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COATING COAL

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9 Claims. (Cl. 44-6)

This invention relates to the protective coating of coal.

It has long been desired to protect coal both from the degradation occurring because of slow oxidation, and from the degradation which occurs by abrasion of the lumps or particles of the coal. This latter may be considered as a physical, rather than a chemical degradation, although it is a fact that oxidation expedites physical degradation, and that physical degradation, by exposing new surfaces, expedites the action of oxidation.

We are here chiefly concerned with the physical degradation in coal which is caused by blows and abrasion in handling the coal. To a great extent, the physical degradation of coal is caused by blows and rubbing between lumps of coal when the coal is loaded and unloaded, and also during its transportation.

It is a well demonstrated fact that moist coal is highly resistant to physical degradation, the moisture appearing to prevent crumbling, and also serving to some extent as a lubricant. The lubricating effect of moisture on coal is particularly marked in the presence of coal dust, since the dust tending to adhere to the coal acts as an efficient lubricant, to cause sliding of the coal lumps, and to lessen abrasion. It is, however, a practical impossibility to maintain coal in an adequately moist condition by the application of water. Hygroscopic materials, such as calcium chloride, have been applied to coal, to keep the surface of the lumps or particles of coal moist. Such materials have served successfully, or at least very favorably, during short periods of time. Gradually, however, the calcium chloride entering into solution penetrates into the bodies of coal, and its effect is thus lost.

When crude petroleum or any of the other oils used for the treatment of coal are first applied to the coal, the effect is to prevent physical degradation due to blows and abrasion. The oils, however, rapidly penetrate the coal lumps, leaving the surface unprotected and unlubricated. It is necessary for the adequate protection of coal, during relatively long periods of time, that there be and remain on the surface of the coal lumps a coating of adherent, non-penetrating material. My prior Patent No. 1,912,697, dated June 6, 1933, discloses a coating consisting primarily of paraffin wax, which possesses to a great extent the noted desirable characteristics.

The coating of paraffin wax, or of paraffin wax and another neutral hydrocarbon, such as a neutral pitch or a neutral asphalt, provides a film

which remains on the surface of each individual lump of coal, without becoming lost by penetration into the body of the lump. It is viscous and adherent, without being tacky, and does not rub off by contact between lumps of coal, or contact of the coal lumps with the surface of handling instruments or containers. At temperatures appreciably higher than 0° C., the coating material does not tend to flake from the surface of a coal lump. At low temperatures, such as 0° C. and lower, however, a refined paraffin wax or a paraffin wax unassociated with a plasticizer containing bodies serving to retard crystallization tends to crystallization and brittleness.

According to this invention, I use as my starting material for the coating of coal that product of petroleum oil distillation known as petroleum jelly or petrolatum. This I take initially in crude state.

Crude petrolatum may be roughly defined as the mother liquor from which paraffin is obtained. The paraffin is present in the petrolatum dissolved in oil. If the crude petrolatum be fractionated, either by distillation, or by solvent precipitation, a certain proportion of paraffin is removed with the lower viscosity cut of the oil, and a certain proportion of the paraffin remains with the heavier oil of higher viscosity. The value of crude petrolatum in coal-coating compositions is positive. Being non-crystalline and compatible with the various cuts of hydrocarbon oil, its addition in substantial quantity to a hydrocarbon oil tends to some extent to modify the fugitive quality of a film of the oil as applied to coal.

I have found crude petrolatum as such relatively impermanent as a film in the protective coating of coal. This is for the reason that the presence of a large proportion of oil separable as the lighter or low viscosity fraction renders the crude petrolatum greasy, so that it is rubbed from the surface of the coal. Further, the penetration of the oil into the body of the coal tends to leave the paraffin unplasticized and present in isolated areas on the surface of the coal, rather than as a uniform coating.

Taking, therefore, crude petrolatum as my starting material, I so subtract from and add to the ingredients of the petrolatum that a coating material wholly satisfactory for coal of all grades and for long continued use under all normal atmospheric temperatures is obtained.

It should be noted that, as present in the mother liquor, paraffin is without tendency to crystallization, there being present bodies capable

of maintaining the amorphous nature of the wax even under low temperature conditions. It is refined paraffin wax in itself which exhibits the tendency to become crystalline and brittle at low temperatures.

5 We shall assume initially that the petrolatum taken as the starting material is a petrolatum derived from Pennsylvania crude petroleum, which has, as is well known, a totally paraffin
10 base. I then remove from the crude petrolatum a proportion or cut of lower boiling point. Desirably I remove that cut, which will distil at a temperature no higher than 500° F. While distillation temperature gives a convenient definition
15 to the removed cut, it is to be understood that the removal may be made by any of the well known solvent precipitation processes, as well as by fractional distillation.

In this topped petrolatum, the heavier cut of
20 oil then providing the total oil content is of body suitable to serve as a plasticizer for the paraffin wax, and is of sufficiently high viscosity to prevent its penetration into the body of the coal. Even as so constituted, however, the petrolatum
25 is greasy, and does not fulfill all of the requirements desirable in a coal-coating material. I have found that in several ways I may render this material wholly suitable.

One mode of improving the qualities of the
30 topped crude petrolatum is to add to it a suitable proportion of unrefined paraffin wax. By unrefined paraffin wax I mean the paraffin wax content of crude petrolatum, from which all or almost all of the oil has been expressed. This material
35 should be added in substantial quantity, and I have found it desirable to restore to the crude petrolatum a quantity of unrefined paraffin wax at least equal to that which has been removed with the lighter cut of oil.

40 Another material which has proven satisfactory, when added to the topped crude petrolatum, is refined paraffin wax, which is the well known paraffin wax of commerce. This refined paraffin wax possesses in itself the tendency to crystallize
45 at low temperatures, but as added to the unrefined wax and oil, constituting the topped crude petrolatum, the presence of crude bodies in the unrefined content entirely or substantially negates the tendency to crystallization. If relatively
50 large quantities of the refined paraffin wax are added to the topped crude material, I have found it desirable to add a small quantity of asphalt or a tar acid, to counteract that tendency. Plasticity, generally considered, is provided by
55 the heavy oil content of the coating material.

Another manner of increasing the proportional content of paraffin wax in the crude topped petrolatum is to remove some of the heavier oil, so that the percentage content of wax
60 in the material is substantially increased. It is to be understood that, while the oil content of the coating material is lessened by the addition of solid wax, or by removal of a portion of the oil, I have found it of relatively great importance
65 to retain a substantial content of the heavier oil, distilling at a temperature higher than 500° F.

While a lessening in the oil content avoids greasiness in the coating material, the oil itself performs a highly useful function, in that it
70 plasticizes the paraffin wax, and gives a coating material having lubricating qualities superior to those of paraffin wax, either refined or unrefined, if used alone. The oil content of the coating material maintains the coating flexible, and
75 maintains the adherence of the coating to the

coal at extremely low temperatures. Even though paraffin wax, applied alone to coal, be unrefined and thus lacks a tendency to crystallize, it does not present adequate flexibility and adherence at the lower atmospheric temperatures. 5

Another procedure by which the topped crude petrolatum may be rendered wholly suitable as a coating material for the enduring protection
10 of coal is to add to this topped crude petrolatum a proportion of pitch or asphalt, either by itself or as combined with a paraffin wax. The quantity of the pitch or asphalt added, or the quantity of a mixed quantity of pitch or asphalt with
15 paraffin wax as added, may likewise desirably equal the quantity of wax initially removed from the crude petrolatum in removing the lighter oil content from it.

The above has dealt with a petrolatum derived from Pennsylvania crude oil, which is an
20 unmixed paraffin base oil. I have, however, found that I may successfully use a petrolatum derived from the mid-continent crude petroleum, which have a mixed paraffin and asphalt base, and that the crude petrolatum derived
25 from these petroleum requires a somewhat lesser adjustment than the crude petrolatum derived from Pennsylvania crude petroleum. Taking the crude petrolatum resulting from the distillation of the mixed base petroleum, I remove a cut of
30 the lighter oils, desirably such cut as distills at a temperature no higher than 500° F., by a suitable process such as a solvent precipitation process.

It is possible that, with this mixed base petroleum, the proper amount of semi-solid may exist
35 in the topped petrolatum. This is for the reason that there is a lesser tendency in such petrolatum for a large proportion of the semi-solid content of the petrolatum to be removed with the lighter oil content of the petrolatum. In
40 general, however, it is necessary to increase the proportion of semi-solids with respect to the heavier oil, in order to have a coating of adequate body; or, conversely, it is necessary to decrease the proportion of semi-solids with
45 respect to the heavy oil content, in order that the flexibility and adherence of the coating may be preserved at the lower atmospheric temperatures.

It is to be understood that, with both the
50 Pennsylvania base petrolatum and the corresponding material produced from a mixed base petroleum, which I also herein term "petrolatum", the quantity of paraffin wax or other semi-solid material which is added after the
55 petrolatum has been topped will vary somewhat with the character of the particular petroleum from which the petrolatum is obtained. Starting with the general proposition that I
60 prefer to add to the topped petrolatum a semi-solid content at least equal to that which has been removed by topping, the quantity so added may be varied above and below the quantity generally so defined. The exact quantity of semi-solid
65 material to be added is subject to determination in each instance by trial, without extended experimentation. It may be stated generally that if the heavier oil remaining in the petrolatum be of particularly high viscosity, or if the percentage of wax or asphalt remaining be particularly high, the quantity of added paraffin asphalt
70 or paraffin asphalt mixture may be lessened.

In applying the coating material to the coal, it is desirable to follow a procedure such as disclosed in my above-noted Patent No. 1,912,697.

According to one method of application as noted in that patent, the coal may be passed through a fused bath of the coating material, drained, and the adherent coating allowed to solidify.

5 The most economical method of procedure is that disclosed in the above-noted patent, in which the coating material is deposited on the coal from heated liquid suspension.

If the last-noted method of application is to be followed, care should be taken that any asphalt or pitch included in the coating material does not bring the acidity of the material to such point that it will tend to emulsify in a bath of heated liquid. It should be noted that, as my coating material is applied by either of the modes mentioned, as distinguished particularly from a method which involves spraying the coal with an emulsified bath of coating material, the coating is continuous, and acts to wholly cover and protect each lump or body of coal.

When my improved coating material has been applied to lumps or particles of coal, it not only protects the coal from chemical degradation due to oxidation, but also prevents dusting and degradation of the coal due to shocks and abrasion resulting from handling and storage. The coating acts both as an intervening film, to prevent abrasion of the coal, and as a lubricant, lessening the effect of blows to which the coal is subjected.

30 Thus when coal having my protective coating on the individual lumps or particles is dumped, the lubricating quality of the coating causes the lumps to slide over each other, thus lessening the force of what would otherwise be direct blows, and preventing breakage of the coal.

Because of the content of heavy oil, the lubricating effect is greater than is obtainable by paraffin wax alone, whether the paraffin wax be refined or unrefined. Because of its resistance to crystallizing tendencies at all atmospheric temperatures, the coating serves to protect the coal at lower atmospheric temperatures, as well as at higher atmospheric temperatures. It may be noted that at high atmospheric temperature the coating does not tend to become tacky.

An additional use of my coating material resides in the fact that it may cause fine coal dust to adhere to the substantial lumps or particles of coal. Thus by applying coal dust to the coal, when freshly coated, the coal dust becomes embedded in the coating in such manner as to form an integral part of the coating. Lumps of coal so coated are additionally protected, in that the coal dust itself serves as a lubricant and as an additional protective armor for the lumps or particles of coal. A further advantage rising from the addition of the coal dust is one of economy, since the coal dust thus forming a component of the coating on the lumps of coal is not lost, but increases the effective fuel value of the lumps.

My improved coating material is economical, in that crude materials of relatively low cost are used, advantage being taken of the peculiar qualities of the crude, as compared with the refined, material. The coating differs widely from crude petroleum as a treating material for coal, in that it is highly viscous, non-penetrating, and forms a coherent coating on the coal. It differs also in a marked degree from crude petrolatum, although the advantageous qualities of crude petrolatum are preserved in it. It is, as explained, notably superior to paraffin wax itself, whether refined or unrefined, and to asphalt or pitch, or any mixture of asphalt and pitch with paraffin. This latter advantage, as has been explained, is due

to the lubricating quality provided by the heavier component oil of the crude petrolatum, and to the plasticizing effect of that oil on the paraffin wax or asphalt included in the coating mixture. As previously explained, the plasticizing effect is such that the coating remains flexible and adherent at extremely low atmospheric temperatures.

It is to be understood that my coating material may be applied to the exterior of briquettes composed of divided fuel particles bonded together. In this connection, the coating material may, or may not, be used as the bonding material, my purpose being to form a protective and lubricating coating on the surface of the briquette in the same manner as on a lump of solid coal. In fact, for my purpose, each briquette may be considered the full equivalent of a lump of solid coal.

It has been noted above that coal dust will adhere to my coated coal lumps, and it should be explained that sawdust and other finely divided solid fuels may similarly be caused to adhere to the lumps, to provide an outer coating. If sawdust is used, the lubricating effect of adherent coal dust is lacking, but an increased cushioning effect is obtained.

As used throughout the specification and claims, the term "heavy cut" of petrolatum, or "heavy cut" of mineral oil, and likewise "high viscosity" mineral oil, each defines the petrolatum of the mineral oil which does not distill at a temperature substantially lower than 500° F. Similarly, the "lighter cut" of petrolatum, and the "lighter" oil designates the cut of petrolatum or oil which distills at a temperature approximating 500° F.

It is to be understood that the material used in coating the coal may be made up of the heavier cut of crude mineral oil, without its naturally associated semi-solids of the class of paraffin wax and asphalt, and that these semi-solids may be added in appropriate quantity to the high viscosity crude mineral oil. In general, such procedure would not be followed, for the reason that it would involve the entire removal of the semi-solids, and their replacement. In the event, however, that there should be available a supply of crude mineral oil of suitable viscosity, which has none or a negligible semi-solid content, it is within the contemplation of my invention to utilize such oil in making up my coating material, by adding adequate quantity of the suitable semi-solids thereto.

Whereas it is desirable to have in the coating material a relatively great quantity of semi-solid content, it should be understood that such content is to be limited, as a maximum, to a quantity which may so be plasticized by the oil content of the coating material that the coating, as such, is flexible and adherent at the lower atmospheric temperatures.

The term "coal" as used throughout the specification and claims is used to designate fossil carbonaceous fuel, in whatever condition it may be. In the case of coal which is in the condition of coke, it is of particular importance that the lighter oil content of the crude petrolatum should not be included in the finished coating material, and that the finished coating material be relatively dense, as well as adequately flexible at low temperatures. This is because of the high adsorptive properties of coke.

I claim as my invention:

1. The herein described method of preparing a coating material for the protective coating of solid lump fuel of the type subject to degradation

by oxidation and to objectionable dusting which comprises removing from crude petrolatum a cut of the lighter oil content with consequent removal of a portion of the semi-solid content of the crude petrolatum associated with the lighter oil, increasing the relative proportion of semi-solid content with respect to the remaining heavier oil content of the crude petrolatum by adding to the heavier end of the crude petrolatum which has been deprived of its lighter associated oil a refined or semi-refined paraffin wax, and inhibiting crystallization of the paraffin content of the coating material by including therein a relatively small quantity of a crude hydrocarbon material.

2. A coating composition for protectively coating solid lump fuel of the type subject to degradation by oxidation and to objectionable dusting comprising a paraffin substance having the approximate composition of a blend of paraffin wax and a petrolatum, said coating composition being substantially non-volatile at temperatures below 500° F., and said coating composition as existing in an applied film on the lump fuel being non-crystalline and tough at low temperatures and having lubricating qualities.

3. A coating composition in accordance with claim 2 which comprises additionally crude hydrocarbon material tending to inhibit crystallization of the paraffin wax content of the composition.

4. A coating composition for protectively coating solid lump fuel of the type subject to degradation by oxidation and to objectionable dusting comprising a paraffin substance having the approximate composition of crude paraffin wax and a petrolatum having the property of crude hydrocarbons in tending to inhibit crystallization of the paraffin wax content of the composition, said coating composition being substantially non-volatile at temperatures below 500° F., and said coating composition as existing in an applied film on the lump fuel being non-crystalline and tough at low temperatures and having lubricating qualities.

5. A coating composition for protectively coating solid lump fuel of the type subject to degradation by oxidation and to objectionable dusting comprising a paraffin substance having the approximate composition of a blend of paraffin wax and a heavy petrolatum, and additionally a relatively small quantity of a hydrocarbon material as an inhibitor of crystallization in the paraffin wax content of the composition, said coating composition as existing in an applied film on the lump

fuel being non-crystalline and tough at low temperatures and having lubricating qualities.

6. A coating composition for protectively coating solid lump fuel of the type subject to degradation by oxidation and to objectionable dusting comprising a paraffin substance having the approximate composition of crude paraffin wax and a heavy petrolatum having the property of crude hydrocarbon in tending to inhibit crystallization of the paraffin wax content of the composition, said coating composition as existing in an applied film on the lump fuel being non-crystalline and tough at low temperatures and having lubricating qualities.

7. The herein described method of preparing a coating material for the protective coating of solid lump fuel of the type subject to degradation by oxidation and to objectionable dusting which comprises removing from crude petrolatum a cut of the lighter oil content with consequent removal of a portion of the semi-solid content of the crude petrolatum associated with the lighter oil, and increasing the relative proportion of semi-solid content with respect to the remaining heavier oil content of the crude petrolatum.

8. The herein described method of preparing a coating material for the protective coating of solid lump fuel of the type subject to degradation by oxidation and to objectionable dusting which comprises increasing the body and decreasing the penetrability of crude petrolatum comprising paraffin wax and oily hydrocarbon by adding thereto paraffin wax, thereby increasing the semi-solid content of the material with respect to the hydrocarbon oil content thereof.

9. The herein described method of preparing a coating material for the protective coating of solid lump fuel of the type subject to degradation by oxidation and to objectionable dusting which comprises removing from crude petrolatum a cut of the lighter oil content with consequent removal of a portion of the semi-solid content of the crude petrolatum associated with the lighter oil, increasing the relative proportion of semi-solid content with respect to the remaining heavier oil content of the crude petrolatum by adding to the heavier end of the crude petrolatum which has been deprived of its lighter oils a refined or semi-refined paraffin wax, and inhibiting crystallization of the paraffin content of the material by including therein a relatively small content of asphalt.

HARVEY R. FIFE. 55