F. PARDEE.

SPIRAL SEPARATOR.

APPLICATION FILED APR. 11, 1910.

977,037. Patented Nov. 29, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

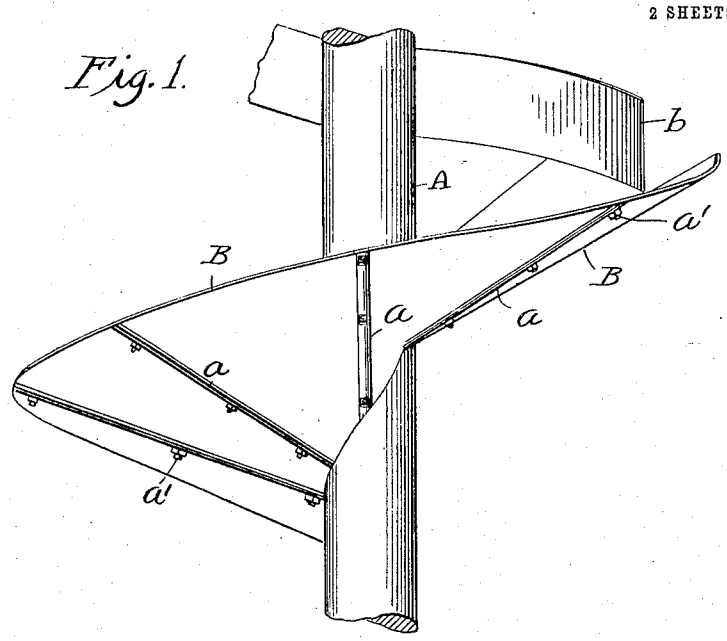
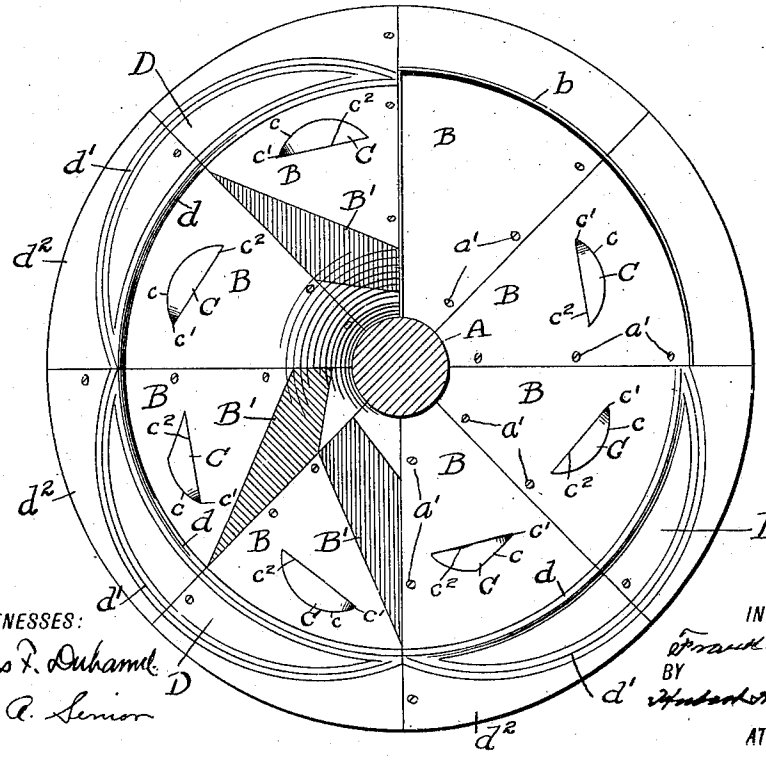


Fig. 2.



WITNESSES:

James F. Duhamel

Geo. A. Senior

INVENTOR

Frank Pardee

BY

Howard A. Banning Jr.

ATTORNEY

F. PARDEE.

SPIRAL SEPARATOR.

APPLICATION FILED APR. 11, 1910.

977,037.

Patented Nov. 29, 1910.

2 SHEETS—SHEET 2.

Fig. 3.

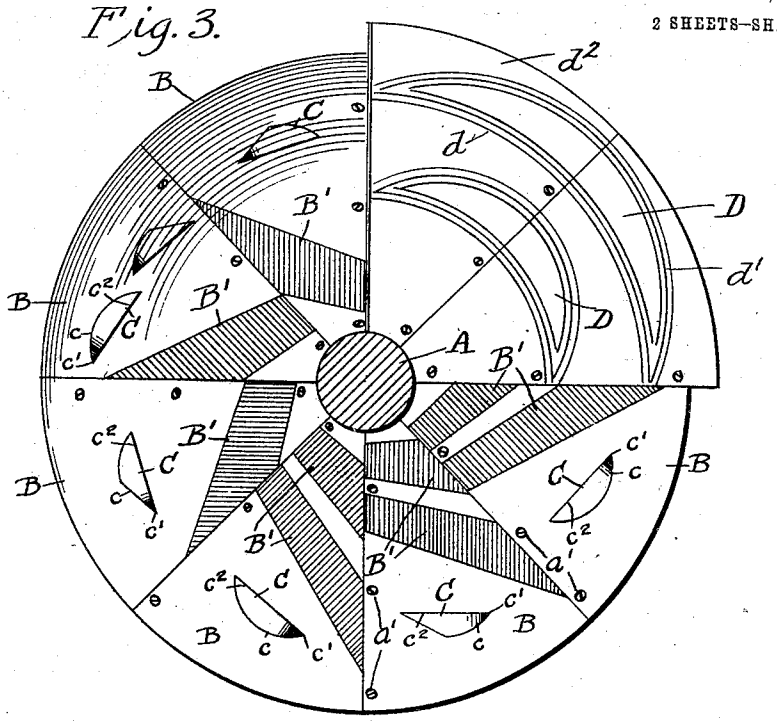
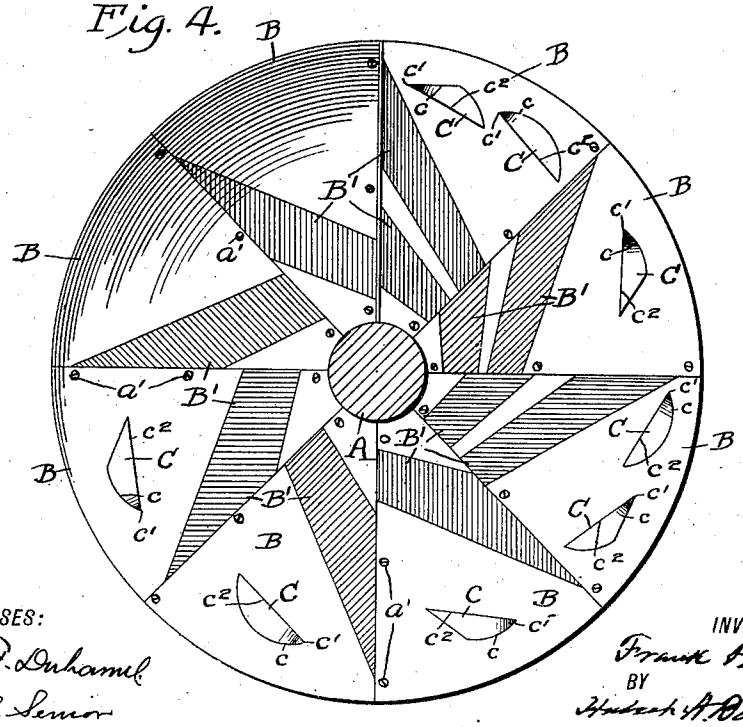


Fig. 4.



WITNESSES:

James D. Dukamel

Geo. A. Senior

INVENTOR

Frank Pardee

BY

Hudson & Banning

ATTORNEY

UNITED STATES PATENT OFFICE.

FRANK PARDEE, OF HAZLETON, PENNSYLVANIA, ASSIGNOR TO ANTHRACITE SEPARATOR COMPANY, A CORPORATION OF PENNSYLVANIA.

SPIRAL SEPARATOR.

977,037. Specification of Letters Patent. Patented Nov. 29, 1910.

Application filed April 11, 1910. Serial No. 554,874.

To all whom it may concern:

Be it known that I, FRANK PARDEE, a citizen of the United States, residing in Hazleton, county of Luzerne, and State of Pennsylvania, have invented certain new and useful Improvements in Spiral Separators, of which the following is a specification, reference being had to the accompanying drawings.

The invention relates to that class of separators which are shown and described in the series of patents issued to me on July 25th, 1899, as combinedly utilizing gravity, friction and centrifugal force, for differentially acting on and sorting the mixed materials while passing along the spiral runways, or floor of the machine.

The speed of a body acted on solely by gravity, is accelerated at a definite rate during each second of the time of descent; but the force of gravity is nearly always resisted by other forces, tending to change the direction of movement or bring the descending body to rest. When acting upon a sliding body, or one which moves on an inclined plane, gravity has to contend with the result of friction, or frictional resistance. The friction, other things being equal, is proportionate to the weight of the moving body, and is greater when the body commences to move than after it has been moving for a time. In the operation of spiral separators centrifugal force is also acting and this force develops and increases in proportion to the square of the speed, other things being equal; and smooth light materials having less friction than rough heavier ones, come more readily under its power.

The principal mechanical features of the separators made under my earlier patents were the downward pitch for permitting gravity to act; the inward pitch, or outward and upward flare, to increase the frictional resistance of the heavier materials tending to move outwardly by a development of too much centrifugal force; and ridges or irregular retarding surfaces intended as additional guards against an outward movement of materials which should remain near the center. The coal being light and smooth, as compared with slate and bone, moved with more speed and was carried by the centrifugal force outside of the other materials, the spiral being provided with a peripheral retaining flange. The fundamental ideas embodied in such machines were on right lines, so far as they went, and the machines produced fairly good results, but did not act with the greatest possible practical certainty or efficiency.

In the practical construction and operation of spiral separators, the differential and modified action of the forces, their equilibrium, and potency or dominance as respects the substances acted upon, the structural features and condition of the plates of the spiral, the inherent properties and condition of the materials, together with their simple, resultant and reflected motions, actions and reactions, are, in some measure, to be anticipated, and should be suitably provided for, or guarded against, in one way or another or in several ways.

The object of the present invention is to construct a spiral which will possess the advantages of the machines heretofore made and other advantages.

The invention consists of a spiral separator having plate or jacket elements with varied degrees of inward inclination on radial lines, and retarders adapted to slow up and change the course of the contactual heavier materials, as hereinafter more fully described and pointed out, or indicated, in and by the claims.

In the drawings Figure 1, is an elevation of a part of the central or supporting post and shows some of the slate jackets at the upper end or top of the spiral. Fig. 2 is a plan view of eight jackets or plate elements completing one circle or turn going down from the top of the post. Fig. 3 is a plan view showing eight plate elements completing the second circle or turn, and Fig. 4 a plan view of the third turn of eight plates.

The drawings illustrate a spiral slate-thread having several forms of plate elements encircling a central post A, provided with supporting rods a, for receiving screws or bolts a^1, which also pass through the plates or jacket B, and secure them.

The mixed materials come down chutes in a coal breaker, and during the transit acquire speed or velocity before reaching the separator, but, as the breaker chutes are usually straight, there is no development of centrifugal force until after the materials enter the spiral. The original speed of the materials is checked to increase the frictional resistance and give them a proper turn at

the time of entering the spiral. The machine is usually fed by suitable attachments connected with the breaker supply chutes and with the upper or top plate. The speed of the entering materials may be checked by regulating the pitch of the feed-attachments or in other ways; but the slate-thread illustrated by the drawings, assumes no special form of feed-apparatus, and is such as to receive the materials well out on the top plate B, which with the next plate below it, is shown as having an outside flange *b*.

The illustration given is that of a slate-thread, for "stove" size of materials, composed of twenty-four plates having a downward pitch or drop of twenty-four inches in one turn or circle of eight plates around the central post. The top plate and the next or second plate each measure eighteen inches out from the post along the supporting rod *a*, and the second plate is provided with one retarder C, located on the bone runway. The retarder C may be of any shape or conformation, but is preferably of the form shown, which has a curved or partly curved outer contour *c*, adapted to exert an edge-friction on the heavier materials coming in contact with it. These retarders may also have a divider end c^1, and an inner edge contour c^2, preferably straight. The single retarder C, Fig. 2, on the second plate of the spiral distributes contactual materials so that they spread on the plate, but at this point some of the coal may be on the inside of slate and bone, and slate and bone may be outside of some of the coal.

The plates or jackets third to the tenth, counting from the top, measure twenty-two inches on the supporting rods, and make one turn, of that width, around the post. This greater width permits the materials to scatter and get well under the influence of the operating forces, so that the pieces of coal which are not impeded will quickly develop centrifugal force and be carried over the periphery to a coal-thread, not shown.

The first and second of these twenty-two inch jackets, that is the third and fourth plates of the spiral, have a graduated or varied outward flare, or inward pitch on radial lines, the variations being produced by a plane surface D, bounded by helical and elliptical curves *d*, d^1, starting on the third plate and terminating on the fourth of the spiral, the greatest divergence between the curves being over the supporting rod *a*, to which both plates are secured. The inner or helical curve *d* is usually struck from the face or upper side of the plate and forms a crease, while the elliptical curve d^1, is struck from the under side of the plate and presents a slight ridge on the face of the plate, adjacent to the warped coal surface d^2, which extends outward to the periphery.

The fifth and sixth plates of the spiral have a similar plane surface D, bounded by helical and elliptical curves *d*, d^1, and these plates each have an inserted or inlay piece B^1, of steel, which has or forms a plane or partly plane surface on the plate, not far from the central post.

The seventh and eighth plates of the spiral have like helical and elliptical curves, plane surface D, and a plane, or partly plane surface, on an inlay piece B^1, of steel, also near the axis.

The third plate of the spiral and each of the others down to and including the eighth, have a single retarder C, as shown in Fig. 2.

The ninth and tenth plates shown in Fig. 3, which are the last two of the series or turn of twenty-two inch plates have outer and inner helical and elliptical curves *d*, d^1, which bound included plane surfaces D, but these plates have no retarders, nor retarding surfaces other than those caused by the flare, by the plane and warped surfaces, and by the creases or ridges produced in forming the helical and elliptical curves, as stated.

The fourteen plates forming the remainder of the spiral, as shown by Figs. 3, and 4, measure twenty inches on the supporting rods. They all have a varied incline toward the axis caused by plane and warped surfaces on the jackets or on inlay pieces B^1, of different materials. Plates eleven to thirteen inclusive, may have an inlay piece B^1, of bronze and one of steel; plates fourteen and fifteen may each have one inlay piece B^1, of steel, and plate sixteen one inlay piece B^1, of bronze; plates seventeen to nineteen inclusive may each have one inlay piece of bronze and one of steel; plate twenty may have one inlay piece of steel, and plates twenty-one to twenty-four inclusive, may each have one inlay piece of bronze. These twenty inch plates may also have one or more retarders. Commencing at the eleventh and continuing to include the fourteenth, one retarder C, is shown on each plate; plate fifteen may have two retarders, plate sixteen, one retarder; plate seventeen, two; plate eighteen, one; plate nineteen, two, and plates twenty to twenty-two inclusive, may each have one retarder while the twenty-third and twenty-fourth have none.

The plane and warped surfaces by which the inward pitch or flare of the plates is graduated, modified, or changed, materially aid in keeping control over the speed of the slate and bone, and gradually act to divert them from a tangential to a helical or inward course. But the conditions vary both as to the plates, or jackets, and as to the materials to be separated. The plates when much used may become smooth; and plates little used or which remain idle for a time may rust; the materials may be dry or they may be wet. Changed condition is one of

the causes for erratic movements of slate and bone, which the retarders on the plates aid in correcting, without interfering with the proper movements and speed of the coal.

It is desirable that some of the retarders C, be located near the outer line of the bone runway, especially on the plates which do not have helical and elliptical curves. One retarder thus located on a plate will perform good service. The retarders act on contactual slate or bone to slow up such pieces, and the retardation changes their course under conditions with which other features of the plate elements may not be suited to cope.

Slate or bone having a strong tangential impetus, on coming in contact with a retarder will be given a reflected motion which turns it helically or inwardly, and gravity will then dominate. When the opposing forces are in equilibrium as respects any of the materials, they will pursue a helical course downward and keep to that course so long as the equilibrium continues to be fairly stable. The varied inclination or flare of the plates and the retarders, affect the slate and bone quite differently, under all conditions, from the actions observed in using the older, or earlier, forms of spiral.

The coal being dominated by centrifugal force, is drawn away from the heavier materials and passes, from different parts of the periphery, to the coal-thread before the run on the slate-thread is completed. The coal finally goes from the spiral to a pocket and is afterward drawn off into cars and inspected for the market.

The slate-thread shown and described, is one form in which the combined features of the plate elements and retarders, may be utilized in dealing with different kinds of materials or with the same kind under a changed condition. The elements, or the spiral as a whole, may be modified and yet have the advantages resulting from the combination of new or improved features with older ones entering into the structure. As already indicated there are certain physical laws in obedience to which the operative forces act on the materials. The spiral is designed to give to each operative force its due measure of power and a control of certain materials within given helical limits, along with greater differential certainty which may be ascribed to the means employed for correcting erratic movements. The structure as described is an example of what I regard as the best mode of applying the principle of the machine, though not as the only mode.

I do not herein separately claim plates or jackets having a graduated inward inclination, on radial lines, with inlay or renewable parts; nor plate elements having plane and warped surfaces and helical and elliptical creases; nor plate elements having any particular arrangement of retarders; nor retarders adapted to exert edge-friction on the contactual heavier materials. These several subjects-matter are more definitely embraced in four other and separate applications executed by me on even date herewith, and respectively filed herewith as Serial Nos. 554,870; 554,871; 554,872; 554,873; to which several applications reference is hereby made for greater certainty as to their respective subjects-matter.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A spiral separator having plate elements graduated with varied degrees of axial inclination along radial lines, whereby the general inclination is changed and runways are formed for materials differing in specific gravity and frictional resistance, said spiral being also provided with retarders adapted to slow up and change the course of contactual heavier materials.

2. A spiral separator having plate elements graduated with varied degrees of axial inclination along radial lines whereby the general inclination is changed, said elements having plane and warped surfaces and being also provided with retarders, whereby the varied surfaces and retarders form runways adapted for differential action on different materials.

3. A spiral separator having plate elements graduated with varied degrees of axial inclination along radial lines whereby the general inclination is changed, said elements having plane and warped surfaces, said elements being provided with retarding surfaces having creased curved perimeters by which the heavier materials may be retarded and guided helically and inwardly.

4. A spiral separator having plate elements on some of which the general inclination is changed by plane and warped runway surfaces, other plate elements of said spiral being provided with retarding surfaces disposed at intervals and approximately defining the runways for the different materials.

FRANK PARDEE.

Witnesses:
ANNA W. WETTERAU,
LILLIAN SAUNDERS.