not allowed to come to a boil. In a short time  
 25 the fluid will raise and seem to grow lighter as to bulk. Then the mass will take on a cream color and become syrup-like. It is then removed from the heat and kept warm, when same is ready for use at any time.

30 By the above process the materials have undergone a strange change, which renders same hard and tough when dry. The sal-soda helps to make the paste, as it were, more cohesive, also acting upon the resin, for without same  
 35 the resin could not be easily dissolved. The sal-soda also solidifies in the briquet. The resin, therefore, is converted into resin-pitch. The alum helps to allay the smoke caused by the bituminous coal.

40 Although resin is meltable by heat, strange to say that when combined with the mentioned materials and used in the manner so described the same in the briquet under pressure and passed through a hot tunnel or baked that  
 45 same is rendered extremely tough, and that said briquet will not crumble, but will become harder and in a few minutes be ready for use.

The special advantage that a binder of my invention has is that when combined with any  
 50 kind of mineral material in a hot state and the material is finely divided and when formed, made, or pressed into briquets and dried by heat such briquets when subjected to a high temperature will retain their shape and not  
 55 disintegrate, because my binder when dry is capable of resisting the action of heat up to 560° Fahrenheit and gradually is converted into a sort of carbon. This is a very desirable feature in a briquet, for the same will stand  
 60 up in the furnace for a long time without disintegration or breaking away. In fact, they will remain intact until completely consumed.

In practicing my invention with brown or lignite coal (fossil wood in those localities  
 65 where bituminous coking coal cannot be had)

I add to my binder before the addition of the alkali fifteen pounds of bitumen or flour made from wheat, corn, or any other grain, and this addition is made so as to make up for the lost  
 70 amount of free carbon and coking qualities that such fossil-wood coal does not possess in the natural state, and I find that this is necessary for a free-burning fuel; also, that said flour in my binder really cokes, only its particles of strength are not as great as that of  
 75 the same size of coking-coal. Thus my binder, with the addition of bitumen or flour, is capable of lifting lignite to a fuel capable of fulfilling the most exacting conditions of industrial furnace and home requirements; but I  
 80 do not claim bitumen or flour as part of my invention, but only as an addition to my binder for the utilization of lignite coal only.

For the successful making of my artificial fuel I use a pug-mill having a steam-jacket or  
 85 supplied with direct heat, so as to keep the materials hot while mixing, therefore evaporating most of the moisture, passing the thoroughly mixed and hot mass into a suitable briqueting-press, and molding the same under  
 90 high pressure into any shape or size, when same are passed through a heated tunnel, taking, as it were, the last vestige of moisture from them and practically baking the same, when such briquets are ready for use.

95 If the briquets are to be used in the immediate neighborhood, the waterproofing may be dispensed with; if for shipment they may be passed through a hot solution of resin of about twenty-seven pounds to the ton, and this  
 100 amount of resin I subtract from the original ingredients; but I do not favor the waterproofing of the briquets, as dampness or a little water does them no harm, for sheltering the same is all that is desired.

105 My process is therefore a simple process, free from all those materials that go to make an artificial fuel so costly, thereby placing such processes beyond actual operation, and from demonstration already given it has been  
 110 proven that briquets made by my process are as good as the real article. Therefore it is possible by my process to utilize a large amount of coal waste or screenings and the like that have always been an undesirable fuel.

115 My artificial fuel is therefore easily handled, is clean to the touch, free from dust, being practically smokeless and odorless, reduces to a very small degree the odor of gas while burning, as the free amount of oxygen in the  
 120 briquets combining with the gas causes complete combustion. Thus most all of the gas is consumed.

Spontaneous combustion in my artificial fuel is impossible, because every particle of  
 125 coal being covered with a film, composing the binder, preserves all the gas. Therefore no heating value is lost by storage.

I am aware of the fact that many formulas have been tried for the utilization of waste  
 130



coal material; but I am not aware that any process relating to my invention has ever been patented.

5 Having thus described my invention, I claim as new and desire to secure by Letters Patent—

10 1. The herein-described process of making an artificial fuel in blocks or briquets, which consists in mixing anthracite culm or screen-  
ings and the like with a pulverulent bitumi-  
nous coking coal, then adding a binding agent  
consisting of water, an alkali, whiting, resin,  
15 and alum, cooking all together, till thoroughly mixed, in a receptacle kept evenly heated at a high temperature, continuing the mixing  
till the water has almost evaporated, then  
molding the mass under high pressure into  
blocks, and finally exposing said blocks to air  
20 heated to a high temperature to remove the moisture from the blocks.

2. The herein-described process of making

an artificial fuel in blocks or briquets, which consists in mixing anthracite culm or screen-  
ings and the like with a pulverulent bitumi-  
nous coking coal, then adding a binding agent  
consisting of water, ammonia, whiting, resin, 25  
and alum, cooking all together till thoroughly  
mixed, in a receptacle kept evenly heated at  
a high temperature, continuing the mixing  
till the water has almost evaporated, then  
molding the mass under high pressure into 30  
blocks, and finally exposing said blocks to air  
heated to a high temperature to remove the  
moisture from the blocks.

In testimony whereof I have signed my name  
to this specification in the presence of two 35  
subscribing witnesses.

GEORGE K. HOLLISTER, JR.

Witnesses:

THEO. G. HOSTER,

EVERARD BOLTON MARSHALL.