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H. BRADFORD.

Separators for Coal, Ores, &c.

No. 143,219. Patented September 30, 1873.

Fig. 2.

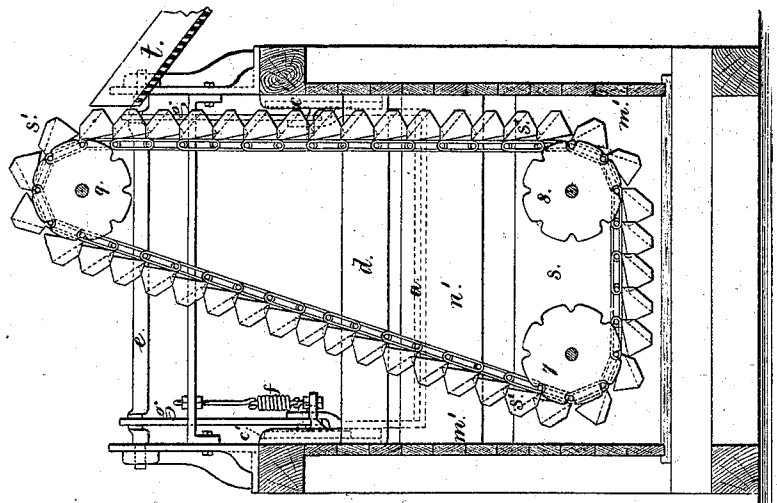
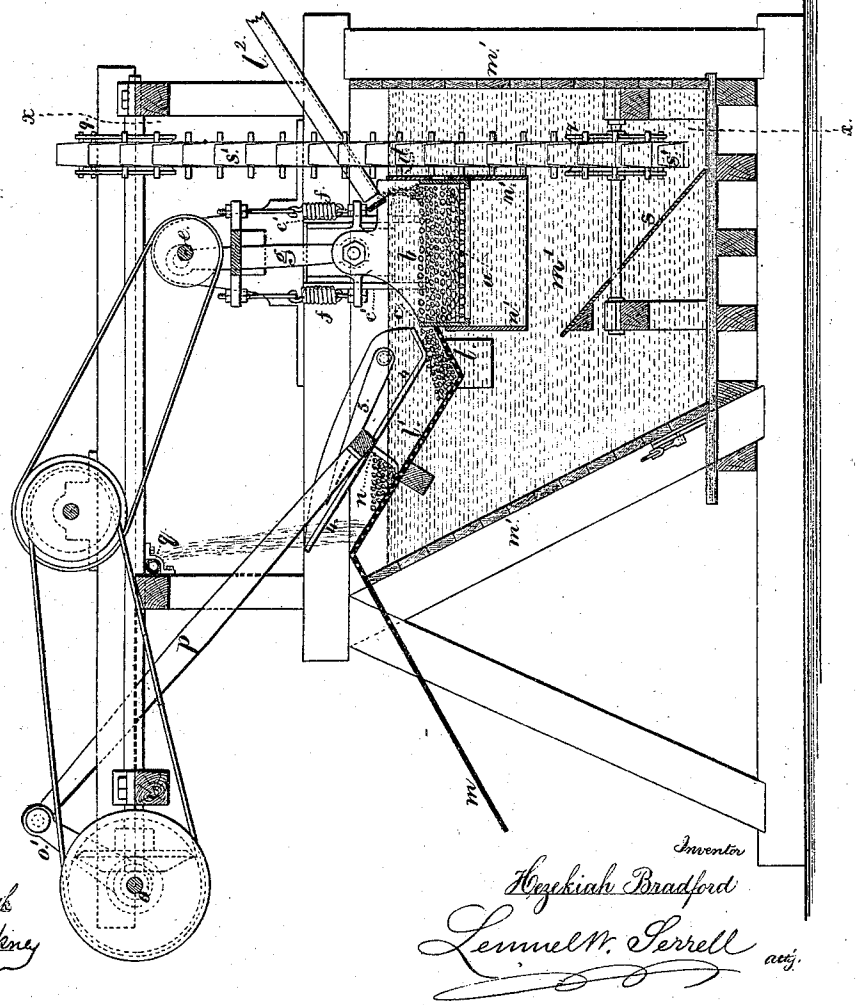


Fig. 1.



Witnesses
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AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS)

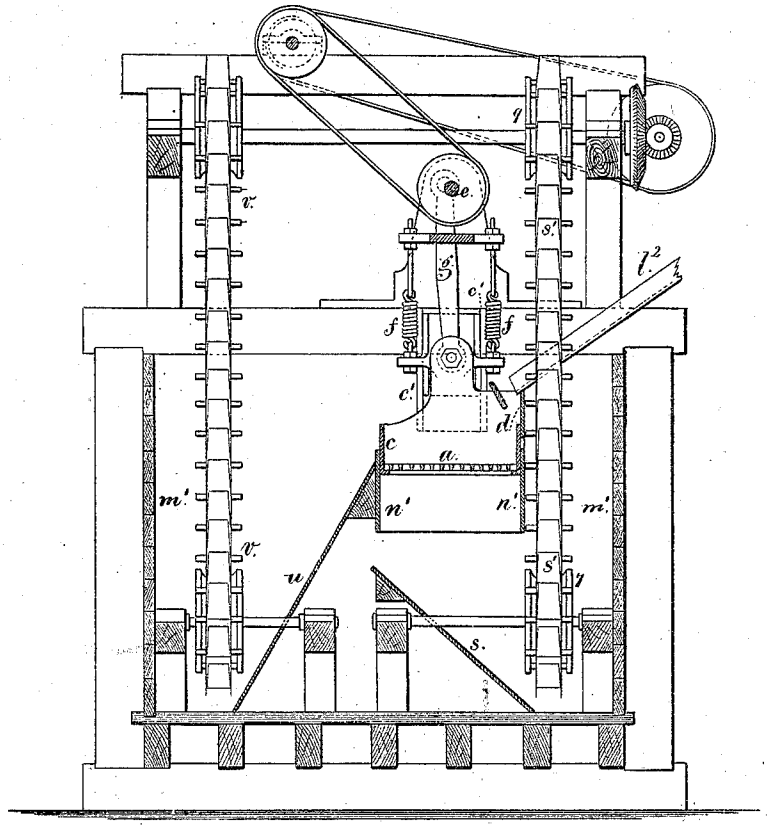
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Fig. 3.



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UNITED STATES PATENT OFFICE.

HEZEKIAH BRADFORD, OF READING, PENNSYLVANIA.

IMPROVEMENT IN SEPARATORS FOR COAL, ORES, &c.

Specification forming part of Letters Patent No. **143,219**, dated September 30, 1873; application filed February 1, 1873.

To all whom it may concern:

Be it known that I, HEZEKIAH BRADFORD, of Reading, in the State of Pennsylvania, have invented Improvement in Separators for Coal, Ore and other substances of different specific gravities, of which the following is a specification:

This invention is an improvement upon that for which Letters Patent were granted June 29, 1858, and duly extended; and my invention is intended especially for anthracite coal, but it may be used whenever available for separating substances of different specific gravities. In my present invention I make use of a rake that removes the coal or other material automatically as it is delivered from the jig, and at the same time the material is washed and the water is drained away from the same. The slate, bone, coal, or materials of greater gravity than coal, pass down through the jig into the appropriate division in the tank, and are removed by means of elevators.

In the drawing, Figure 1 is a vertical longitudinal section of said improved apparatus, and Fig. 2 is a cross-section at the line *x x*.

The jig is made with a perforated bottom, *a*, ends *b b*, and sides *c d*. The side *c* is the lowest, so that the lighter materials may pass over the same when the jig is vibrated vertically, as described in aforesaid patent. This side is made higher or lower, according to the size of the material operated upon, in order that the stratums of material may only be of the proper depth. In separating anthracite coal, stove or egg size, the height of the side *c* should be about four diameters of the pieces, and with smaller particles the proportionate height should be greater; in all cases the depth of the stratums should only be sufficient to insure a uniform action under the jigging motion. With other materials the depth of the stratums will vary according to the gravity and size of the pieces. It is preferable to make the jig-box of one casting, so as to be very strong, rigid, and durable, and that all the material therein contained shall have a uniform movement given to it. The jig is suspended by the adjustable springs *f*, so that the weight of the jig and its contents is nearly balanced, and these springs should be of uniform tension and so applied as not to produce any lateral action, and the connecting-rods *g* extend to the crank-shaft *e*, by which the reciprocating motion is given to the jig and its contents. The jig moves up and down perpendicularly in guide-slides *c'* that prevent lateral motion. I prefer to have the perforated jig bottom level, and the movement from the cranks uniform, or else the valves or material will be apt to pile up at one side or end, or the valves, or slate, or bone-coal will be liable to pass away with the lighter material that is delivered over the side *c* of the jig, or else the coal will pass down through the jig in places where the valves are deficient. If the valves are not in a uniform layer upon the perforated jig bottom the separation will be imperfect.

The valves that are employed above the perforated jig bottom, and the operation of the same in separating articles of different specific gravity, are described in the aforesaid patent, and in that granted to me February 27, 1872, No. 123,974.

In separating slate from anthracite coal it is important that the valves shall be of a gravity greater than the coal, or the lighter portion of the bone-coal or slate, and of less gravity than the heaviest portions of the slate. When the valves are flat or flattened spheres they can be of greater gravity than when spherical. In this manner the coal will not be wasted. It is also important that the amount of vertical jigging motion shall be proportioned to the sizes of the pieces of material operated upon. In separating the stove and egg sizes of anthracite coal the jigging motion should be about the same length as the diameter of the pieces to insure the best results; but with smaller pieces the movement is preferably more in proportion, and the number of reciprocations should increase as the distance of motion is lessened. The movements are to be greater and swifter with material of greater gravity, as the valves should subside before the upward movement again commences.

The holes in the perforated jig bottom are to be only large enough to allow the material operated upon to pass through freely, and the valves are only of a size to close these openings reliably; thereby the jig bottom can be made to contain as many holes as possible,

and the valves are as near the size of the pieces of material operated upon as circumstances will allow.

The water is to stand at a level in the tank or box sufficiently high above the material in the jig to properly regulate the delivery of the coal over the edge of the jig, because when the water only just covers the coal in the jig the water rushes off as it is pumped up by the jigging motion with greater impetuosity than it does when there is considerable depth of water above the level of the coal in the jig; hence in one case the water will carry away the coal or other material more rapidly than in the other case. It is preferable to extend the sides of the jig-box down below the perforated bottom to a sufficient depth to confine the necessary body of water to act upwardly to raise the material in the jig as the same descends; but when this downward extension makes the jig too heavy, or interferes with the uniform upward movement of the water through the jig, a stationary box may be used below the jig-box, and the jig be moved up and down within this stationary box. To further lessen the weight of the jig-box, a stationary extension of the side *d* may be employed, the same rising above the jig-box itself, up a little above the level of the water. This is available with material of large size, but with small sizes this side of the box should be in one piece extending up above the water-level. In order to remove the coal or other lighter material that flows over the side *c* of the jig, I make use of a receptacle, *l*, which is perforated to allow the water to pass away freely. The perforated incline l^1 rises above the water-line and connects with the delivery-chute *m* to the cars. A rake, *n*, is employed to draw the coal up the perforated incline l^1, and this rake is operated by suitable mechanism, preferably by the shaft *o*, cranks *o'*, and connecting-rods *p*, the shaft *o* being revolved by suitable power. The rake is to be raised in passing back over the coal, and then dropped behind or upon the same at the lower end of its movement. As a convenient mode of accomplishing this motion, I extend the ends of the rake-heads so that they travel upon the ways 4, as the rake and coal are drawn up the incline. In this movement the ends pass under the pawls 5 and lift them. These pawls, dropping after the rake has passed, form the ways upon which the rake-head moves back over the coal, and then drop behind or upon the coal at the lowest end of the incline. It is preferable to introduce the supply of water by a perforated pipe, *q*, near the upper end of the incline, so that the water running upon the coal or other material as it is raked up the incline out of the water, will be washed or rinsed off previous to delivery to the chute leading to the cars, and the incline at this point, being perforated, allows the water to run through into the vat containing the apparatus. The coal is supplied by the incline l^2, and at the bottom end a deflector may be used that arrests the movement of the material and deflects it toward the side *d* of the jig.

I here remark that the fine particles of anthracite coal are usually regarded as refuse, and can be removed from the vat *m'* by the same elevators that take away the slate or bone-coal; therefore the perforations in the incline l^1 are to be of a size to allow these small pieces to pass through with the water that rushes over from the jig. I have, however, shown a means for separating the larger particles of coal from the fine dust, which I will hereinafter describe.

The incline *s* below the jig causes the slate, bone-coal, or heavier substances that pass through the jig to be delivered in the path of the elevator-buckets *s'* that are upon an endless chain or belt that passes around the pulleys 7 8 9, so that the buckets act as scrapers to remove the substances along the bottom of the incline *s*, and convey the same up to the chute *t*.

By this construction the vat is kept free from the accumulations of the different substances that are separated, and, by using the two pulleys 7 and 8, the elevator scrapes up the material across the entire width of the jig, rendering end inclines unnecessary, and lessening the depth of the vat containing the water. But little water is required, the operation is continuous, and no interruption occurs for emptying any portion of the apparatus.

In the apparatus patented, as aforesaid, the rush of water and surface agitation were liable to interfere with the perfect separation according to the specific gravity.

In the present device the stationary box *n'* in which the jig moves incloses sufficient water to enforce a uniform and regular action of the water on the material that is being separated. I also remark that the return circulation should be sufficiently free to prevent the water at the delivery side of the tank accumulating and being higher than at the other side of the tank.

In operating upon bituminous coal for the removal of pyrites and other foreign substances, also in operating upon ores and other substances of different specific gravity, it often is necessary to grind, break, or crush the substance comparatively small, in which case the rake, described as aforesaid, would not operate to advantage. I therefore make use of two elevators, as seen in the section, Fig. 3, where the material as delivered from the jig runs down the incline *u*, and is removed by the chain of buckets *v*, or the substances may be delivered at the bottom of the receptacles in the tanks through gates as the separated substances accumulate. Where the fine particles passing with the water over the front of the jig, or through the perforations of the incline, are, like the heavy particles that pass down through the jig, of no value, as is generally the case with anthracite coal, the circulation of water necessary to supply the pumping operation of the jig may pass down through the

incline and through the aperture into the other portion of the tank, and any particles carried with the water in that way will do no injury; but where it is desired that the substances passing down through the jig-box should be kept entirely separate and distinct from what passes over the front of jig-box, care should be taken that the water returns to the back division only after the floating particles have subsided. In that case the water-tank can be made large enough to allow the substances in the water to settle before the water passes by suitable channels near the water-line at the ends of the jig back to the other portion of the tank. This is especially desirable in the separation of bituminous coal from slate and sulphur, and iron ore from its gangue.

It is to be understood that some of the devices herein described may be used in cases where the jig stands still and the flow of water is in pulsations upwardly through the jig, as set forth in the aforesaid Letters Patent.

If the vibrating jig-box is made of several pieces it is impossible to unite them, so that there will not be more or less looseness and inequality of movement under rapid reciprocation. I prevent this by casting the moving jig-box and the connections upon the same all in one piece, together with the supports that are required for the removable and changeable perforated bottom; thereby the action will be rendered reliable and uniform throughout, even with the finest material and shortest reciprocating motion.

If the pieces of material operated upon vary considerably in size, the separation will not be as perfect as it will where the size is nearly uniform. This results from the fact that the extent of motion and number of reciprocations given to the jig, the depth of the stratums and of the water at the delivery edge, the size of the valves and of the openings in the jig bottom, all have to harmonize to produce the most perfect separation; hence this harmony is disturbed where the material is not properly assorted in size previous to reaching the machine.

I claim as my invention—

1. A delivery-incline, *l*, and rake *n*, combined with the jig, substantially as set forth.

2. A perforated delivery-incline and rake or elevating mechanism, in combination with the said jig and a water-supply acting to wash the material as delivered, substantially as set forth.

3. Elevating-buckets passing around pulleys in the tank *m'*, in combination with the jig, and an incline to direct the material that is separated into the path of the buckets, substantially as set forth.

4. A jig, with a perforated bottom and valves to which a reciprocating motion is communicated, of a length proportionate or about corresponding to the diameter of the pieces of material operated upon, substantially as set forth.

5. A reciprocating jig with perforated bottom and valves, in combination with a stationary box to confine the water below the jig-box, substantially as and for the purposes set forth.

6. The reciprocating jig-box and its connections cast in one piece, and provided with supports for the removable perforated bottom, substantially as and for the purposes set forth.

7. The method herein described of regulating the discharge of the material from the jig by varying the height of the water above the place of delivery, as set forth.

8. The method herein specified of separating articles of different specific gravity by screening or assorting the same in size previous to the jigging operation in water, in which the movement is proportionate to the size of the material operated upon, substantially as set forth.

Signed by me this 31st day of January, A. D. 1873.

HEZEKIAH BRADFORD.

Witnesses:
GEO. T. PINCKNEY,
CHAS. H. SMITH.