W. S. AYRES.

PROCESS OF TREATING SOFT OR BITUMINOUS COAL OR THE LIKE.

APPLICATION FILED APR. 17, 1913.

1,086,503. Patented Feb. 10, 1914.

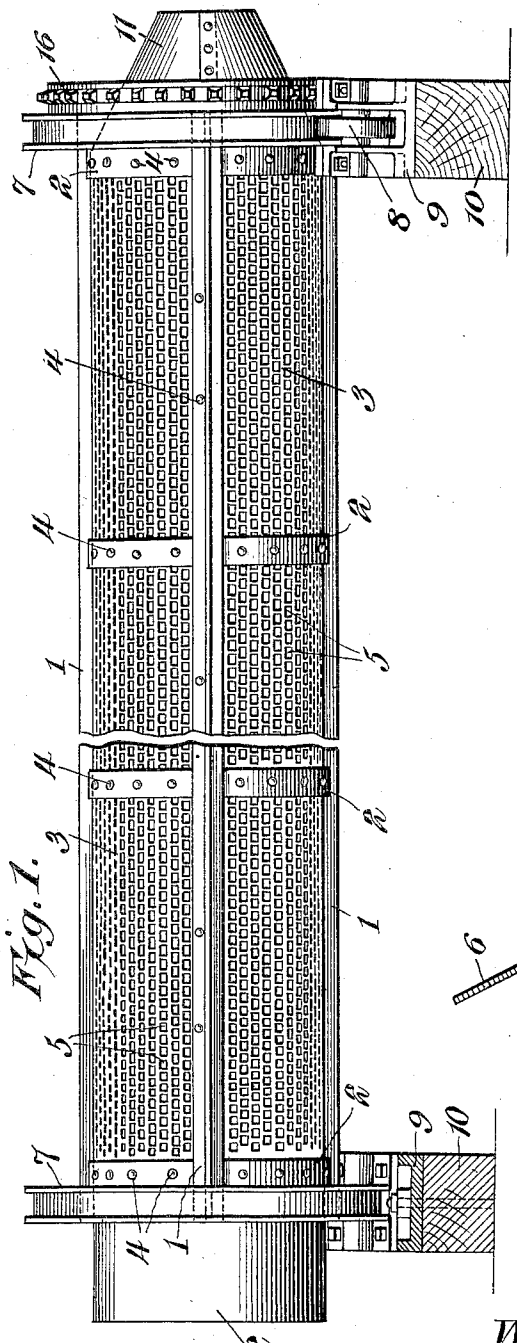


Fig. 1.

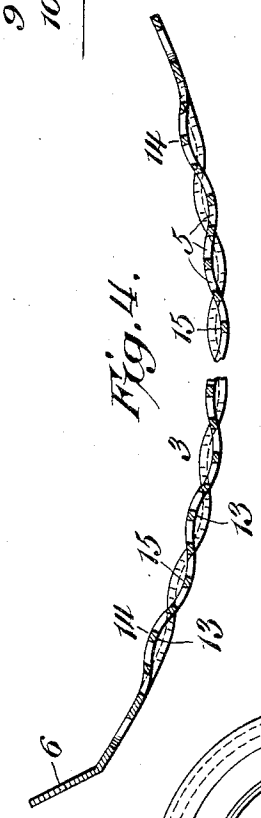


Fig. 4.

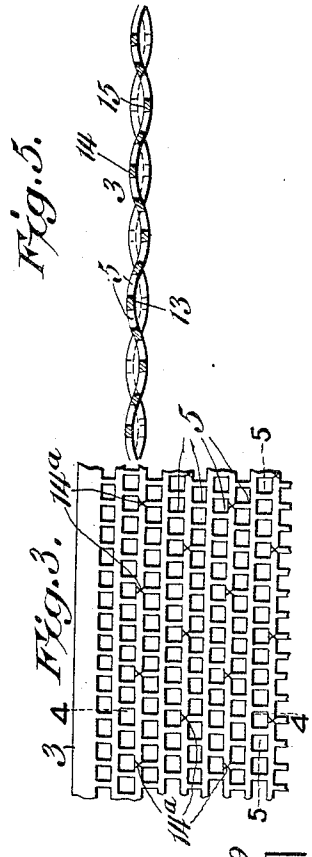


Fig. 5.

Fig. 3.

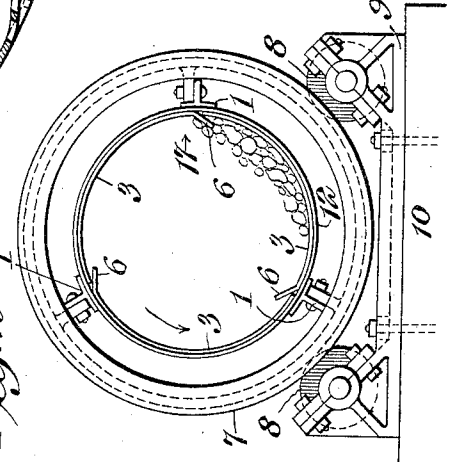


Fig. 2.

WITNESSES

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PROCESS OF TREATING SOFT OR BITUMINOUS COAL OR THE LIKE.

1,086,503. Specification of Letters Patent. Patented Feb. 10, 1914.

Application filed April 17, 1913. Serial No. 761,822.

To all whom it may concern:

Be it known that I, WALLACE S. AYRES, a citizen of the United States, residing at Hazleton, in the county of Luzerne and State of Pennsylvania, have invented a new and useful Process of Treating Soft or Bituminous Coal and the like, of which the following is a specification.

This invention has reference to improvements in the process of treating soft or bituminous coal and similar materials, and its object is to so treat the coal that contained or combined slate is not broken up and the slate or other impurities may be removed in the dry state.

Soft or bituminous coal often has slate associated therewith and it is customary to remove the slate in various ways. The larger or purer lumps of slate are picked out and then the remainder of the run-of-mine products, including the combined or associated pieces of slate, are crushed into a fine material of a size which will pass through a three-quarter inch mesh or less, after which the slate is removed from the coal by a washer or jig, but this causes great loss of coal and a high cost of maintenance, while a great outlay is necessary to provide a continuous and sufficient supply of water. All this is avoided by the present process, whereby the coal is disintegrated without an appreciable disintegration of the slate and without the use of any water and the coal is expeditiously and economically treated.

Slate as found associated with coal is almost invariably harder and tougher than the coal and there is a height from which slate may fall without breaking under the shock of sudden stoppage, while the coal because of its more friable nature will under the same circumstances become disintegrated. However, in practically all soft or bituminous coal there is a small percentage that resists disintegration by the gravity treatment mentioned, because of the presence of thin bands of silicious slate which at times are as thin as paper, such bands firmly binding or cementing the layers of coal together, so that such portion of the coal passes out of the disintegrator with the slate. Experience has shown that this slate-cemented coal cannot be recovered on dry separating machines which employ frictional difference as the principle of separation, since the thin bands of silicious slate protrude beyond the abraded bands of the more friable coal, thus presenting a slate contact with a frictional dry separator, wherefore a very large amount of coal goes out with the slate. In order to avoid this difficulty the coal is so treated by the present invention that the pieces of hard compact coal are changed from their natural angular form to a rounded form quite closely approximating a sphere. In this form the coal is readily separated from the slate by means of a separator such as shown and described in Letters-Patent No. 798,385, granted to me on August 29, 1905.

In accordance with the present invention the coal as it comes from the mine and in a dry state, that is, without the addition of water, is lifted and allowed to fall by gravity from such a height that the shock of the fall is sufficient to disintegrate a large proportion of the coal, but has no appreciable effect upon the slate and the disintegrated coal is separated from the slate and larger lumps of coal by means of a screen which may in itself be the means for causing the elevation and fall of the coal. At the same time the coal is caused to roll in various paths, so that by impact with other pieces of coal and by shock of falling the angular projections of the lumps of coal containing thin imprisoned bands of slate cementing the coal together are worn or broken off until these harder pieces of coal or those harder pieces of coal containing no slate, but which resist the disintegrating action, are rounded into a more or less spherical form, so as to move much more freely on an incline than either the more angular pieces of slate or angular pieces of coal and hence these rounded lumps of coal are easily separated from the angular slate. The result is that when the angular or flat pieces of slate and the rounded lumps of coal are treated to the separating operation, the flat and angular pieces of slate cling to the upwardly moving floor of the separator and are carried out of the forwardly rolling stream of coal. The process therefore comprises the disintegration of the coal without disintegrating the slate, and all in a dry state, and the rounding of the more compact or hard pieces of coal into spherical shapes, thus facilitating the removal of the slate from such coal.

The practice of the process is not confined to any particular apparatus, but in the accompanying drawings forming a part of this specification there is shown an appara-

tus which may be successfully employed for the carrying out of the process, and which apparatus forms the subject-matter of and is claimed in another application for patent, Serial No. 761,821, filed by me on even date herewith, for an apparatus for treating soft or bituminous coal to effect the separation of slate therefrom. The showing of the apparatus so far as the present invention is concerned is more or less indicative, wherefore the practice of the invention is by no means confined to the employment of such an apparatus, but may be practised by quite distinctly different apparatus.

In the drawings: Figure 1 is an elevation of a disintegrator which may be employed in the practice of the process. Fig. 2 is an elevation of the disintegrator, as viewed from the left hand end of Fig. 1. Fig. 3 is a plan view of a portion of one of the screen members drawn on a larger scale than Figs. 1 and 2. Fig. 4 is a section of a portion of the screen of Fig. 3 on the line 4—4 thereof. Fig. 5 is a section on the line 5—5 of Fig. 3.

For the practice of the invention on a commercial scale it is important that the action should be continuous, wherefore the apparatus of the drawings may be employed. There is provided a frame consisting of T bars 1 which may be three or more in number and arranged in a circular series and secured together by rings 2, and interior to these T bars and rings are screens 3 secured by bolts 4 to the bars 1 and rings 2 and formed of an appropriate number of segments or parts, so that the screen is in effect a cylindrical screen having numerous perforations 5 therethrough of a size depending upon the desired maximum size of the disintegrated coal. Ordinarily the perforations of the screens 5 will be about five-eighths of an inch square. In the particular structure shown there are three screen sections to the circumferential extent of the screen 3, and each section terminates at one edge in a lip 6 slightly offstanding from the body of the screen section to more or less disturb the contents of the cylinder. At each end the screen cylinder frame carries a circular track member 7 mounted upon rollers 8 in turn carried by bed pieces 9 secured to the beams 10. The screen cylinder is tilted slightly from the horizontal and at the higher or feed end is provided with a feed cone 11, while at the other end there is a discharge cylindrical apron 12.

The screen members 3 are indented inwardly, that is, in a direction toward the axis of the cylinder, as indicated at 13, so that the inner surface of the cylinder presents alternate crowns 14 and valleys 15 throughout the perforated part of the cylinder, and these crowns and valleys extend circumferentially of the inner wall of the cylindrical screen and may also have a slightly forward pitch from the high end of the cylinder toward the lower end, the high points being indicated at 14^a in Fig. 3. At the higher or feed end of the cylinder there is secured a sprocket wheel 16 for the reception of a sprocket chain by means of which rotative movement may be given to the screen cylinder but it will be understood that the sprocket wheel may be at either end of the cylinder as may be desired. In the arrangement shown the crowns and valleys of the indented portion of the screen are arranged in alternate rows, that is, the crowns of one row alternate with the valleys of the next succeeding row in the direction of the length of the cylinder.

Let it be assumed that the cylinder is being rotated in the direction of the arrow in Fig. 2, that is, counterclockwise as viewed in Fig. 2, and that at the higher end of the cylinder coal as it comes from the mine is being fed in through the cone 11. The speed of the cylinder is so regulated that the pieces of coal and slate are carried to an appropriate height, say the point 17 in Fig. 2, and then they will begin to fall back to the bottom of the revolving cylinder by tumbling down one over the other, so that instead of the pieces making a sheer drop, the pieces of slate are more or less cushioned, while the more friable pieces of coal are disintegrated and such fine coal passes out through the openings in the screen. The harder or less friable pieces of coal on rolling down the rising side of the revolving screen are thrown from side to side by the action of the crowns and valleys on the inner surface of the screen and are thereby rounded, by attrition and impact, into more or less spherical form, even quite closely approaching spheres, and these spherical or ball-like pieces of coal are ultimately discharged from the end 12 of the disintegrator with the slate.

The disintegrating and rounding action is facilitated by the alternate arrangement of the crowns and valleys, formed by the indentations, in the direction of the length of the cylindrical screen, which causes the pieces of coal in their downward rolling to also roll from side to side, and this action occurs whether the indentations are in circumferential order or follow a helical path of any desired pitch.

Experience has shown that the results are obtained by elevating the mass of coal and slate less than a height sufficient to break the slate on falling, while the length of the cylinder should be such as to retain the material fed into it in action for sufficient length of time to complete the disintegration and round the hard pieces of coal.

The subsequent separation of the more compact and hard pieces of coal which have been rounded by the present process may be

performed in the machine described in the aforesaid Letters Patent, and hence needs no further description herein.

To carry out the process of the present invention with a tumbling cylindrical screen the cylinder must be relatively long and of relatively small diameter in order to obtain the results sought. To give a better understanding of the proportions it may be stated that a cylinder, between the end rings 2, of about twenty feet in length with an internal diameter of about thirty inches and an inclination of about one-fourth of an inch per foot, is about right for Pennsylvania bituminous coal, and the perforations may run about sixteen per linear foot with the high points caused by the indentations spaced about three inches from center to center. The lip or bevel 6 along one edge of each section of the screen or jacket is but very mild and is designed to turn over the mass of material a suitable number of times during each revolution, and since in the particular structure shown in the drawings there are three plates circumferential to the screen between adjacent rings 2, the material being acted upon is agitated three times by these mild baffles.

In the present arrangement the material is raised by the machine to a point where the angle of repose is slightly exceeded, whereupon the pieces of the material tumble down one over the other and by attrition and impact reduce the coal, but the distance of fall is too short to cause the force of the impact to break the slate. The tumbling action in addition to the sidewise rolling imparted to the pieces of coal as they tumble down inside of the rising run of the cylinder imparts the spherical form to the pieces of coal, so that these balls of coal will roll ahead of the angular pieces of slate and the latter, which are carried to the highest point, will, on striking the pieces of coal, cause a further disintegration of the coal and also avoid any sudden impact of slate upon the jacket or screen itself. While a quarter inch inclination to the linear foot has been found to answer for certain varieties of coal, this inclination may vary in practice from one-eighth of an inch upwardly, so long as the time of travel through the cylinder is not too greatly shortened.

While the process has been described more or less in detail in connection with soft or bituminous coal, it is of value in disintegrating other soft materials mixed with harder materials which it is desirable should be separated from the soft material, but bituminous coal may be taken as typical of any suitable material of like character to which the process is adapted and the term bituminous coal is to be understood as covering other materials of like characteristics so far as this process is concerned, and the term slate is to be understood as covering any material of similar characteristics with reference to the coal or other similar material.

While former processes of separating slate and coal are more or less wasteful, and some quite markedly wasteful, the present process is characterized by a practically complete elimination of the slate from the coal and a retaining of practically all the coal treated, so that the waste is negligible and the clean coal is sensibly free from slate.

What is claimed is:—

1. The process of treating soft or bituminous coal containing slate, which consists in elevating a mass of such coal and slate to a height above the angle of repose to cause the friable portions of the mass of coal rolling downward over the rising portion of the mass to disintegrate by concussion and attrition, but insufficient to disintegrate the harder lumps of coal and the slate, and at the same time imparting to such harder lumps of coal movements lateral to the direction of movement due solely to the action of gravity to cause a rounding of such lumps of coal.

2. The process of treating soft or bituminous coal preparatory to the separation of slate therefrom, which consists in disintegrating the more friable parts of the coal and rounding the harder lumps of coal by causing the mixture to roll downwardly at an angle from a height sufficient to disintegrate the friable coal and at the same time imparting to the harder lumps of coal movements lateral to the direction of fall to cause rounding of such lumps of coal.

3. The process of treating soft or bituminous coal containing slate preparatory to the separation of slate therefrom, which consists in tumbling the mixture of slate and coal from a point above the angle of repose sufficient to cause the higher parts of the mass to roll down over the rising portions of the mass, such height of elevation being also sufficient to disintegrate the more friable parts of the coal without like effect upon the slate and harder lumps of coal, and at the same time imparting a sidewise agitation to the harder lumps of coal to shape such lumps into rounded or spherical form.

4. The process of dry treating soft or bituminous coal containing slate preparatory to the separation of slate therefrom, which consists in disintegrating the more friable parts of the coal and removing it from the slate and the harder lumps of coal and at the same time causing movements of the harder lumps of coal to impart a rounded or spherical form thereto.

5. The process of dry separation of slate from bituminous coal, which consists in disintegrating the more friable parts of the coal without affecting the slate, rounding the harder parts of the coal without affecting

the slate, separating the disintegrated coal from the slate and rounded lumps of coal, and then separating the rounded lumps of coal from the slate.

6. The process of treating soft or bituminous coal for the dry separation of slate therefrom, which consists in tumbling the mixture of coal and slate to cause disintegration of the more friable parts of the coal, separating the disintegrated coal from the remainder of the mass, and at the same time rounding the harder parts of the coal by imparting thereto motions in other directions than that due solely to the action of gravity, and finally separating the rounded lumps of coal from the slate.

7. The process of treating soft or bituminous coal preparatory to the separation of slate therefrom, which consists in continuously elevating the mass of coal and slate and allowing it to roll back to a lower level by gravity, the lifting of the mass being to a height ineffective to the slate or to cause disintegration of the harder lumps of coal, removing the disintegrated coal from the mass, and at the same time rounding the harder lumps of coal by imparting thereto movements in other directions than that caused by gravity alone.

8. The process of treating soft or bituminous coal containing slate, which consists in tumbling the mass to an extent to disintegrate the more friable portions of the coal and at the same time be ineffective to the slate, removing the disintegrated coal from the mass, rounding the harder lumps of coal by tumbling them with the slate and imparting to such harder lumps a rolling movement in a direction lateral to that imparted to the mass, and finally separating the rounded lumps of coal from the slate.

9. The process of treating soft or bituminous coal for the dry separation of slate therefrom which consists in causing the disintegration of the more friable parts of the coal by attrition and impact less than that active to the slate, rounding the harder lumps of coal by attrition and impact less than that active to the slate, and finally separating the rounded lumps of coal from the slate.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

WALLACE SHAW AYRES.

Witnesses:
GEO. H. MARTIN,
C. F. REICH.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents Washington, D. C."