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APPARATUS FOR SEPARATING MATERIALS

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Fig. 1.

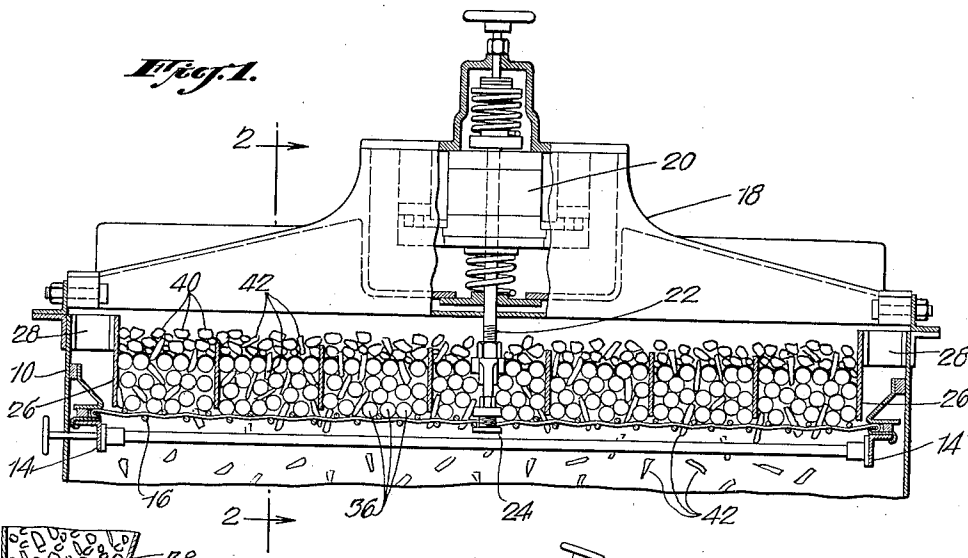


Fig. 2.

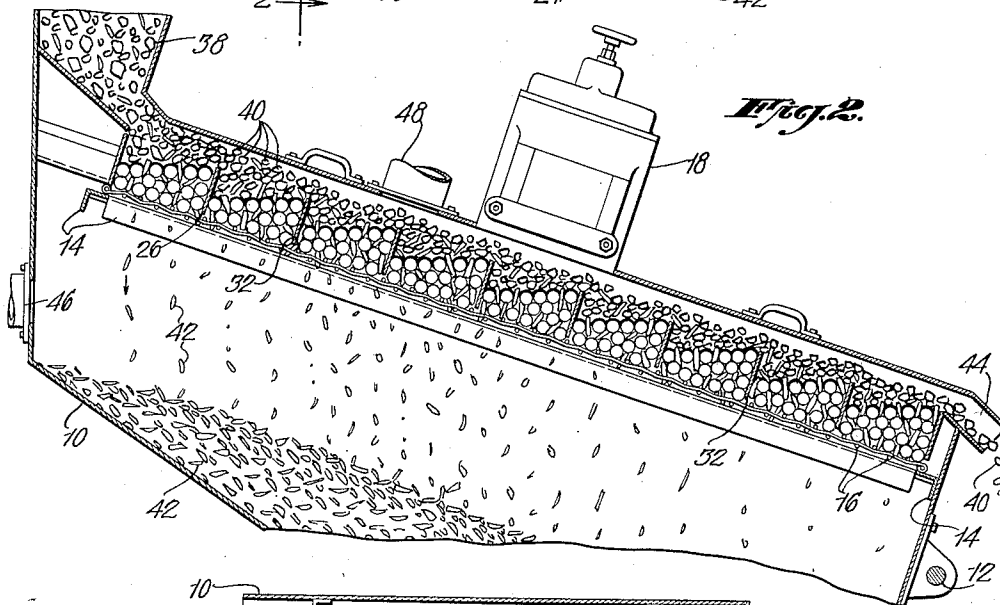
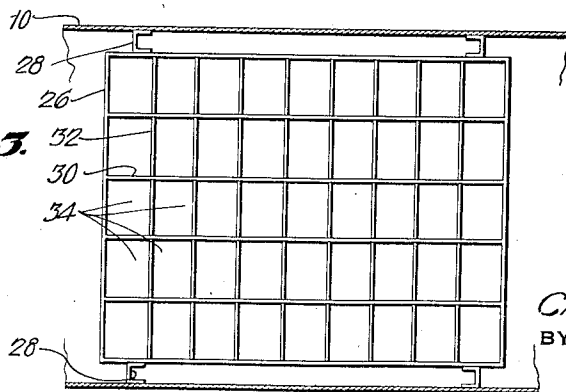


Fig. 3.



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APPARATUS FOR SEPARATING MATERIALS

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5 Claims. (Cl. 209—44)

This invention relates to improvements in separating apparatus. While not limited thereto the invention is particularly adapted for the separation of slate and other impurities from coal.

Heretofore, coal has been separated in one general type of apparatus known as a coal washer jig by subjecting the mixed materials to the action of an agitated body of water. Other types of separators depend upon the frictional characteristics of coal and slate traveling from inclined or spiral chutes. The hydraulic separators require great quantities of water for their operation and the friction separators are not entirely satisfactory on small sizes.

For several years past, there has been an effort on the part of those interested in the industry to get away from the necessity of using water as a medium for separating the impurities from the coal. The necessity of fine crushing in order to part the impurities from the coal before washing is becoming more and more accentuated due to the fact that larger tonnages are produced from the various mines, tending to dirtier loading of coal and also because the better coal fields are rapidly being worked out. This in turn makes the problem of drying the coal after washing more difficult since fine coal holds moisture more tenaciously than coarser coal, and the moisture is very detrimental to coking operations particularly in the modern by-product oven. Engineers and others interested in these problems have therefore turned their attention to dry cleaning of coal, using air as a medium instead of water in order to facilitate the separation of impurities and coal. This presents many disadvantages as is well known to those versed in the art, such as the production of great quantities of dust, the handling of which presents a problem of its own, and also due to the uncertainty in the action of air which is an elastic medium expensive to produce and control.

To those versed in the art, it is known that in order to obtain a fair separation of impurities and coal, sizing must be applied and well known laws govern the limits between which a fair separation can take place on material of different specific gravities. When cleaning coal, these limits are narrow due to the slight difference in specific gravity between the coal and the slate, and with finer crushing sizing difficulties are rapidly multiplied as the size of the particles diminish.

I have observed that if materials of approximately the same size but of unequal weight are subjected to a vibratory or shaking motion in a

confined space the heaviest pieces will find their way to the bottom and the lighter pieces will remain on the top of the mass.

This phenomenon is made use of in certain types of coal washers wherein water is used as a medium by which the particles are separated due primarily to the induced currents in the water.

My improved apparatus embodies a similar principle but contemplates the separation of impurities from the coal or other materials without the use of water. In fine, an object of my invention is to separate materials by a dry method. In order to carry out this method, I have been presented with a number of problems, one of which was the necessity of finding some means of in effect changing the consistency of the material to be separated from that of a solid to a fluid. Or, in other words to make the action of the various dry particles resemble the action of the various particles when subjected to immersion and currents of water as in known types of coal washers.

An apparatus adapted to attain this end and embodying other features of my invention is illustrated in the accompanying drawing, in which—

Fig. 1 is a transverse section through one form of separator;

Fig. 2 is a longitudinal section thereof on line 2—2 of Fig. 1;

Fig. 2 is a plan view on a reduced scale showing part of the apparatus detached.

Referring in detail, the apparatus consists generally of a substantially rectangular casing 10 mounted on suitable adjustable supports 12 so that its angular inclination can be varied. Supported within the casing is a frame 14 to which is secured a screen 16 of known construction adapted to be put under a high degree of tension, for example, similar to that of a drum head. Located in a housing 18 is an electromagnetic vibrating mechanism 20 of known construction arranged to transmit an extremely rapid or high frequency vibrating motion through the bar 22 to the tension screen 16, the bar being connected by suitable clamping bolts and washers, as shown at 24. The apparatus thus far described is a known type of vibrating screen similar in construction to what is known in the trade as the "Hum-mer electric screen".

My improved apparatus for carrying out the method contemplates supporting a bed of filtering material on a vibrating screen and in the provision of means whereby the filtering material or particles are prevented from traveling

along the screen. As shown in the drawing, I provide a frame 26 which is supported by brackets 28 which in turn are secured to the casing 10. The frame 26 is formed with a number of longitudinal and transverse walls 30 and 32, respectively, which divide the frame into a plurality of separate compartments 34. The arrangement is such that the screen can vibrate without interference with the frame. Within the compartments 34 and supported by the vibrating screen is a mass or body of separate pieces 36 which in effect form a filter bed. This filter bed may be composed of irregular pieces of material or, as shown, of uniform pieces such as balls of aluminum, common glass or various other substances. The pieces, whether they be irregular in shape or of spherical shape, are of such a size that they cannot pass through the mesh openings of the screen. They are also, preferably, of a weight or specific gravity between that of the pure coal and that of the refuse. If made of glass balls, they can be made hollow so as to combine a certain size with the most suitable weight.

In operating my apparatus, the mixture of coal and impurities is fed in through the hopper as at 38 and deposited on the filter bed composed of the multiplicity of pieces 36. The high frequency vibration of the tensioned screen causes the mixed materials to spread out over the surface of the filter bed. Due to the difference in specific gravity of the coal and slate and other impurities, the coal, as indicated at 40, being lighter, rides on the upper surface of the filter bed and the slate 42 and other heavy impurities work their way downward through the interstices between the filter particles 36 and are discharged through the mesh openings in the screen. The extremely high frequency vibration of the tensioned screen imparts a tremor to the multiplicity of filtered particles. These many pieces jostle the mixed materials and assist in working the heavier particles downward toward the discharge surface of the screen. The lighter and clean coal may be said, figuratively speaking, to float in a thin layer on top of the tremoring or vibrating filter bed. Due to the inclination of the screen, this pure coal gradually works toward the chute 44 which discharges into a suitable bin or other receptacle not shown.

In treating some classes of material and particularly certain mixed materials of very small size, I may, if desired, use air currents preferably pulsating, to augment the separating action of the vibrating filter bed. To these ends, I have indicated conventionally an air inlet pipe 46 which may be connected to a suitable blower not shown for forcing air upward through the meshes of the screen and the filter bed. Or, alternatively, I may exhaust the air through a pipe 48 connected with a suitable exhaust fan or pump not shown. With the latter arrangement, it will be appreciated that the air sucked through the screen and the interstices between the filter particles will assist in the separating action and that the dust carried in suspension can be readily disposed of.

The rate of vibration and amplitude thereof may be varied to suit different materials being treated. I have found for treating certain classes of coal that vibrations of a sixteenth of an inch at the frequency of two hundred per minute produces good results.

This high frequency rate of vibration of an amplitude of the order of $\frac{1}{16}$ of an inch is to be

distinguished from the shaking action which is secured by merely reciprocating members at a low rate of speed by the use of cranks, eccentrics and the like. Where a vibration of high frequency and low amplitude is referred to herein it is to be understood that this differs from the effect which will be secured by shaking screens or the like and the high frequency low amplitude vibration in accordance with my invention is preferably effected by imparting a vibratory motion to a screen maintained relatively taut or in a high state of tension.

From the foregoing, it will be clear that the invention provides a novel method for separating materials of different specific gravities by subjecting the mixed materials to vibration on a bed of intermediate particles which may be said to filter out the heavier class of material from the lighter class determining the points of discharge of the different classes. While I have referred specifically to the separation of slate and other impurities from coal, it is clear that the method and apparatus disclosed may be effectively used for treating other substances such as graphite, phosphate, rock, etc., by utilizing the vibrating mass of intermediate filter particles to cause a stratifying of the materials being separated.

Though I have described with great particularity a specific method and apparatus, it is not to be construed that I am limited thereto as various modifications may be made by those skilled in the art without departing from the invention as defined in the appended claims.

What I claim is—

1. The separating apparatus of the class described comprising an inclined material separating screen maintained under tension, means for imparting low amplitude high frequency vibrations to said screen, means providing a plurality of separate compartments above said screen and respective masses of filter particles in said compartments.

2. An apparatus for separating materials including an inclined material separating screen maintained under tension, means for imparting a high frequency vibration thereto, means defining a plurality of compartments in juxtaposition above the screen and a multiplicity of balls in said compartments adapted to permit the passage therethrough of one class of material and to support the other class of material in a plane spaced above the surface of the screen.

3. Apparatus for separating materials including a material separating screen maintained at drum head tension, means for imparting a high frequency vibration thereto, a filter bed on the screen comprising a multiplicity of glass balls adapted to permit the passage therethrough of one class of material and to support another class of material in a plane spaced above the surface of the screen.

4. Apparatus for separating materials including an inclined material separating screen maintained under tension, means for imparting a high frequency vibration thereto of the order of 200 impulses per minute at an amplitude of approximately $\frac{1}{16}$ of an inch vibratory movement, a filter bed on the screen comprising a multiplicity of hollow balls adapted to permit the passage therethrough of one class of material and to maintain the other class of material in a plane spaced above the surface of the screen.

5. Apparatus for separating materials including an inclined material separating screen main-

5 tained under tension, means for imparting a high frequency vibration thereto of the order of 200 impulses per minute at an amplitude of approximately $\frac{1}{8}$ of an inch vibratory movement, a filter bed on the screen comprising a multiplicity of hollow balls adapted to permit the passage

therethrough of one class of material and to maintain the other class of material in a plane spaced above the surface of the screen and means for passing a current of air through the screen to augment the separating action.

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5