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METHOD OF SIMULTANEOUSLY WASHING AND COATING COAL

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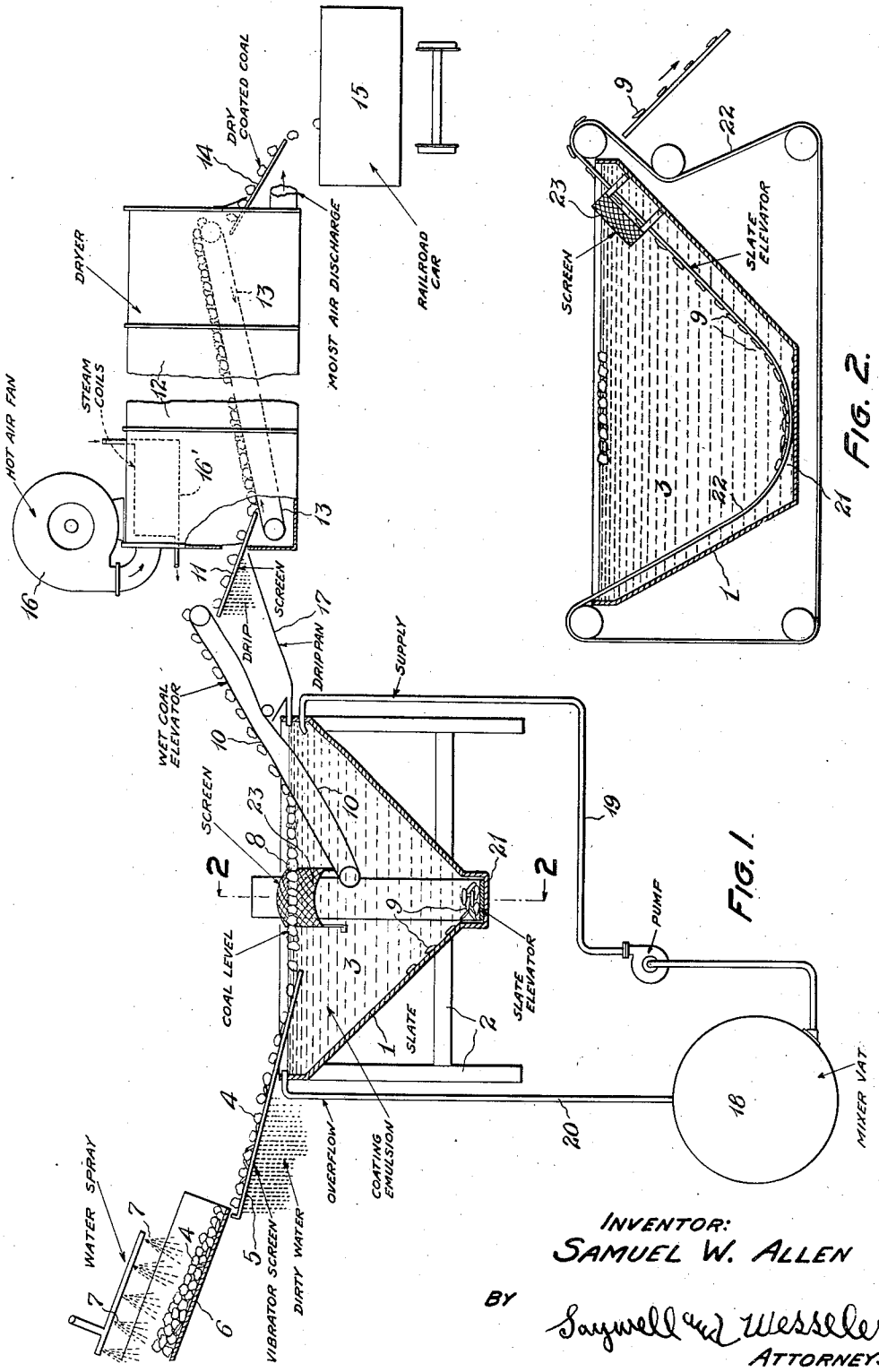

FIG. 1.

FIG. 2.

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METHOD OF SIMULTANEOUSLY WASHING AND COATING COAL

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5 Claims. (Cl. 209—173)

My invention relates to coal treatments, and particularly to improved methods of simultaneously washing the coal and applying thereto a coating. The coating has many advantages which are hereinafter described. Although not limited thereto, the invention is particularly applicable to the washing and coating of bituminous coal of substantially the well-known "egg", "nut", and "pea" sizes. The treatment also effects the segregation of the substantially pure coal from the bony coal, slate, and other impure ingredients of the coal mixture undergoing treatment. The coating treatment gives the coal a clean appearance and, in fact, renders the coal clean so that it can be handled without creating dust or unduly soiling the person and clothes of the operator, and also causes the coal when initially ignited to burn without smoke flaring out therefrom and without the production of a material amount of soot, the coating also enhancing the fuel value of the coal.

The annexed drawing and the following description set forth in detail certain steps illustrating the working of my improved methods, and also a form of apparatus in which the methods can be worked, such steps constituting, however, only a few of the various series of steps by which the principle of the invention can be worked.

In said annexed drawing:

Figure 1 represents a side elevation, partially in section, of apparatus in which my improved methods may be worked; and

Figure 2 is a fragmentary transverse vertical section, upon an enlarged scale, taken in the plane indicated by the line 2—2, Figure 1.

It is well known to segregate pure coal and the impure content of the coal, as mined, or in the condition which results from certain preliminary treatments of the mined coal, such as sizing, etc., by utilizing the different specific densities of the pure coal and the impure content. Usually, a fluid mass is utilized for effecting the segregation of the pure coal from the impure coal, this fluid mass having a specific gravity greater than that of the pure coal so that the latter will float upon the top of the fluid mass and a specific gravity less than that of the impure content so that the latter will settle through the fluid mass and collect upon the bottom of the chamber in which the washing and segregation are effected. I utilize this principle in working my improved methods, but I utilize for the fluid mass a composition suspended in water which will not only wash the coal, but also give the coal a coating of the general characteristics hereinafter mentioned. A preferred form of this composition and the improved fuels which result from the coating of fuels therewith is the subject matter of my pending application Serial No. 95,441, which is directed to the treatment of coal for coating purposes only, and to a new and improved fuel produced thereby, and not directed to the washing of coal. The coating which the coal receives and which it retains in the final product is a thin film of titanium dioxide, or titanium dioxide and calcium hydroxide, or equivalent materials. In the coating mixture the titanium dioxide is utilized in various forms, preferably in the form of titanox which is approximately twenty-five per cent titanium dioxide and seventy-five per cent barium sulphate. Furthermore, on account of the comparatively high cost, under usual conditions of titanium dioxide, I utilize a suitable filler, as a part of the coating mixture, fillers such as various forms of talc, preferably, a fibrous talc known as "asbestine." Furthermore, I have discovered that lithopone, or other suitable coating materials of the order of titanox and lithopone, may be substituted for the titanox, or two or more of the materials of this order utilized. Titanox and lithopone, and materials of this order, are distinctively efficient for covering the surface of the solid coal and for sealing the pores and small cracks. Instead of using more or less refined titanox and lithopone, and materials of their order, for producing the titanium dioxide coating, I may use titanox clay or titanium dioxide in the form in which it occurs in nature. For certain compositions, calcium hydroxide is also utilized. This ingredient contributes to the white color of the eventual coating. Furthermore, as hereinafter fully explained, an oil and water emulsion may be utilized, instead of water alone, as the liquid ingredient of the fluid mass and as the evaporable carrier of the coating material and, when such an emulsion is utilized, the calcium hydroxide acts as an emulsifying agent, thus assisting the oil to disperse in the water the other ingredients of the coating composition. The calcium hydroxide effects an emulsifying action to a degree, even if water alone is utilized as the liquid ingredient and evaporable carrier.

The coating material is held in suspension in the water or emulsion, there being no material dissolving of the coating materials in the water. I add an ingredient for definitely effecting the suspending action, and preferably I use starch. In order that secure adherence of the coating to the coal may be effected, I also incorporate in

the coating composition a suitable binder having glue-like characteristics and, for this purpose, I prefer to use casein. In preparing the composition, I also preferably use a suitable dispersing agent for the coating material proper and, for this purpose, I prefer to use materials of the order of tri-sodium phosphate, sodium fluoride, and borax.

The ingredients above-mentioned are mixed together in powdered form, and form a white mixture which is mixed with water and held suspended therein. In addition to water, some suitable oil to form an emulsion, such as linseed oil, cotton-seed oil, soybean oil, or toluol, or a combination of such oils, may be used to form the washing and evaporable vehicle.

There is considerable possible variation in the proportions of the above ingredients which may be used, depending upon the conditions which it is desired to meet, including differences in grades of coal. However, of course, the water content and the content of the materials suspended therein, must be in such proportions as will effect a specific gravity of the whole fluid mass greater than the specific gravity of the pure coal which it is desired to separate out, and less than the specific gravity of the impurities in the coal. I have ascertained that from two to eight pounds of the mixed powder can be mixed with one gallon of water, and that about one ton of coal can be suitably coated with one gallon of the coating mixture. If oil is used with the water, I preferably use about one pint of oil per gallon of coating mixture. The varying requirements of different grades of coal vary the necessary strength of the coating mixture and, furthermore, comparatively thick or thin mixtures may be applied to produce heavy or light coatings. About four pounds of the mixed powder to one gallon of vehicle is a standard mixture.

The coating mixture above-mentioned is white, but, if it is desired to color it, this result can be readily effected by adding suitable coloring matter, such as dyes and pigments. The particular coloring of the coal, other than the substantially pure white appearance effected by my improved methods, I consider no part of my invention, inasmuch, as stated, a great number of coloring materials may be employed to effect the particular coloring desired.

In so far as the coating of the coal is concerned, the water, or water and oil, utilized in the working of my improved methods, serves only as a vehicle for applying the coating composition, and complete results are obtained from the coating only after the evaporable content of the coating film on the coal surface has come off or been driven off, a procedure which is illustrated in the accompanying drawing showing one form of apparatus in which my improved methods may be worked.

Referring to the annexed drawing, a tank 1 is supported upon any suitable superstructure 2 and serves as a reservoir for holding the fluid mass 3 in which the simultaneous washing and coating of coal by my improved methods is effected. The coal 4, as mined, but preferably of a desired size classification, such as "egg", "nut", or "pea" size, is fed into the liquid mass 3 from a vibratory screen 5, this screen 5 being fed with coal from a shute 6 which receives the coal from any suitable source (not shown). The coal in the shute 6 is subjected to water sprays 7, by means of which dust and dirt is removed from the coal, the dirty water escaping through the vibratory screen 5.

In the liquid mass 3, the substantially pure coal 8 floats, and the bony coal, slate, and other comparatively heavy impurities 9, sink to the bottom of the tank 1. The pure coal 8 gradually travels and is forced toward the far side of the tank 1 and is picked up by an elevator 10 from the top of which it is discharged onto a screen 11 down which it slides into the confines of a drier 12 and onto a conveyor 13 from which it is discharged over the top of the conveyor 13 onto a slideway 14 whence it is discharged into a railroad car 15 or any other suitable form of storage or conveyance. The drier 12 is supplied with hot air by a fan 16 and steam coils 16', and the size of the drier 12 and speed of the conveyor 13 are such as to effect substantial drying of the coated pure coal during its travel through the drier 12. The dripping coating liquid which remained on the coal 8 at the time of its discharge from the conveyor 10 had previously been drained off through the screen 11 and conveyed by a drip pan 17 back into the tank 1.

A suitable liquid mass for the washing and coating operation is made in a vat 18 from which it is pumped, as desired, through a line 19, into the tank 1. An overflow 20 which taps the tank 1 adjacent the top thereof leads back into the mixer vat 18. I show suitable means for removing the bony coal, slate, and other impurities from the bottom of the tank 1, such means including, in combination with a hopper bottom for the tank 1 and a sump 21 in the extreme bottom of the tank 1, an endless conveyor 22 which passes transversely of the tank 1 through the sump 21 and adjacent the bottom of the latter and picks up the refuse 9 and discharges it above the upper edge of the tank 1, all as clearly appears in Figure 2. A screen 23 is supported by and interiorly of the tank 1 adjacent the top of the latter, and extends over the refuse conveyor 22, and thus prevents the coal 8 from being carried off by the refuse conveyor 22.

By the method illustrated and above-described, pure coal is satisfactorily separated from the impurities in the original content thereof, and the coal is discharged after the separating action having a tightly adherent clean coating. The advantages of this coating are many. It is well known that all coal is considerably broken during transportation and handling after it is released from the mine ready for the market. Breaking of the coal produces considerable dust and the amount of this dust varies according to the amount of breakage. Different coals vary widely in breakage characteristics but these characteristics are considerable in all grades of coal and, generally speaking, a particular disadvantage in the best or most expensive grades of coal, such as Pocahontas, in which the breakage, due to handling and shipping, is frequently as great as fifty per cent, so that the lump portion of the coal delivered at its place of use is reduced to one-half what it was when mined. The usual breakage of coal during handling and shipping is greatly reduced when the coal is coated by my improved composition. Furthermore, natural coal, when subjected to atmospheric conditions, breaks up or slacks, creating dust and making the coal less valuable. Also, coal has pores and minute cracks through which volatile gases pour when the coal is applied to a hot bed of coals, and these gases are immediately burned creating much smoke, which is very objectionable from the

stand-point of the furnace operation and furnace appliances as well as being uneconomical from the stand-point of heating value. Natural coal is also dirty to handle and creates a great amount of objectionable dust in storage bins.

The coating applied to the coal, by my improved methods, concurrently with the washing thereof, gives the coal a clean appearance so as to render it attractive and thus creates in the mind of the customer an idea of cleanliness; in fact, the coal so coated is clean and may be handled without the hands of the operator becoming soiled or blackened by coal dust. Also, much dust is always on the surface of coal and tenaciously clings thereto, but my coating mixture which forms a thin film over the entire surface of the coal covers the small particles of adhering dust or the dust is incorporated therewith creating of the latter a component part of the film itself.

My improved coating acts as a protection to the coal in that it excludes air from contact with the coal surface which is coated and from cleavage fractures or cracks in the coal, thus preventing the breaking up or slacking of the coal, due to its exposure to air, and thus the formation of dust and a material deterioration in the coal are obviated.

My improved coating mixture improves the heating value of the coal. These results arise to a considerable degree from the following facts. Coal, particularly the more expensive grades thereof, such as Pocahontas coal, is formed with small pores and minute cracks in the surface. My improved composition coats or seals these pores and cracks. Therefore, when the coated coal is applied to a hot furnace bed, the particles of the coal which would normally immediately burn and volatilize and create a great amount of smoke, such as is experienced by all furnace operators, when firing a furnace, cannot flare out with the production of much smoke. In fact, the dust and particles are not substantially burned, or volatile gases and smoke produced, from coal coated by my improved composition, until the temperature is materially raised, so that more efficient combustion of the coal is assured. Thus, the heating value of what would be lost, viz., soot and black smoke, which are the most valuable heating units in coal, is saved. Also, incident to the improved burning of the coal itself, there is eliminated to a large degree the formation of objectionable glassy slag-like clinkers. All of the constituents of my improved composition are more or less combustion-retarding so that, particularly in the case of the more expensive coals, the value thereof is materially enhanced by reason of the retarding to the burning thereof caused by my improved coating, although the fire produced is unusually intense due to the consumption of smoke, soot and gases.

The lumps or pieces of coal treated by my improved composition are not tacky and will not stick together or agglomerate into a mixed mass and lose their individuality.

Furthermore, the cost of the materials of which my improved composition is comprised, and the cost of compounding the same, are so comparatively slight that no material increase in the cost of producing and furnishing coal coated with my improved composition results. Of course, the cost of washing the coal and applying a coating thereto, by my improved method, is no greater than the cost of any suitable washing to which coal is usually subjected, inasmuch as, by my improved methods, the coal is coated incident to the washing thereof. Therefore, the applying of my improved coating introduces no additional cost whatever.

What I claim is:

1. A method of separating the pure coal content of unpurified coal from the impure content thereof and of simultaneously producing an improved solid carbonaceous fuel which will be substantially impervious to atmospheric deterioration, will be cleanly to handle and dustless, and will have burning characteristics which substantially eliminate the creation of smoke and soot when the fuel is freshly fired, consisting in introducing the unpurified coal into a bath of an evaporable carrier having suspended therein a mixture of titanium dioxide, a glue-like binder, and materials for dispersing the titanium dioxide and the binder in the bath, the latter and the said materials suspended therein being formed into a fluid mass having a specific gravity higher than that of the pure coal and lower than that of the impurities, then removing from the bath the segregated pure coal, and drying the latter.

2. A method of separating the pure coal content of unpurified coal from the impure content thereof and of simultaneously producing an improved solid carbonaceous fuel which will be substantially impervious to atmospheric deterioration, will be cleanly to handle and dustless, and will have burning characteristics which substantially eliminate the creation of smoke and soot when the fuel is freshly fired, consisting in introducing the unpurified coal into a bath of an evaporable carrier having suspended therein a mixture of titanium dioxide and barium sulphate, casein, and materials for dispersing the aforementioned materials in the bath, the latter and said materials suspended therein being formed into a fluid mass having a specific gravity higher than that of the pure coal and lower than that of the impurities, then removing from the bath the segregated pure coal, and drying the latter.

3. A method of separating the pure coal content of unpurified coal from the impure content thereof and of simultaneously producing an improved solid carbonaceous fuel which will be substantially impervious to atmospheric deterioration, will be cleanly to handle and dustless, and will have burning characteristics which substantially eliminate the creation of smoke and soot when the fuel is freshly fired, consisting in introducing the unpurified coal into a bath of water and oil emulsion having suspended therein a mixture of titanium dioxide and barium sulphate, calcium hydroxide, casein, and materials for dispersing the aforementioned materials in the bath, the bath and the materials suspended therein being formed into a fluid mass having a specific gravity higher than that of the pure coal and lower than that of the impurities, then removing from the bath the segregated pure coal, and drying the latter.

4. A method of separating the pure coal content of unpurified coal from the impure content thereof and of simultaneously producing an improved solid carbonaceous fuel which will be substantially impervious to atmospheric deterioration, will be cleanly to handle and dustless, and will have burning characteristics which substantially eliminate the creation of smoke and soot when the fuel is freshly fired, consisting in introducing the unpurified coal into a water bath having suspended therein a mixture of titanox, calcium hydroxide, tri-sodium phosphate, and

casein, the water and said materials suspended therein being formed into a fluid mass having a specific gravity higher than that of the pure coal and lower than that of the impurities, then removing from the bath the segregated pure coal, and drying the latter.

5. A method of separating the pure coal content of unpurified coal from the impure content thereof and of simultaneously producing an improved solid carbonaceous fuel which will be substantially impervious to atmospheric deterioration, will be cleanly to handle and dustless, and will have burning characteristics which substantially eliminate the creation of smoke and soot when the fuel is freshly fired, consisting in introducing the unpurified coal into a water bath having suspended therein a mixture of titanox, talc, trisodium phosphate, and casein, the water and the said materials suspended therein being formed into a fluid mass consisting of from two to eight pounds of the suspended material and one gallon of water per ton of coal introduced therein, and said mass having a specific gravity higher than that of the pure coal and lower than that of the impurities, then removing from the bath the segregated pure coal, and drying the latter.

SAMUEL W. ALLEN.