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T. M. CHANCE

METHOD FOR SEPARATING MATERIALS

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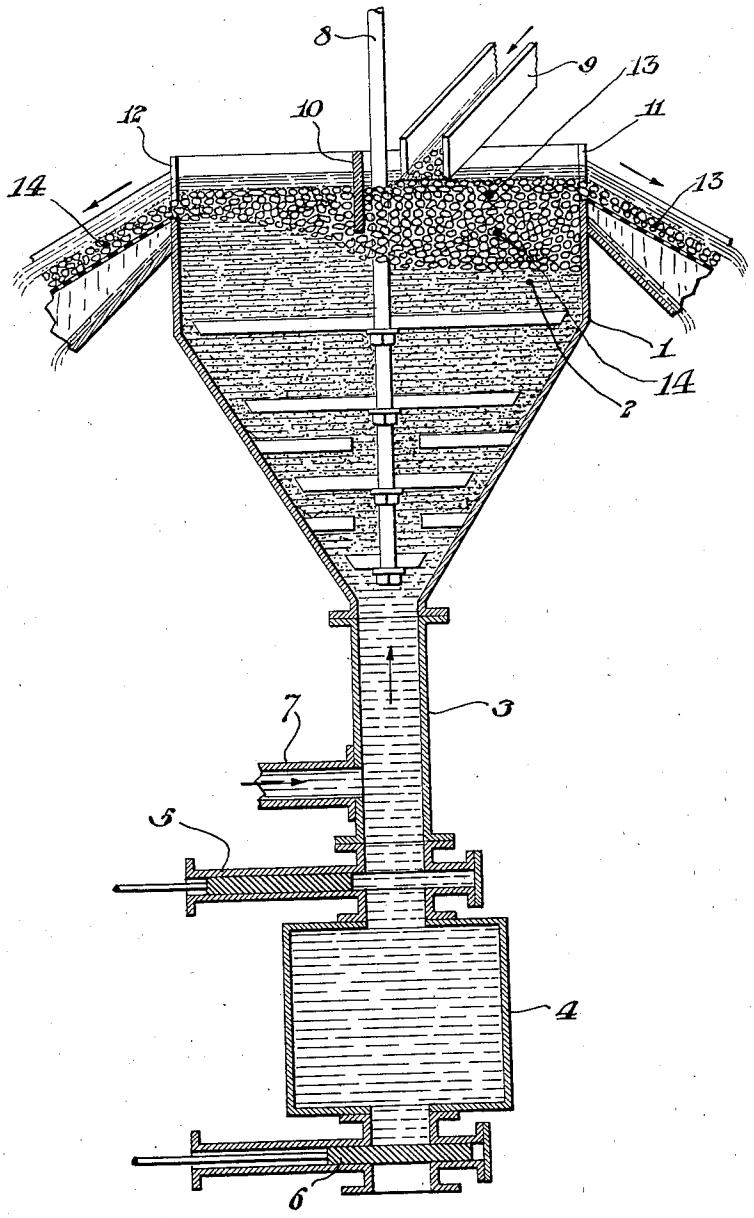

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UNITED STATES PATENT OFFICE.

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METHOD FOR SEPARATING MATERIALS.

Application filed August 31, 1923. Serial No. 660,428.

To all whom it may concern:

Be it known that I, THOMAS M. CHANCE, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Method for Separating Materials, whereof the following is a specification.

My invention consists of an improved process for separating materials such as ores, coal or the like, from impurities which they contain.

The first step in my process consists in subjecting the ore or coal to the flotational action of a fluid mass consisting of a mixture of comminuted solid matter in liquid, substantially as described in United States Patent No. 1,224,138 issued to me on May 1, 1917, in which the lighter materials will float and the heavier materials will sink, but in carrying out my present improvement the specific gravity of the fluid mass is made greater than that necessary to float the lightest of said materials which are to be separated by flotation, so that the lightest materials and also those somewhat heavier than the lightest materials will float, while materials having specific gravities materially greater than that of the fluid mass will sink; the second step in the process consists in removing the lightest of the materials which are floated by said fluid mass, said light materials floating above those of somewhat greater specific gravity, and in thus causing the said materials of greater specific gravity to accumulate in a zone below the zone occupied by the lightest of the floated materials; the third step in the process consists in the removal of these materials of intermediate specific gravity said removal being effected either by directly removing these materials from the fluid mass, or by causing these materials, especially the heavier of these materials, to be carried down with the heavier materials sinking in said fluid mass; and the fourth step which may or may not be essential to the successful use of the process, consists in removing such material of intermediate specific gravity from the heavier materials by which they have been carried down into the lower portion of the said fluid mass.

I will describe the process as applied to the preparation of anthracite coal, as such description will enable those familiar with ore dressing or with coal washing to apply the process to the preparation of coal of any kind or to the washing or concentration of ores.

Anthracite coal as mined consists of pieces of relatively pure coal, of pieces of coal of relatively high gravity (that is of high ash), of pieces of coal having slate or rock interlaminated therewith, of pieces of coal with attached pieces of slate or rock, of pieces of slate with attached coal, and slate, rock or other impurities free from coal. Hence the specific gravities of the particles of material vary from that of pure coal, (which for purposes of illustration we may assume to have a specific gravity of 1.45,) by imperceptible gradations up to that of slate or rock having a specific gravity of 2.50 to 2.60. In using this process in the preparation of anthracite coal I prefer to use a fluid mass with a specific gravity of about 1.65 to 1.70, more or less, although the specific gravity of the pure coal may not exceed 1.45, and a fluid mass of 1.50 specific gravity would be sufficient to float and separate all of the pure coal from other heavier materials. By using a specific gravity greater than that necessary to float the pure coal the fluid mass will also float all of the "bony" or high ash coal, and coal with slate or rock interlaminated therewith, or coal with small attached pieces of slate or rock, having specific gravities which approximate to or are less than the specific gravity of the fluid mass, namely 1.65 to 1.70, more or less. If a small quantity of coal to be separated is fed into the fluid mass, so that the quantity of material that will float is sufficient to form a layer floating at the top of the fluid mass but one particle deep, then all of this floating material including the pure coal, bony coal, laminated coal, etc., will float at the top of the fluid mass and no separation between pure coal and impure coal will be effected, but if material be fed into the fluid mass at a rate more rapid than the rate at which it is being removed from the fluid mass, then a floating mass of considerable depth will accumulate in a zone near the top of the fluid mass, and if the fluid mass be sufficiently fluidic, this floating mass will become, so to speak, stratified in layers, with the purest and lightest coal floating at the top, that having a somewhat greater specific gravity floating in contact with but below

the pure coal and that having a specific gravity approximating or very little less than the specific gravity of the fluid mass floating in the lower portion of this zone of floating material, it being understood that slate, rock, heavy bony coal and heavy laminated coal having a specific gravity greater than that of the fluid mass, have sunk to the lower part of the fluid mass.

The drawing is a vertical cross-section and elevation illustrating one way in which the method may be carried out, 1 being a tank or receptacle containing a fluid mass 2 of the described type and superposed upon a classifier pipe or conduit 3, which is in communication with a refuse (or concentrates) chamber 4 supplied with valves 5 and 6 which may be alternately opened and closed to trap out the materials falling through the fluid mass 2. An inlet for liquid (water) under pressure is shown by 7 and the agitation of the fluid mass is accomplished by water rising through it from 7 and by stirring arms which are attached to the revolving agitator shaft 8; 9 is a feed chute for feeding into the apparatus the materials to be separated, 10 is a partition extending across the separating receptacle to confine the lightest of the floating materials to that portion of the receptacle to the right of said partition, 11 is an open weir through which the lightest 13, of the floating materials is discharged and 12 is an open weir for the discharge of floating materials 14 that are heavier than said lightest floating materials. The drawing illustrates how floating coal accumulating in that part of the receptacle in the right side of said partition 10 will discharge through weir 11, and how the less buoyant floating material accumulating below the more buoyant material may pass under partition 10, float upwardly through said fluid mass and be discharged through weir 12. In this drawing the pieces of materials shown all represent coal of different grades as to weight, that, 13, floating high in the accumulation illustrated to the right of partition 10 being of lower specific gravity than that, 14, floating lower in said accumulation.

By operating the method in this manner it becomes possible continuously to remove the purest coal from the upper or overlying stratum of the floating material, and if this method of operation be pursued, the heavier of the floating materials will accumulate in the fluid mass and in some cases those particles having the least buoyancy may be mechanically carried down into the refuse by the slate and rock falling or sinking through the fluid mass.

The presence below the lightest coal floating at the top of the fluid mass, of a floating zone of materials of somewhat greater specific gravity provides a screen or barrier to prevent pieces of slate and rock or other refuse from carrying down pieces of pure coal into the refuse, because the buoyancy of this floating material reduces the falling velocity of pieces of slate, rock or other heavy material and reduces the danger of losing good coal with the refuse. This is perhaps especially true when material is being fed rapidly into the fluid mass, taxing its capacity to effect complete and satisfactory separation.

It is of course evident, when operating the process in this manner, that if a large quantity of middlings product is thus carried down with the refuse, the refuse can be retreated to recover this product. Such retreatment can be carried out by any of the processes in common use for separating coal, bony coal, laminated coal, etc., from slate, rock and other refuse, with or without recrushing of all or a part of such product.

While the maintenance of a layer of floating material below the zone of pure coal floating at the top of the fluid mass is thus useful it will be understood, of course, that this material can be removed from time to time merely by stopping the feed of material to be separated, for after the top layer of pure coal is removed, this heavier material takes its place at the surface of the fluid mass, can be similarly removed from the fluid mass and either merged with the purer coal or diverted for recrushing or further treatment.

My improved process therefore consists essentially in the use of a fluid mass having a specific gravity materially greater than that necessary to float or to separate the pure coal from other materials, and in causing the floated materials to become stratified with the lighter and purer coal floating at the top and immediately in juxtaposition to and resting upon materials of heavier specific gravity but which are also floated by the fluid mass, and in thus obtaining most of the material of greatest value by direct removal of the same from the fluid mass, and material of intermediate value for subsequent retreatment or for direct addition to the purer coal, thus effecting differential separation of the coal and impure coal with a fluid mass of predetermined specific gravity and without employing two or more fluid masses of different specific gravities or superposed fluid masses of different specific gravities.

This description of the process as applied to the separation of anthracite coal will be sufficient for any versed in the art to apply the process in the concentration of ores, the separation of gangue, etc.

It will, of course, be understood that in retreating intermediate products thus obtained, either all or a portion of the said product may be retreated by crushing and

separating the crushed products or otherwise by any of the methods in common use in the washing or preparation of coal.

My invention is based upon the discovery as above disclosed, that materials of different specific gravities floating in a fluid mass of the described type will become arranged approximately in the order of their specific gravities, with those of lowest specific gravities at the top and those of highest specific gravities at the bottom of the zone of floating materials. Slate, rock and other heavy impurities falling through such zone of floating materials will therefore most readily mechanically carry down the lowest and least buoyant of said floating materials. This latter material, being that of highest specific gravity, is usually a high ash product, comprising laminated coal and slate, coal with attached slate and heavy bony coal, which it is desirable to separate from the lighter floating materials which are of lower ash content. By thus carrying down this material with the refuse, the average grade of the floating materials is improved. This relatively heavy material can be separated from the refuse by any method in common use for the separation of such materials and can be re-crushed to free the better coal from its impurities and the crushed product retreated by the herein described or any other method adapted to the separation of coal from its impurities.

My invention therefore includes the production and maintenance of a zone of floating impure coal in said fluid mass below, but in contact with coal floating at the top of the fluid mass, this zone comprising coal of greater specific gravities than that of the coal floating above it, thus providing a screen or baffle to prevent pure coal from being carried down by the falling refuse and at the same time effecting a differential separation of pure coal from impure coal.

I have herein also disclosed the flotation of all floatable material as a thin layer at the top of a fluid mass of the described type, but I do not herein claim that method for separating materials as it has been made the subject of another application, filed simultaneous herewith, for method for separating material, Serial No. 660,429 filed August 31, 1923.

Having described my invention, I claim,

1. A method for separating materials of different specific gravities which consists in immersing said materials in a maintained suspension in liquid of comminuted solid matter of greater specific gravity than said liquid and substantially insoluble therein, and constituting a fluid mass having a specific gravity materially greater than that of the lightest of said materials, the quantity of said materials so immersed being sufficient to form a zone of floating materials of such thickness as to permit said floating materials to stratify in the order of their relative specific gravities; in maintaining the lower portion of said zone of floating materials as a baffle to prevent the heavier falling materials from carrying down the lightest of said materials floating at the top of said fluid mass; in causing materials of greater specific gravity than said fluid mass to sink to the lower part of said fluid mass; in removing the lighter materials floating in the upper portion of said zone of floating materials and in separately removing the materials comprising the lower parts of said zone of floating materials, whereby differential separation of the said floating materials is effected into grades of different specific gravities, and in separately removing said heavier materials from the lower part of said fluid mass.

2. A method for washing coal which consists in immersing said coal with its associated impurities in a maintained suspension in water of a comminuted solid matter of greater specific gravity than water and substantially insoluble therein and constituting a fluid mass having a specific gravity materially greater than that of the purer particles of said coal, the quantity of said coal so immersed being sufficient to form a zone of floating coal of such thickness as to permit said floating coal to stratify in the order of the relative specific gravities of the particles of said coal; in maintaining the lower portion of said zone of floating coal as a baffle to prevent heavier and larger falling particles of said impurities from carrying down pieces of the lightest and purest of said coal floating at the top of said fluid mass; in causing impurities of greater specific gravity than said fluid mass to sink to the lower part of said fluid mass; in removing the lightest and purest coal floating in the upper part of said zone of floating coal and in separately removing coal composing the lower parts of said zone of floating coal, whereby differential separation of said floating coal is effected into grades of different specific gravities, and in separately removing said impurities from the lower part of said fluid mass.

Witness my hand and seal at Philadelphia, Pennsylvania, this 30th day of August 1923.

THOMAS M. CHANCE. [L. S.]