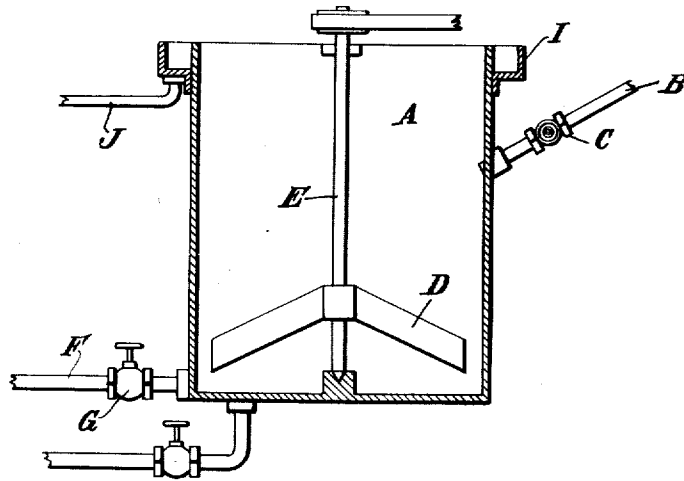


W. E. TRENT.
PROCESS OF PURIFYING MATERIALS.
APPLICATION FILED MAR. 6, 1920.

1,420,164.

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Inventor

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PROCESS OF PURIFYING MATERIALS.

1,420,164.

Specification of Letters Patent. Patented June 20, 1922.

Application filed March 6, 1920. Serial No. 363,797.

To all whom it may concern:

Be it known that I, WALTER E. TRENT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Processes of Purifying Materials, of which the following is a specification.

The invention relates to the separation of mixed materials containing a carbonaceous content, originally in either a moist or dry state, such as may be produced by reduction or pulverization of certain materials.

More specifically the invention has reference to the treatment of materials having a carbonaceous content, such as coals, lignites, shales, ash, etc., in which the carbon or hydrocarbon content is mixed with non-combustible or ash-forming substances. The treatment, however, is applicable to other materials.

The invention is based on the discovery that when pulverized coal mixed with water is treated with a suitable agent, such as certain liquid hydro-carbons, the carbonaceous particles will be amalgamated, excluding both ash-forming content and water and the amalgamated mass consists of an agglomeration of carbonaceous fuel matter and oil. The exact nature of the reaction is not at present fully understood, but possibly it may result from the non-miscibility of the water and liquid hydro-carbon and the greater affinity existing between liquid hydro-carbon and carbon particles, than that between said liquid and the ash-forming content, or between the carbon particles and the water. However this may be, the effect produced is a more complete and rapid separation than can be obtained by any other method of which I am aware. The separation of the carbonaceous from the non-carbonaceous content and water is effected when the treating agent or oil has been sufficiently commingled with the carbonaceous mass and water to result in an amalgamation of the carbonaceous materials, and an expulsion of the water and suspended impurities, if such exist.

The detailed treatment may be varied according to the particular materials operated upon, and various forms of apparatus may be employed in carrying out the method.

In the drawings the figure represents a cross section of a container or treatment chamber.

As disclosed in the figure, the comminuted material produced by any suitable means, such as by a wet crushing apparatus or the like, and preferably freed or partially freed except when otherwise desired as when collecting carbon and iron from flue dust, of certain substances such as iron, iron-sulphide, etc., by a preliminary hydraulic separation, is introduced to the container A together with a sufficient quantity of water to temporarily hold the comminuted particles in free suspension therein, the suspended particles being exposed so as to present surfaces to contact with the oil or other treating agent which is later used. Into this container the treating agent, which may be fuel oil, gasoline, crude oil, benzol, or the like, is introduced through a feed pipe B controlled by the manually operated valve C, the agent and the carbon particles having mutual exclusive affinities when in definite proportions. The mass in the container is then agitated or stirred by the revolving paddles D, mounted upon the agitator shaft E driven either manually, or by power mechanism. The rotation of this shaft effects a thorough commingling of the treating agent with the suspended carbonaceous particles in the container A, the two substances having mutual exclusive affinities and forming an amalgam of said agent and carbon, from which amalgam water and suspended impurities are largely rejected. The kind of ash-forming substances removed by my process include natural intrinsic impurities which, so far as I am aware, have not been separated from the carbonaceous particles of the coal by present day methods. These inherent impurities may be detached from the carbon by a fine reduction of the coal, or other convenient means and are generally such impurities as silica, silicates, 100

iron sulphide, etc. The finely ground material, as before stated, may whenever desirable, be introduced to any convenient type of hydraulic gravity separator for a preliminary separation wherein the heavier impurities, such as iron, etc., are separated from the lighter carbonaceous substances containing such impurities as very fine ash forming materials, the fine comminuted materials being then introduced to the container A. The comminuted material, when introduced into the container A, is, as before stated, suspended in a liquid to be subjected to the action of the treating agent. The quantity of the treating agent required to bring about the separation and amalgamation of the carbonaceous particles may vary with different materials, but I have found that with benzol, approximately one part thereof, to two parts by weight of the carbonaceous content of the comminuted material, which has passed a screen of substantially 100 meshes to the inch will properly bring about the reaction when sufficiently agitated. Some materials that have been ground coarser than 100 mesh have been successfully subjected to the treatment. This is in cases where the ash forming materials are detached at this size sufficiently for some purposes or uses such as recovering seams and layers of relatively pure coal from slate and bone but for maximum ash removal from most coals approximately 200 mesh size is necessary.

When a mass of carbonaceous material has been agglomerated by the treating agent, a washing substance such as water is preferably introduced to the treatment chamber A, by means of the water feed pipe F leading thereto and controlled by the valve G for the purpose of cleansing the amalgamated substances consisting of carbon and a treating agent carrying away impurities not previously removed by the treatment of the mass. The water carrying with it these impurities is permitted to overflow into the trough I, from which it is discharged through a suitable discharge outlet J. When the treating agent has been intimately commingled with the carbonaceous content of the material introduced to the container, the carbonaceous particles will, as before stated, begin to collect and form an amalgam of the substances having mutual affinities, expelling or excluding the water and any impurities that may be suspended therein. After this amalgamated substance of relatively pure carbonaceous material has been formed, the introduction of additional water heretofore referred to will result in a more thorough cleansing or washing of the amalgamated substance carrying away impurities, inasmuch as the treating agent has little if any affinity for these impurities and will readily

allow the water to collect the same to be carried away in suspension therein. The amalgam of the treating agent and carbon of course remains segregated during this cleansing action in view of the fact that the carbonaceous particles are filmed or coated with the hydrocarbon oil. If desirable, the treating agent may be introduced to the container, through a suitable feeding apparatus, with the water and suspended impurities whereby a partial commingling results before the mass enters the treatment chamber.

As a substitute for benzol I have successfully employed as a treating agent such hydro-carbon liquids as crude oil, navy fuel oil, gasoline and the like all of which with the comminuted carbon have mutual exclusive affinities when in definite proportions. When using navy fuel oil to bring about the separation or reaction, I preferably employ approximately two parts thereof to about five parts by weight of the carbonaceous content of the dry comminuted material, which has passed a screen of from substantially 100 to 200 meshes to the inch. The quantity of water used has little if any bearing upon the reaction although it is expedient to use a sufficient quantity to make a mixture that will flow, the comminuted material being usually of such a fineness as to produce slimes, although of course the degree of fineness is largely dependent upon the structure of the coal and the amount of ash content. The degree of fineness of the material has considerable bearing upon the amount of ash removed. If the material is so fine that most of the ash is detached from the carbon, then of course substantially all of this detached ash is separated from the carbon and the finer the material, the greater the quantity of detached ash. The purification of the carbonaceous material and the expulsion of the non-carbonaceous materials and water will result when either a large quantity or a relatively small quantity of water is employed if proper agitation is given the mass containing the treating agent. It will also be understood that many other treating agents having the desired action upon the carbonaceous matter may be used and also that instead of water other liquids may be employed as a suspension medium for the comminuted material.

By the word "carbon" or the term "carbon particles" as used in the specification and claims, it is not intended to convey the meaning of the element carbon. The words are intended to indicate carbonaceous material, as for example in coals.

The word amalgam as herein used in the specification and claims is intended to define a mixture consisting principally of carbon particles and the oil or other treat-

ing agent which mixture may contain a small percentage of water, the water or moisture contained of course varying and ranging at times from 5 to 10 percent. The
 5 amalgam may be formed in small firm masses of the combined carbon particles and oil, or said particles may be united in large coherent masses. The amalgamated masses, whether they be large or small,
 10 which is principally dependent upon the violence and time of agitation, are largely free of froth, detached impurities and water. The amalgam is of a firm consistency, resembling somewhat the consistency of mortar, and is sufficiently firm
 15 to be shoveled, handled in mechanical stokers, etc. In certain of the claims where the amalgam is defined as a substantially non-aqueous amalgam or a non-flowing amalgam, it is meant that the product
 20 is one of a substantially plastic consistency, and will not flow as a liquid. There is of course a small percentage of water in the amalgam, but not sufficient to cause the
 25 mass to be of a frothy or liquid nature, as the amalgamated masses regardless of size are always of a plastic consistency.

The product obtained is adapted for many uses. As an agglomerated mass it
 30 may be used directly as a fuel and will burn with but slight ash. Attention is called to the applicant's co-pending application Serial No. 361230, filed Feb. 25, 1920, which discloses and claims a treatment of the
 35 amalgam as formed in the process herein claimed.

Having thus described the invention what I claim is:

1. A purifying process which consists in
 40 mixing fine carbonaceous fuel and a liquid with an agent having a selective affinity for said fine fuel, and in agitating said substances to form a fuel amalgam and substantially excluding the liquid originally associated with said carbonaceous fuel.

2. A purifying process which consists in
 mixing finely divided carbonaceous fuel, non-carbonaceous matter and a liquid with
 50 an agent having a selective affinity for said fine fuel, and in agitating the substances to form a fuel amalgam and substantially excluding said liquid and non-carbonaceous matter originally associated with the fine carbonaceous fuel.

3. A purifying process which comprises
 mixing with finely divided wet carbonaceous fuel and non-carbonaceous matter intermingled with one another, an agent having a
 60 selective affinity for said carbonaceous fuel, and in commingling said substances to form an amalgam of the carbonaceous fuel and agent and excluding liquid and non-carbonaceous matter originally associated with the carbonaceous fuel.

4. A purifying process which consists in

mixing finely divided carbonaceous fuel and non-carbonaceous matter while wet with an agent having a selective affinity for said carbonaceous fuel, and in subjecting the aggregate to agitation to commingle the carbonaceous fuel and the agent, and form an amalgam and excluding non-carbonaceous matter originally associated with the carbonaceous fuel.

5. A purifying process for minerals having a carbonaceous fuel content, and non-carbonaceous matter, which consists in placing the aggregate in a finely comminuted condition in suspension in a liquid, and in subjecting the same while in liquid suspension to the action of an agent having a selective affinity for the carbonaceous fuel particles forming therewith a fuel amalgam excluding liquid and non-carbonaceous matter.

6. A process of purifying minerals having a carbonaceous fuel content and non-carbonaceous matter, which consists in subjecting the substances in a finely divided condition to the action of a liquid, in treating the same while wet with an agent having a selective affinity for the carbonaceous fuel content forming therewith an amalgam, rejecting liquid and non-carbonaceous matter originally associated with the carbonaceous fuel.

7. A process of purifying minerals having a carbonaceous fuel yielding content and non-carbonaceous matter, which consists in subjecting the substances in a finely divided condition to the action of a liquid, in treating the same while wet with an agent having a selective affinity for the carbonaceous fuel content forming therewith an amalgam, rejecting liquid and non-carbonaceous matter originally associated with the carbonaceous fuel, and then subjecting said amalgam to a cleansing action to remove additional non-carbonaceous matter therefrom.

8. A purifying process which consists in mixing finely divided carbonaceous fuel, non-carbonaceous matter and a liquid, with a hydrocarbon agent having an affinity for the finely divided carbonaceous fuel, in so commingling the hydrocarbon agent and the carbonaceous fuel as to form a fuel amalgam substantially excluding said liquid and non-carbonaceous matter originally associated with said carbonaceous fuel.

9. The method of purifying minerals having gangue and fuel yielding content, which consists in subjecting the aggregate in finely comminuted condition to the action of liquid, subjecting the same, while wet, to the action of an agent having a selective affinity for the fuel producing content and forming a fuel amalgam while subjecting the amalgam to treatment to remove gangue.

10. A purifying process which consists in mixing together finely divided carbonaceous fuel containing non-carbonaceous matter, a

liquid and an agent, said agent having a selective affinity for said finely divided carbonaceous fuel and in agitating the substances to form a fuel amalgam and substantially excluding said liquid and non-carbonaceous matter originally associated with the fine carbonaceous fuel.

11. The herein described process, which consists in placing fine carbonaceous fuel in water suspension, in subjecting the mixed substances to the action of an agent having an affinity for the fine fuel, and in agitating the materials to form an amalgam consisting principally of the carbonaceous fuel and the agent and largely excluding water originally associated with said fuel.

12. A purifying process which comprises placing material containing a carbonaceous fuel content and gangue of at least 100 mesh in water suspension, and in treating the material while suspended in the water with a hydrocarbon treating agent in a proportion not exceeding 50 per cent by weight of the carbonaceous fuel content of the material to cause the carbonaceous fuel matter and the hydrocarbon oil to form an amalgam, largely rejecting water and non-carbonaceous matter.

13. The process of treating a mineral mixture containing a substantial percentage of carbonaceous fuel matter and associated gangue, which comprises reducing the mineral to a sufficient degree of fineness physically to detach a substantial portion of the gangue from the carbonaceous matter, in treating the finely divided materials while wet with an aqueous liquid, with an oil having an affinity for said carbonaceous matter, said oil being in a sufficient quantity to form therewith a substantially non-aqueous amalgam, and in separating such amalgam from the aqueous material and gangue associated therewith.

14. The process of treating mineral mixtures containing a substantial quantity of carbonaceous fuel matter associated with gangue, which comprises reducing the mineral in the presence of an aqueous liquid to a sufficient degree of fineness, physically to detach the greater portion of the non-carbonaceous matter from the carbonaceous fuel content, and in then treating the fine material while in aqueous suspension with a sufficient amount of oil to form therewith a non-flowing amalgam consisting principally of oil and carbonaceous fuel matter, and in separating such amalgam from the aqueous material and the gangue detached from the mineral mixture.

15. The process of treating coal containing a carbonaceous fuel content and non-carbonaceous matter, which consists in reducing the coal to a degree of fineness sufficient to detach a substantial portion of the non-carbonaceous matter from the carbonaceous fuel

content, in treating the finely divided materials while wet with an aqueous material with an agent having an affinity for the carbonaceous fuel material, said agent being of sufficient quantity to form with the carbonaceous fuel matter a non-flowing amalgam consisting principally of the agent and the carbonaceous fuel matter, and in separating the amalgam from aqueous material and non-carbonaceous matter originally associated with the coal.

16. The process of treating minerals containing a carbonaceous fuel content, and non-carbonaceous matter, which consists in reducing a mineral to a fineness sufficient to detach a substantial portion of the non-carbonaceous matter from the carbonaceous fuel content, in treating the finely divided materials while wet with an agent having an affinity for the carbonaceous fuel, said agent being in sufficient quantity to form with the carbonaceous fuel a non-fluid amalgam rejecting liquid and non-carbonaceous matter.

17. The process of purifying coal, which comprises the pulverizing of coal to a sufficient degree of fineness, physically to detach the greater portion of the ash forming substances from the carbonaceous fuel content of the coal, in subjecting the material in its finely divided condition while wet to the action of a treating agent to form with the carbonaceous fuel content a non-flowing amalgam consisting principally of carbonaceous fuel particles and the agent, rejecting detached ash forming materials and liquid substantially free of carbonaceous fuel matter.

18. The process of treating a mineral containing a substantial percentage of carbonaceous fuel matter and associated gangue which comprises reducing the mineral to a sufficient degree of fineness, physically to detach a material portion of the gangue from the carbonaceous fuel matter, in treating the fine materials while wet, with a treating agent, in agitating the mass to cause the treating agent to combine with the carbonaceous fuel matter and form therewith an amalgam, rejecting liquid and non-carbonaceous matter originally associated with the carbonaceous fuel content.

19. The process of purifying minerals containing a carbonaceous fuel content, comprising reducing a mineral to a fineness sufficient to detach a material percentage of the carbonaceous fuel matter from gangue, in effecting a preliminary separation of the heavier impurities from the carbonaceous fuel, and in subsequently effecting a separation of the detached gangue from the carbonaceous fuel by treating the fine material while wet with an agent having an affinity for the carbonaceous fuel to combine therewith forming an amalgam rejecting detached ash and water.

20. The process of purifying coal which

comprises reducing coal to a fineness sufficient to detach a material portion of the carbonaceous fuel matter from its gangue, in subjecting the coal to a hydraulic classification to effect a preliminary gravity separation of heavier impurities from the carbonaceous fuel matter, and in finally sub-jecting the material while in water suspension to the action of an agent having an affinity for the carbonaceous fuel matter forming therewith an amalgam rejecting water and gangue. 10

In testimony whereof I affix my signature.

WALTER E. TRENT.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,420,164, granted June 20, 1922, upon the application of Walter E. Trent, of Washington, District of Columbia, for an improvement in "Processes of Purifying Materials," an error appears in the printed specification requiring correction as follows: Page 2, after line 120 insert the paragraph:

The present process also contemplates the collection of carbonaceous materials suspended in water without the presence of impurities whereby the carbonaceous material is agglomerated and the water substantially expelled. This applies in the case of carbonaceous materials which already contain considerable quantities of water from which it is desired that they be separated.;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of July, A. D., 1922.

[SEAL.]

KARL FENNING,
Acting Commissioner of Patents.