

UNITED STATES PATENT OFFICE.

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METHOD OF TRANSPORTING CARBONACEOUS SUBSTANCE.

1,390,230.

Specification of Letters Patent.

Patented Sept. 6, 1921.

No Drawing.

Application filed December 3, 1919. Serial No. 342,263.

To all whom it may concern:

Be it known that I, LINDON W. BATES, a citizen of the United States, and resident of Mount Lebanon, in the county of Columbia and State of New York, have invented a certain new and useful Improvement in Methods of Transporting Carbonaceous Substance, of which the following is a specification.

10 This invention pertains to a method of transporting coal or other solid carbonaceous substance through pipes with the aid of a liquid carrier. More specifically it pertains to the transportation of pulverized coal, 15 coke, or other solid carbonaceous substance through pipes by means of an oil carrier, or other liquid hydrocarbon carrier, in which the particles are artificially stabilized to enable the passage of the composite through 20 the pipes without congesting the same. It also refers to the method of adapting the carrier for such service. The word "solid" is used in contradistinction with liquid and gaseous. It does not refer to size, inasmuch 25 as the material to be carried is reduced to a small size and may be partially dissolved or peptized in the carrier. By the word "stability" there is meant non-separation of the components for a given period of time, such 30 as will enable the carriage of the particles through pipes by the carrier. It does not mean permanent stability, nor simply slow sedimentation which proceeds naturally. It means the retardation of separation by artificial means of the particles, especially those 35 above colloidal size, since those within colloidal limits are naturally stable to a high degree.

40 Coal may be taken as a typical example of the solids it is proposed to transport. At the present time this mineral is conveyed from the coal fields to market chiefly over railroads and in vessels. The cost of so doing, however, is becoming more and more 45 expensive. On the other hand, the transportation of oil long distances through pipes has been carefully developed and perfected in recent years. Attempts have been made to carry or force coal through pipes by 50 means of water, but owing to rapid sedimentation it has been possible to convey as a maximum only about 20% by weight of particles under a considerable head of water traveling some twenty feet per second. Save 55 under such exceptional circumstances or in rivers, water has not served as a carrier to

transport coal. Only very small amounts may be made into a colloid with water, and so made naturally stable for transportation. So too pulverized coal is carried short distances through pipes by means of air under 60 pressure, and also with the aid of a vacuum. But for economic reasons it is necessary to provide a method for carrying larger quantities of coal long distances through pipe 65 line. The ability to pipe coal to market is of importance to the prosperity of localities situated far from the coal deposits.

By combining high percentages of pulverized coal with oil in such a fashion as to 70 form a composite stable for the period of transportation, the composite like oil may be pumped or caused to flow considerable distances through pipes. In order to convey coal or other solids of a carbonaceous character through pipes with the aid of an oil 75 or similar liquid carrier, it is necessary to reduce the solid by pulverization or otherwise so that about 95% passes through a hundred mesh per inch screen and 85% through a two 80 hundred mesh screen. Finer subdivision is desirable but is not essential. Such particles are far above colloidal size. The fineness desired depends to a certain extent upon the specific gravity of the solid and of the liquid, 85 and upon the nature of the carrier and composite. It is possible to convey even coarser particles through pipes in the manner indicated because of the motion of the carrier in the pipes. There is not only the 90 forward movement of the liquid, but there is a tumbling motion and currents of all sorts due to natural or specially introduced unevennesses in the pipes, bends, elevations, and differences in temperature. The composite 95 in passing through a pipe is constantly and irregularly agitated, and a mixture which is agitated separates less rapidly than one which is quiet.

The method of transportation consists in 100 blending the particles with a liquid hydrocarbon carrier which is itself treated so as to be able to maintain high percentages of particles in a dispersed state for long periods of time. In order to prepare the liquid to 105 so carry the particles it must be "fixated," that is to say treated or combined with other substance having stabilizing qualities. Of the substances which may be used to adapt the carrier to the proposed service one may 110 mention mineral soaps, of which a soap comprising lime and rosin, or like or equivalent

lent acids or alkali, is preferred. Such an amount of this "fixateur" which adds from $\frac{1}{2}\%$ to $1\frac{1}{2}\%$ of rosin to the total composite of carried and carrier will give a stability which may be varied in degree and duration and which may be caused to endure for days, weeks or months. Another class of stabilizing substances, having for certain coals a peptizing effect, is that of coal derivatives, such a creosote, naphthalene, and water gas tar. The percentage required of the latter class of substances varies between 5% and 20%, also by weight. It is likewise possible to stabilize coal and other particles in oil as a carrier by adding from 10% to 30% by weight of a liquid combustible immiscible with the carrier, such as tar in oil. These methods are not equally effective or applicable, and one may combine them or some of them to advantage when the transportation of particles through pipes and use of the product is concerned. When the liquid carrier is composed of two or more different liquid hydrocarbons it is found that it is superior as a carrier to a single liquid hydrocarbon. This may be explained by the fact that densification is more easily broken up by agitation in the case of such a composite carrier.

The particles may be combined with the carrier either before, during or after the fixation of the latter. The combination treatment consists in blending the components by means of mechanical agitation or heat treatment or both, preferably the latter method. The same commingling treatment may be used to fixate the carrier as to blend the carrier with the particles. The heat treatment consists in heating the mixture for some time, up to three hours, at a temperature of from 65°C . to 95°C . The mechanical blending consists in passing the components simultaneously through a coal pulverizing mill, paint mill, or other mixing apparatus of this sort. A few minutes of such treatment usually suffices. When heat and mechanical blending are combined, the heat need not be applied so long as if it were used alone. The combined heat and mechanical treatment, may be given simultaneously, successively or alternately. The components may be combined in batches or in a continuous process.

All liquid hydrocarbons which are suitable for fuel purposes, such as oils and tars, are suitable when fixated or when fixated and further treated, to serve as carriers for particles. It is desirable to have such a liquid of low viscosity, but not so low as to prevent its being made to carry up to about 45% by weight or particles, depending upon the character of the solid, the carrier and carried forming a liquid. In the case of heavy oils it is for this reason sometimes useful to reduce viscosity. The addition of

high percentages of coal particles increases the viscosity from that of light oil to about that of a heavy oil. The addition of important amounts of particles to a heavy oil may cause the composite to approximate a paste in its normal consistency. The increase in viscosity due to the addition of carbons to a light oil is greater than to a heavy oil. Therefore, the viscosity of the carrier may well be reduced by blending therewith other liquid of a suitable character. Of the viscosity reducing liquids one may mention pressure still oil, naphthalene and water or oil gas tar. There are other liquids of low viscosity available. It is found that the lower the viscosity of the components the less heat, and even no heat, need be applied to enable it to readily flow.

Inasmuch as an oil of extremely low viscosity can not be made to carry as high a percentage of particles as an oil of moderate viscosity, it is occasionally desirable to raise the viscosity of the carrier. This may be done in several ways. The carrier when fixated may be alternately heated and cooled which ages it and raises its viscosity. Or again there may be blended with the carrier liquid or liquified hydrocarbons of higher viscosity, like pitch and road oils. The best viscosity to load high percentages of carbonaceous particles is about 20° Engler at 20°C . The adjustment of the viscosity, by way of increase or reduction thereof, is of considerable importance.

In order to transport particles incorporated in an oil carrier through pipes it is often desirable to heat the mixture so as to increase fluidity. In the case of a heavy oil it is sometimes necessary to apply a heat of from 150°F . to 230°F . Heating the oil to 150°F . is frequent. In the case of the composite heat is also of value to assist the transportation. The amount of heat varies in each individual case. In some cases it may not be necessary to elevate the temperature over the 70°F ., which is considered the normal temperature in the case of oil. Any elevation of temperature by artificial means over this normal is considered as a heating of the carrier. The heat may be applied either to the liquids when in storage by means of coils or otherwise, and when in pipes by heating the pipes or the pumps.

There are a number of things that may be done to the components and composite aside from the blending described above. The particles may be dealt with for purposes of disintegration or for other purposes besides transportation. It is entirely feasible to combine the treatment necessary to enable carbonaceous substance to be piped when stabilized in an oil carrier, with treatment to remove ash. Ash has a specific gravity of about 2.2, while that of anthracite coal is 1.6 and bituminous is 1.4, more or

less. Removal of ash facilitates, therefore, the transportation of the particles and the use of the product carried. All the ash or some of it may be removed from pulverized carbonaceous substance, such as coal or lignite, in any of several known ways, wet or dry, such as air blast separators, sifting mechanisms, screens and tables, flotation and other mechanical or chemical treatments. Such additional steps assist the preparation of the solid carbons for transportation and may be applied, generally speaking and according to the method, either before, during or after the composite is made or transported. Upon arrival at destination the particles which are in the suspension class as regards size, may be removed from the carrier by centrifuging, or by filtering, or may be allowed to settle and then the carrier removed. The carbonaceous particles with their coating of oil are highly suited for further treatment to make briquettes or may be used just as they are as a mobile fuel paste. The carrier with the larger coal particles removed, and retaining the coal particles which are of molecular or colloidal size and which cannot be filtered or centrifuged out, may be used as a high grade liquid fuel, suitable not only for burning purposes, as fuel oil, but also for Diesel engines, semi-Diesel engines, or even internal combustion engines of more delicate mechanism with the aid of the latest carbureters. Or again the composite as piped with its full load of coal may be used as a liquid or mobile fuel, its stability being such that it may be used in oil fuel apparatus. The completed product or the partially separated product may also be used to make gas, instead of the coal and oil being separately treated for gas-making. Or again the fuel may be used for other purposes for which its nature fits it. The removed carrier may be used several times and each time becomes more enriched with colloidal and molecular coal. Whatever disposition is made upon arrival of the particles and of the carrier, the solid substance in pulverized form has been transported through pipes, which is the vital matter herein treated. Aside from these indications with regard to the possible future utilization of the particles and carrier and of their separation, the subsequent disposal of these substances is not exhaustively dealt with herein.

An example of carbonaceous particles incorporated in a carrier which will enable them to be piped for miles and without material sedimentation for a long time is the following: Pulverize the carbonaceous substance, in this case crude oil coke, to the fineness first mentioned. Incorporate the particles in a Mexican reduced fuel oil as a carrier, which is fixated by the addition of such amount of lime-rosin grease as adds

1% rosin to the composite. Blend 33% by weight of coke particles with the carrier by running them together through a fuller, or other coal pulverizing mill for a few minutes. This blending treatment disperses the particles in the carrier and the dispersion endures for several months to an adequate extent to enable the composite to be piped without congesting the conduits through sedimentation. This same method may be used to transport coal containing high percentages of ash. The ash, whose specific gravity is high, is also stabilized in the carrier.

Having thus described my invention what I claim is:

1. That method of transporting carbonaceous substance, which consists in reducing the substance to the form of particles, combining the particles with liquid hydrocarbon as a carrier, treated with substance having stabilizing qualities so as to carry the particles in stable suspense, passing the liquid composite through a pipe-line, and upon arrival at destination removing solid carbonaceous substance with associated liquid hydrocarbon from the carrier.

2. That method of transporting carbonaceous substance, which consists in reducing the substance to the form of particles, combining the particles with liquid hydrocarbon as a carrier, treated with a lime-rosin soap so as to carry the particles in stable suspense, passing the liquid composite several miles through a pipe-line and thereupon separating transported particles from most of the liquid hydrocarbon carrier.

3. That method of adapting carbonaceous substance containing ash so that it may be transported through pipes, which consists in reducing the same to the form of particles, removing ash, and combining the particles with a liquid carrier comprising high boiling liquid hydrocarbon, which is prepared by the addition thereto of substance having stabilizing qualities, to carry in stable suspense the particles of solid carbonaceous substance reduced in specific gravity by the removal of ash.

4. That method of adapting carbonaceous substance containing ash so that it may be more readily transported through pipes which consists in reducing the same to the form of particles, removing ash, and combining the particles with liquid hydrocarbon of moderate viscosity which is treated with lime-rosin soap for stabilizing purposes, the components being blended by mechanical means when heated above normal temperature.

Signed at New York city in the county of New York and State of New York this 1st day of December A. D 1919.

LINDON WALLACE BATES.