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PROCESS OF PRODUCING COKE.

No Drawing.

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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 Producing Coke, of which the following is a specification.

The invention relates to a process for producing metallurgical coke in which the organic sulphur originally contained in the coal is dissolved in the slag when the coke is consumed in a blast furnace.

In the past, efforts have been made to keep the sulphur out of iron made in blast furnaces by mixing with the coal undergoing a coking treatment, a substance such as limestone.

The coarsely ground coal, when mixed with limestone and subjected to a coking action, causes some of the sulphur to combine with the limestone, producing in the coke calcium sulphide, but this reaction is not entirely satisfactory for the reason that a very substantial portion of the organic sulphur never comes in contact with the limestone in view of the size of the coal, and therefore a substantial part of the sulphur comes in contact with the pig iron in the blast furnace.

The present invention comprises a process by which the most substantial portion of the organic sulphur is prevented from becoming associated with the iron. In accordance with this invention very finely ground particles of limestone or lime hydrate or an equivalent substance mixed with oil, are uniformly distributed or mixed with finely ground coal particles forming a plastic mass in which there is a close association between the sulphur and the limestone. On account of the uniformity of the mixture when the mass is coked the sulphur of the coal is taken up as calcium sulphide and is dissolved in the slag and discharged from the furnace during a blast furnace operation, thereby preventing deleterious quantities of sulphur from becoming associated with the iron.

In a more specific aspect, the invention comprises a process wherein coal is first finely pulverized, and then preferably saturated with water. Finely pulverized limestone is mixed with hydrocarbon oil, and these substances then commingle with the water saturated or suspended coal particles. The agitation causes the oil, limestone and carbon content of the coal to intimately

associate and form a homogeneous plastic mass, excluding water and a substantial portion of the wet impurities originally contained in the coal which have no affinity for the oil after once receiving a coating or saturation with water, the specific reaction which occurs having been fully described and broadly claimed in my Patent, No. 1420164. The product produced consists of a plastic mass in which the fine particles of limestone are uniformly distributed throughout the mass so that the limestone particles are in very close association with the organic sulphur whereby the coking of the mass causes the sulphur to be largely taken up as calcium sulphide. This coking also causes some of the sulphur to be discharged from the coal as a vapor in the form of sulphur gases. When the coke thus produced is used in a blast furnace the calcium sulphide is absorbed in the slag and discharged from the furnace, thereby preventing the deleterious sulphur from coming in contact with the pig iron.

In carrying out my process, I preferably take a bituminous coal of any desired grade and reduce this coal by a wet grinding to a fineness sufficient to pass through a screen having 100 meshes per linear inch. I then place this coal in water suspension or at least wet the coal with water. A hydrocarbon oil which may be fuel oil, gas oil, crude oil or the like, is mixed with limestone which is also very finely ground, preferably to the fineness equal to the fineness of the coal. The oil should be in the proportion of about one-fourth of the coal, or that is to say, with four tones of coal I preferably use about one ton of oil. The quantity of limestone added may be from ten to twelve percent of the oil by weight, although this will vary considerably, depending upon the sulphur content of coal used and also the type of oil, because many oils contain a sulphur content, and it is an object to remove the sulphur from such oils as much as it is from the coals and the quantity of sulphur contained therein. The finely pulverized limestone is thoroughly agitated in the body of oil so as to be uniformly distributed in said oil. The oil with the suspended particles of limestone is then introduced to an agitating vessel containing the water suspended coal. These substances are at this time most thoroughly agitated, the oil serving to coat or film the coal and to

carry with it the suspended particles of limestone. Sufficient agitation will cause the oil and coal with the limestone to agglomerate or amalgamate in dense plastic masses of a consistency resembling mortar, or in marble-like agglomerates. Ash forming substances, iron sulphides, etc., originally contained in the coal detached by the fine grinding thereof are excluded from said amalgamated masses together with a greater portion of the water so that the amalgamated mass consists largely of coal oil, limestone and a small quantity of water. The coal impurities are rejected because having once been saturated in water, they have no affinity for the oil. It is to be observed, however, that the limestone having once been saturated with the oil and after having once been coated with oil, it has no affinity for the water and therefore remains with the oil and coal while the ash forming substances are eliminated.

The thorough agitation of these materials, as before stated, results in formation of the amalgamated substances in which the fine particles of lime have been carried by the oil into intimate contact with the coal and becomes uniformly distributed throughout the masses. The lime particles being in direct or intimate contact with the various individual coal particles, and also with the oil, it is therefore closely associated with the organic sulphur contained in the coal particles and also with the sulphur of the oil.

When a mass of the amalgamated material is introduced to the coke oven and subjected to a temperature, some of the organic sulphur leaves as sulphur gases, but the predominating portion thereof chemically combines with the limestone and forms in the coke calcium sulphide. Because of the intimate mixture of the limestone with the coal and oil, substantially all of this sulphur is caused to unite with the limestone producing calcium sulphide. The coke thus produced when used in a blast furnace in the reduction of iron ores, causes a release of the calcium sulphide which is absorbed in the slag in the furnace, and is discharged therefrom without contact with the pig iron. The iron thus produced, therefore, is not subjected to any substantial quantity of sulphur and for this reason an improved product can be obtained.

As a specific example of the proportions which I have successfully used in carrying out my process I find that with a coal containing from 1 to 1.5 percent sulphur remaining therein, that sufficient limestone should be added to the oil to represent from 1 to 3 percent of calcium in the final coke. Generally one ton of the fuel oil is used with approximately four tons of coal. Before this oil is added to the coal, pulverized

limestone of an impalpable fineness, preferably equal to the fineness of the coal, which may be from 100 to 200 meshes per inch, is added to the oil, and if the coal is not exceedingly high in sulphur, this quantity of limestone would be sufficient to perform the reaction herein described. As previously stated, however, the relative quantities may vary, depending upon the amount of sulphur the coal contains, and also on the type of coal used, but with the usual run of coking bituminous coals, the examples given above have proven successful.

The process may be applied to oils that are high in sulphur for the purpose of desulphurizing the oil by first making the oil lime coal mixture then distilling out the oil as gases and condensable vapors.

Having thus described my invention what I claim is:

1. The herein described process, which consists in mixing pulverized coal with water, in adding pulverized lime to a liquid oil, and in mixing said oil and lime with the pulverized coal to form an amalgamated mass.

2. The herein described process, which consists in introducing to hydrocarbon oils a quantity of finely pulverized limestone, and in intimately mixing said limestone with finely reduced coal to form an amalgamated mass of a plastic consistency.

3. The herein described process, which consists in mixing a substance possessing the properties of lime with hydrocarbon oil, and in then agitating such materials with finely reduced coal to form a plastic mass.

4. A process of the character described, consisting in commingling hydrocarbon oil with finely pulverized coal having a sulphur content to form a substantially plastic mass, and in incorporating with the hydrocarbon oil an agent adapted to be thoroughly distributed throughout the plastic mass of coal and oil to intimately contact with the sulphur content of the coal and possessing the properties of forming with said sulphur when the mass is heated calcium sulphide.

5. A purifying process, consisting in intimately mixing finely pulverized coal containing a sulphur content and a hydrocarbon oil having an agent therein to form a substantially plastic mass of coal and oil, the agent possessing the properties of forming with the sulphur calcium sulphide when said mass is subjected to a coking heat.

6. A purifying process, consisting in intimately mixing wet pulverized coal with a hydrocarbon oil and an agent incorporated in said oil to form a fuel mass of a substantial plastic consistency, said agent being adapted to be brought into intimate contact with the sulphur in said mass and to

form with said sulphur when the mass is subjected to a coking temperature calcium sulphide.

7. A purifying process, which consists in 5 mixing comminuted coal, hydrocarbon oil and reagent to form a homogeneous mass and to bring said reagent into intimate contact with the sulphur contained in the coal to remove said sulphur when the mass is 10 subjected to a coking temperature.

8. A purifying process, which consists in 15 mixing comminuted coal, hydrocarbon oil and reagent to form a homogeneous mass and to bring said agent into intimate contact with the sulphur contained in the coal to remove said sulphur when the mass is subjected to a coking temperature as calcium and sulphide compounds.

9. The herein described process consist-

ing in thoroughly intermixing a hydrocar- 20 bon oil, finely comminuted mineral carbonaceous material and oxides of the calcium group to form a homogeneous substantially plastic mass.

10. The herein described process which 25 consists in mixing comminuted coal, a mineral oil, and oxides of the calcium group to form a homogeneous mass with said materials distributed throughout the same.

11. The herein described process consist- 30 ing in thoroughly mixing a mineral oil with a wet finely reduced comminuted mineral carbonaceous material and pulverized oxides of the calcium group.

In testimony whereof I affix my signa- 35 ture.

WALTER EDWIN TRENT.