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METHOD FOR THE PREBURNING PREPARATION OF FUELS.

No Drawing.

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This application is a continuation in part of my copending applications Ser. No. 720,650, filed June 17, 1924, and Ser. No. 127,917, filed Aug. 7, 1926. The invention is the outcome of a recognition of the fact that about one-half of the coal that is mined becomes lost to the use of man, and that the causes of such losses are various, and need removal. Among the losses, is the fact that much the largest part of the crude coal deposits produce smoke in their burning, are usually incompletely burned so far as the gases evolved in their use is concerned, that some of them including so-called "steaming coals," in their fracturing into graded sized particles, produce a large amount of small sized particles including dust, that in high-volatile bituminous coals their volatile oily content is in such excess amounts that they swell, crumble and more or less melt in their burning and compact the fuel-mass, and form slag, clinkers and funnels and hence pass excess air for combustion thru such fuels when in fuel-masses. Above all other causes, is the fact of the widespread ignorance of coal users as to the nature of combustion processes, and the need of economy in the use of fuels both for present day and future uses of the world. As the result of such conditions, the present day does and the future day world will suffer not only great waste of fuel and damage to health; but also, mining interests produce and accumulate large amounts of fuel-culm particles that are little used, and when used, only sell for very low prices as compared with high cost graded anthracite, smokelessly burning coal.

What I propose as a remedy for this situation is practically possible because of the fact that while anthracite coals only have from 3% to 7% of volatile content and do have a large ash-content, the soft coals contain from 20% to 40% or more volatile content but lesser ash content, are more easily mined and are hence produced at a lower cost per volume of weight. Also, anthracite "fines" and dust, and lignite coals can be purchased at very low figures. But such low cost materials in "crude" form when burned in masses, become compacted and are so lacking in porosity that air for combustion does not easily find access into or thru such compacted materials into contact with the surfaces of the fuel particles.

My inventive remedy for the latter situation is in part to so harden soft coal by

its more or less coking that it will not swell, crumble and melt so as to effect compactive clogging of the fuel mass to gas passage as occurs in the use of these crude soft coals; and then use the coked fuel to give porosity to fuel-masses that otherwise would be lacking in porous texture, the process being either thru admixture, or thru special production of new forms of fuel.

I use for my purpose, cokes of various degrees of hardening-carbonization as basic constituents in mixed fuel-masses, and in new solid fuels. With coke basic frameworks in fuel-masses, which may be replaced with hard particles of anthracite or graphitic coals, I admix enriching particles of uncoked coals richer in volatile content, such as bituminous slack or anthracite or semi-bituminous fines, in varying proportions that are in accord with the method I use in burning such fuels. In using "induced" natural draft in ordinary methods of burning, only a smaller proportion of the enriching constituent is used than if a mechanically forced draft is used. In the latter case, a larger bulk proportion of soft coal or anthracite fines may be used.

As a special rule, I admix relatively large sized graded particles of coke with smaller sized particles of enriching ingredients. I may have the large sized coke or hard coal basic particles in juxtaposed contact, and only occupy a part of the interstices between the larger sized particles, with the smaller sized enriching particles. This prevents the smaller sized particles from becoming compactly compressed. In other cases I completely fill, and more than fill the interstices with enriching small particles. I may enrich the coke by impregnation with low cost heavy fuel-oils, and use such impregnated coke as a gas-forming and enriching fuel. I may make thoroughly admixed mixtures of coke, high-volatile bituminous and anthracite dust, as a gas-forming fuel, and subject such mixture, with or without fuel oil impregnation, to heat in a gas retort or on a traveling grate, and heat and drive off some volatile matters from the admixture and melt the high-volatile bituminous constituent, which then incorporates with the anthracite dust and agglutinates with the coke, the agglutinated material being partly absorbed into the coke thru the capillary attraction of the coke. This makes a byproduct fuel, the heat of which when

cooled by steam, forms water-gas, that may be admixed with other gases driven off from the mixed fuel in its heating, in a gas retort or on a traveling grate.

5 I make some mixtures that are of a character specially suitable for "banking" fuels. For example: I admix moderate or small sized graded hard (anthracite or graphitic) coal particles, and crushed coke or coked
10 breeze and anthracite dust in sufficient amounts and in correct proportions, to substantially fill all of the interstices between the hard coal particles, and thoroughly moisten the entire mixture. This makes an
15 excellent "banking" fuel for various purposes, including the repression of the rates of combustion in greenhouse boilers during daylight hours, and also for "banking" domestic furnace fires during night sleeping
20 hours.

I admix coke with fuel dust that is moistened so as to prevent the flying of dust and cinders in the burning of such mixtures, either in the use of induced natural draft, or
25 with mechanically forced draft. In this case the moistened dust adheres to the rough coke pores and surfaces, and leaves the inter-spaces more or less open. With forced draft, such mixtures in enormous quantities can be
30 burned with advantage.

I admix large sized particles of coke or hard coal with small sized anthracite or medium or low-volatile semi-bituminous soft coals. By frequent or continuous feeding of
35 such mixtures, large amounts of such fuels can be utilized thru the use of strong forced draft projected upwardly into the mixtures, and thus securing great economy in the cost of fuels thru such practice. In such mix-
40 tures the smaller sized particles of coal burn more quickly than the larger sized particles, which larger sized particles gravitate to the grate line before becoming entirely burned, and there form a bed-shelf or platform resting
45 on the grate, which intercepts and holds any unburned smaller sized particles until they are entirely burned. This prevents grate sifting of the smaller sized particles. Large amounts of such low-cost fuel materials can thus be used.

Mixtures of coke or hard coal in large sized particles and in moderate bulk amounts and high-volatile comminuted or slacked bituminous coals in larger bulk amounts, I
55 burn in "heaps" with or without forced draft; in which case, the heaps burn from their under surfaces, the gases and vapors escaping by a horizontal travel thru the interstices between the large sized coke particles to the periphery of the heaps, where
60 more air rises thru the grate and becomes admixed with and burns with the unburned volatilized matters, and at which peripheral point, other air can be forced into quick and
65 intimate contact with the vapors and gases

in the combustion space. The heat of complete combustion produced at such points, is usually in close contact with the heating surfaces, and is there absorbed progressively in the gravitational rise of the burned gases
70 against the heating surfaces.

In my copending applications Ser. Nos. 703,006; 706,201; 710,426; 717,197; new Ser. Nos. 67,182 and 239,964, I describe and illustrate how I admix air with burnable gases
75 in connection with various forms of stationary and moving grates, and secure substantially complete combustion of my pre-burning prepared low cost or other fuels.

In the mixtures I use, I secure thru uniformity of texture a greater uniformity of rates of combustion in all parts of the fuel-bed, and thus avoid the losses due to the passage of excess air of combustion thru the fuel-bed, and due to unequal combustion in
80 various parts of the fuel-bed.

Thoroughness of admixture of the constituents of my fuel mixtures is of great importance, and on that account I preferably use mechanically rotating mixers to secure
85 such uniformity of texture in fuel-masses. This uniformity of texture prevents the formation of air-passing funnels, and also, formation of masses of slag in the fuel-bed.

In my copending application Ser. No. 697,769, I describe and illustrate how I convert admixed fuels, including coke impregnated with heavy fuel-oils, into low cost fuel-gases of various thermic values, and incidentally produce as a byproduct, the low cost
90 smokeless solid fuel claimed in the present application. In that process heat developed in the process is converted into water gas. The same solid fuel can be produced on traveling grates as a byproduct in generating
95 steam for process or power uses, the by-product fuel being used in cycle with repeated enriching admixtures with high-volatile bituminous fuels.

In my copending applications Ser. Nos. 703,006; 706,201; 710,426; 717,197 and 67,182, I disclose and claim special methods of burning my fuel mixtures under mechanically controlled draft by introducing air for combustion into and over fuel-masses in specially desired amounts at specially selected
100 points of air introduction. Such methods are a part of the present invention.

In the copending application Ser. No. 697,769, I describe preferred methods of producing various fuel products in one special apparatus, in which gases of various characters as well as solid fuels are economically produced, and in which the heat of the process is utilized regeneratively in producing
105 water gas, as well as in cleaning gases. In the present case, my claims are restricted to producing the special fuel products herein described as specific fuels, all of which have special value for special purposes.
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The degrees of heat I apply to soft coals in their hardening will vary according to the nature of the coke product wanted. High temperature coke is of special value for impregnation with fuel oils. Low-temperature carbonized coke is good to use in mixtures for generating producer or other gases if impregnated with fuel oil; or, after crushing, for admixture with other solid fuel materials. So long as the porosity of a fuel-mass is attained and maintained to secure a sufficient heating effect, the more volatile enriching matter added to the hardened fuel, the better.

15 What I claim as new, is:

1. The method which consists in mixing coke of relatively large sized particles, high-volatile bituminous coal particles of relatively smaller size, and anthracite dust, subjecting the mixture to a bituminous-coal-melting temperature, and cooling the product of the process.

2. A new fuel which consists of coke particles having agglutinatively adherent to the coke particles, agglutinated high-volatile soft coal and hard coal dust.

3. The method which consists in producing a liquefied form of high-volatile soft coal, securing the agglutinated absorption by and adherence of the liquefied coal with coked particles of coal, the process including a preliminary melting-heating of the soft coal and its subsequent cooling and hardening.

4. A new fuel composed of particles of hard coke, coated with adherent soft coal that has been liquefied by heating and subsequently cooled.

5. The method which consists in heating and coking a mixture of large sized particles of coked coal and small sized particles of high-volatile soft coal and producing a volatilized burnable gas from a part of the volatile content of the mixture and a liquefied adherence of a part of the high-volatile constituent of the mixture to the coked coal.

6. A new fuel byproduct secured by admixing particles of coke and soft coal, subjecting the admixture to a melting and volatile-volatilizing heat and gasifying a

part of the volatile content of the soft coal and agglutinating the coke and the unvolatilized part of the soft coal and cooling the agglutinated coke and unutilized agglutinated soft coal.

7. The method which consists in liquefying a soft coal and securing the absorptive adhesion of the liquefied soft coal with particles of coke.

8. The method which consists in coking soft coal sufficiently to harden the coal, admixing the coked coal with comminuted particles of soft coal and other enriching coal product material, bringing the admixture to a liquefying temperature and agglutinating the liquefied material and the sufficiently hardened coal, and hardening the agglutinating material by cooling.

9. A fuel composed of coke agglutinated with hardened melted coal materials containing high-volatile soft coal.

10. A fuel composed of coke impregnated with cooled liquefied soft coal.

11. A particle of coke having agglutinated with the coke, dry adherent soft coal.

12. A fuel-mass composed of admixed particles of coke and comminuted small particles of semi-bituminous low-volatile coal.

13. The method which consists in mixing coke particles of relatively large size, soft coal particles of comminuted or slacked sizes smaller than the coke particles and fuel oil, subjecting the mixture to a soft-coal-melting heat until the soft coal melts and becomes agglutinatively adherent with the coke particles.

14. The method which consists in mixing particles of high-temperature coke of relatively large size and particles of soft coal moistened with a petroleum oil fractionate, subjecting the mixture to a soft coal melting and volatile-volatilizing heat and volatilizing and gasifying part of the mixture and agglutinating the balance of the coal into adherence with the coke particles, and cooling with steam the agglutinated coke and soft coal.

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