Patented July 12, 1927. 1,635,520

UNITED STATES PATENT OFFICE.

HERBERT E. WETHERBEE, OF CLEVELAND, OHIO, AND WILLIAM L. JACOBUS, OF WILKES-BARRE, PENNSYLVANIA, ASSIGNORS OF ONE-THIRD TO RICHARD F. GRANT, ONE-THIRD TO HOWARD M. HANNA, AND ONE-THIRD TO HERBERT E. WETHERBEE, ALL OF CLEVELAND, OHIO.

METHOD OF TREATING ARTIFICIAL FUELS.

No Drawing. Application filed July 10, 1926. Serial No. 121,732.

Our invention relates to improvements in methods of treating and forming artificial fuel, and to the resultant fuel produced thereby; the object of our invention being to produce a fuel from small sizes of fuel materials, such as anthracite or bituminous coals, lignite or other carbonaceous materials. Primarily, our invention thus far has been applied to coalescing various small sizes of anthracite in order to produce a fuel commercially available for domestic and other uses.

The present invention is not concerned with the particular mode of coalescing or of briquetting the fuel, as commercially practiced, but relates primarily to the preliminary step or treatment of the subdivided fuel whereby a suitable binding material may expeditiously and cheaply be applied to the fuel particles. This binding material is then coked in order to produce a fuel that will be satisfactory, not only for combustion purposes even after a considerable lapse of time, but will be adapted for transportation. The requirements for these purposes are distinctly different, in that a binding material affording the requisite toughness for rough handling of the completed product, may not serve to retain the particles in their coalesced state when subjected to combustion, and the converse is equally true. These requirements are best complied with when the coking binding material is reinforced by a toughening binding ingredient that does not lend itself readily to the coking process.

The preferred binding material, therefore, is of composite character and essentially consists of a carrying medium and a readily coking hydrocarbon derivative, with which there may advantageously be associated a toughening ingredient that does not readily lend itself to the coking process. This binding material, therefore, is readily and cheaply applied in a hot or cold aqueous circuit by means of a filming carrier adapted to displace moisture or water films upon the surfaces of the fuel particles. Thus, an oil associated with a suitable binder, preferably of the composite nature above indicated, and otherwise difficult of application to carbonaceous materials, may be employed as a carrier for applying the binder evenly to the fuel. The percentage of binder required, approximately, varies inversely in accordance with the sizes of the subdivided fuel employed, hence we ordinarily avoid fine grinding of the coal.

We should explain that the coking action preferably does not materially affect the body of the fuel itself, since much lower temperatures are available for coking relatively small percentages of a suitable binder. Thus, the process of heat-treating the fuel material is minimized, as compared with a process which would coke or partially coke the fuel particles as well. However, in describing and claiming herein the coking of the binder, it is to be understood that there is merely a more or less complete coking action upon one or more of the ingredients thereof, as will be further explained.

Our experience has shown that a relatively small amount of suitable binding material, evenly distributed over the particles of the subdivided fuel and in intimate contact therewith, after subjection to the coking action, will suffice to bind the fuel material into permanent commercial forms equally available for shipment and firing. Accordingly, our efforts have been directed toward perfecting a method which will, first, bring the selected binding material into intimate contact with the subdivided fuel without incurring the expense of drying the same; second, a method which will apply such binding material cheaply, evenly and quickly over the fuel particles, and, third, a heating at moderate temperatures which will coke a part or all of the binding material and substantially increase the effectiveness of a large percentage thereof, whereby definite savings in operating and material costs are obtained.

The range of possible carriers and associated binders, obviously, is considerable, and we shall not attempt herein to furnish any exhaustive list thereof. Nevertheless, we have selected some typical examples of applying varying amounts of different binding materials to subdivided fuel by means

of carriers, affording a filmed binder capable of being readily coked. However, we do not wish to be understood as necessarily limiting our invention to the particular ingredients, formulæ or temperatures set forth in explaining the same.

As a filming agent or ingredient we preferably employ 150° commercial kerosene, although other agents or fluxes, such as light mineral distillates, light coal tar and gas producer distillates, or even chemically manufactured solvents may be used to advantage.

For the coking ingredients of the binder we preferably employ a residuum from the last stage of petroleum distillation, comprising a tacky, plastic solid having a melting point approximating 134° F., but as a substitute therefor we have also advantageously employed a 130° residuum from the distillation of coal tars, such as by-product or gas-producer tars. All of these materials, it will be understood, are still products, the heat-treatment of which has been arrested a little short of the coking point.

As a toughening and non-coking ingredient we preferably use air-blown residuum from petroleum distillation supra, which is a tough, rubber-like solid material having a melting point approximating 240° F., or in lieu thereof a similar blown product from other bituminous sources may be employed with advantage.

The precise character and condition of the fuel body is not important as to our instant disclosure, since small, irregular sizes of suitable carbonaceous materials are readily coalesced by practicing our improved process. However, as a specific example of a very excellent briquet fuel body we may state that anthracite in the sizes known as No. 2 buckwheat, No. 3 buckwheat and slush are used in equal proportions, by weight. The filming and binding medium, amounting to about 6 per cent, by weight, of the fuel body is applied to the coal in a hot water circuit until the fuel particles are coated by the known filming action, which takes place during moderate agitation of the immersed fuel, hot water and binder. Any suitable apparatus adapted for agitating the immersed fuel and filming binder in a hot or cold water circuit may be employed for this purpose.

The excess water is then drained off and the fuel material is molded into briquets under suitable pressure, or otherwise compressed into commercial sizes of fuel. Thereupon, the briquets or fuel bodies are heated approximately two to three hours at temperatures ranging from 550° F. to 600° F., thus causing substantially the volatilization of the kerosene or other flux and carrier, as well as a portion of the volatile matter in the binding material, followed by a more or less complete coking action on the coking residuum employed as a binder.

It is our understanding that the air-blown residuum, which is substantially non-coking at the temperatures employed, when used as a binder, serves to fill or occupy the minute cellular spaces of the coked residuum, thereby toughening the product against fracture and overcoming the normally brittle structure of the coked film.

When immersed in benzol or other solvent, it is found that the briquets or fuel products produced in accordance with our process above outlined are but slightly affected by the solvent, thereby confirming the advantage and importance of employing a coked binder. The product, naturally, is of permanent character, exhibiting no disintegrating effect during considerable periods of time, being non-brittle and difficult of fracture, while burning without cracking or melting in furnace temperatures produced by combustion thereof.

Premising the disclosure of a few typical formulæ for employing associated carrier and coking binding materials, we may explain that the latter most advantageously may be used with a toughening ingredient, yet the coked binder alone is adquate for many purposes.

From the foregoing it will be seen that the composite filming binder solution comprises a relatively volatile fluid solvent and one or more ingredients capable of ready solution therein under proper conditions of admixture. The ingredients for the binder solution, in approximately the proportions hereinafter specified, are placed in a reflux condensing appliance and heated, say to 350° F., until solution takes place and uniform fluid condition obtains.

The inadequate binding characteristics of the air-blown residuum instanced above, when employed alone, may be shown by employing a binder solution comprising 25% kerosene and 75% air-blown residuum. Six per cent, by weight, of this solution applied to 94%, by weight, of the mixture of anthracite in small sizes, produced an agglomerate which was molded at 2500 pounds pressure per square inch and thereafter heated during three hours at 560° F.

During the heating this agglomerate became soft and plastic at the early stages and very little coking action occurred even in the final stages of heating. While the briquets thus produced were tough and coherent, the binding material is semi-fluid under heat and readily dissolved from the briquet in benzol, hence the fuel is not to be classed as a satisfactory product.

On the other hand, the same mixture of anthracite treated with a filming binder solution comprising 10% kerosene and 90% residuum having a melting point approxi-

mating 134° F., molded into briquets and heat-treated for three hours at 560° F., produced briquets of hard, although brittle coherence. The filmed binder is found to be more or less completely coked and very little thereof is soluble in benzol. The fuel itself, of course, is practically unaffected at the relatively low temperatures employed for coking the binder and the fuel product is one that may advantageously be used for many purposes with entire satisfaction.

Nevertheless, as indicated above, we preferably employ a composite binder comprising both the residuum supra and its air-blown product, to wit, one having a melting point approximating 240° F. These ingredients brought into solution in the proportions of 45% of each in 10% of kerosene are readily filmed upon fuel particles of the anthracite mixture, or other desired carbonaceous fuels. The molded briquets, after being heated approximately three hours at 560° F., are found to be hard and tough, due to the composite characteristics of the binding material, the partially coked residuum being reinforced by the intermixed and non-coked air-blown residuum. These briquets are highly recommended for most commercial purposes, combining all of the advantageous features of our instant improvements.

From the foregoing the importance of employing a coked binder, with or without a toughening ingredient incorporated therewith, for the purpose of binding the fuel particles intimately together, but without materially affecting their condition or structure, is amply demonstrated by our investigations and illustrated by the exemplifications above given. Nevertheless, it should be understood that the proportions and temperatures recited, both with respect to the subdivided fuel and the heat-treated ingredients, admit of wide variation without departure from the spirit of our invention.

Having now described the preferred procedure for practicing our invention and the novel fuel product thereby produced, we claim as new and desire to secure by Letters Patent, the following:

1. A fabricated fuel product comprising a body of subdivided carbonaceous material, the particles of which are coalesced by a filmed and coked binding material, substantially as set forth.

2. A fabricated fuel product comprising a body of subdivided carbonaceous material, the particles of which are coalesced by a filmed and coked binding material, fortified by a non-coking hydrocarbon, substantially as set forth.

3. A fabricated fuel product comprising a body of subdivided carbonaceous material, the particles of which are coalesced by a filmed and coked residuum having marked coking characteristics, substantially as set forth.

4. A fabricated fuel product comprising a body of subdivided carbonaceous material, the particles of which are coalesced by a filmed and coked residuum intimately associated with a toughening ingredient, substantially as set forth.

5. The method of producing artificial fuel, which consists in filming the subdivided carbonaceous material with a binding material capable of being coked, shaping the filmed material in the desired sizes, and heating the same sufficiently to partially coke the filmed binder and coalesce the fuel body, substantially as set forth.

6. The method of producing artificial fuel, which consists in filming the subdivided carbonaceous material with a composite binding material, comprising coking and non-coking hydrocarbons, shaping the filmed material in the desired sizes, and heating the same sufficiently partially to coke the filmed binder and coalesce the fuel body, substantially as set forth.

7. The method of producing artificial fuel, which consists in filming the subdivided carbonaceous material with an oil solvent carrying a coking residuum during immersion and agitation of the carbonaceous material, shaping the filmed material in the desired sizes, and heating the same sufficiently to coke the said residuum and coalesce the fuel body, substantially as set forth.

8. The method of producing artificial fuel, which consists in filming irregularly subdivided sizes of anthracite with a composite binding material carried onto the fuel particles by a filming oil; said binding material comprising a residuum capable of being coked and an air-blown residuum resistant to the coking action, shaping the filmed material in the desired sizes, and heating the same sufficiently to coke a portion of the filmed binder and coalesce the fuel bodies, substantially as set forth.

9. The method of producing artificial fuel, which consists in filming irregularly subdivided sizes of coal with a composite binding material, comprising a coking and a relatively non-coking ingredient carried in a filming solvent agent, shaping the filmed coal in the desired sizes, and heating the same sufficiently to effect a coking of the filmed binder and coalesce the fuel bodies thus produced.

10. The method of producing artificial fuel, which consists in applying to the subdivided coal particles a binding agent comprising approximately equal parts of readily coked and relatively non-coking ingredients, shaping the treated coal in the sizes desired, and heating the same sufficiently to coke a portion of the binding agent and coalesce the fuel bodies thus produced.

11. A composite binding material comprising approximately equal proportions of readily coked and relatively non-coking hydrocarbons with a hydrocarbon solvent.

12. A composite binding material comprising approximately equal proportions of a petroleum residuum having marked coking qualities and of an air-blown residuum in a filming oil.

In testimony whereof we do now affix our signatures.

HERBERT E. WETHERBEE.
WILLIAM L. JACOBUS.