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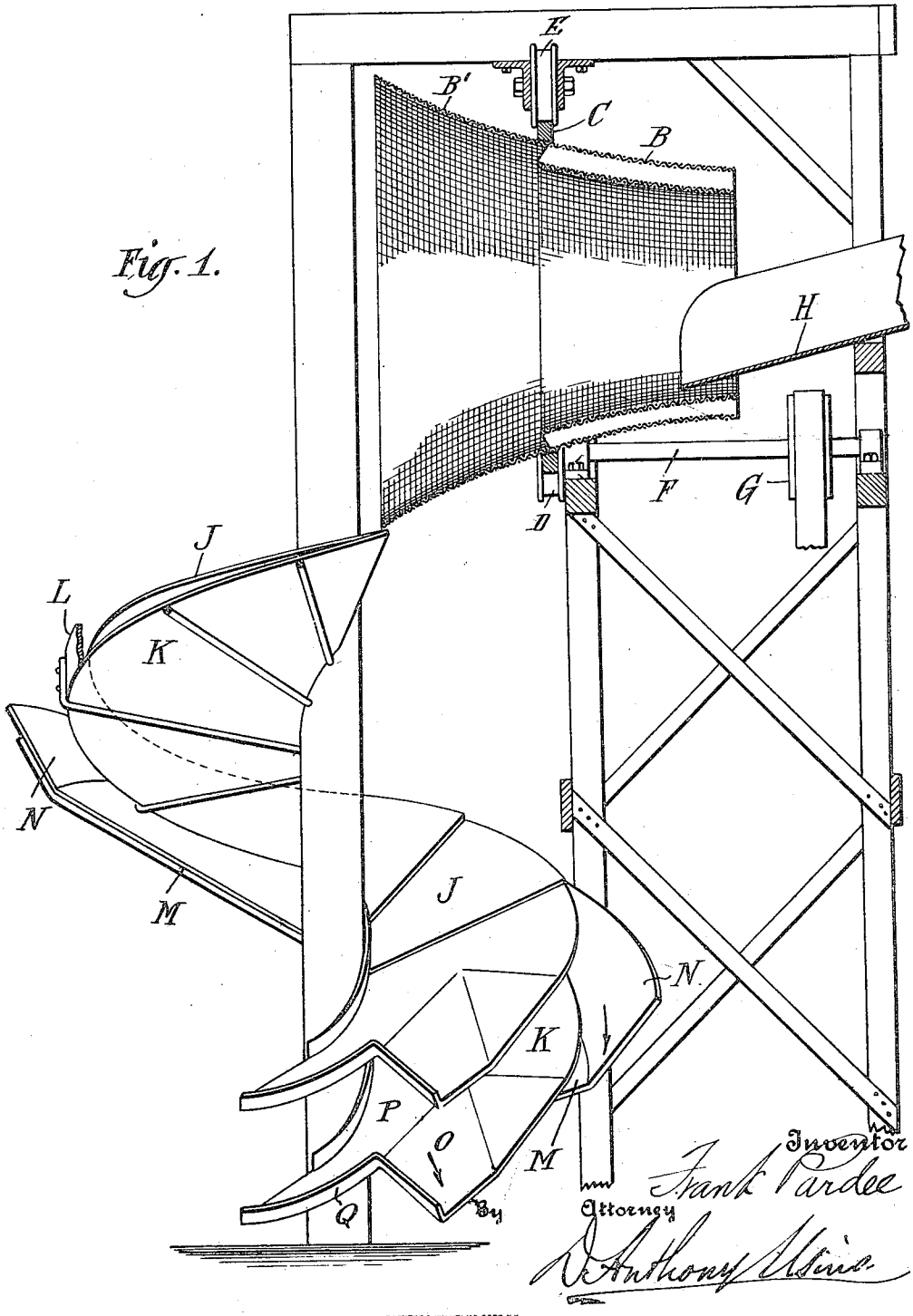
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1,259,435.

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4 SHEETS—SHEET 1.

Fig. 1.



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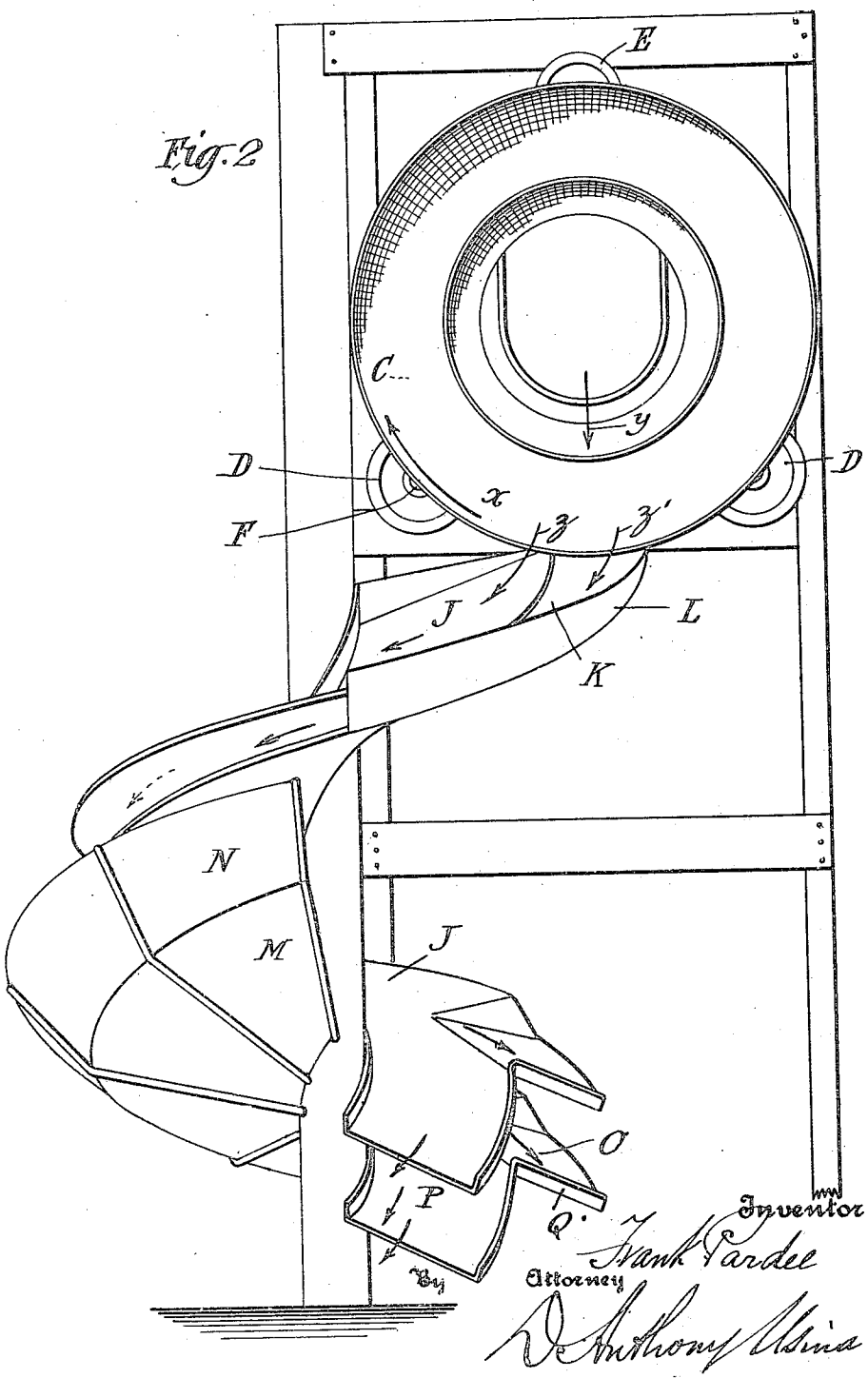
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4 SHEETS—SHEET 2.

Fig. 2



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4 SHEETS—SHEET 3.

Fig. 3.

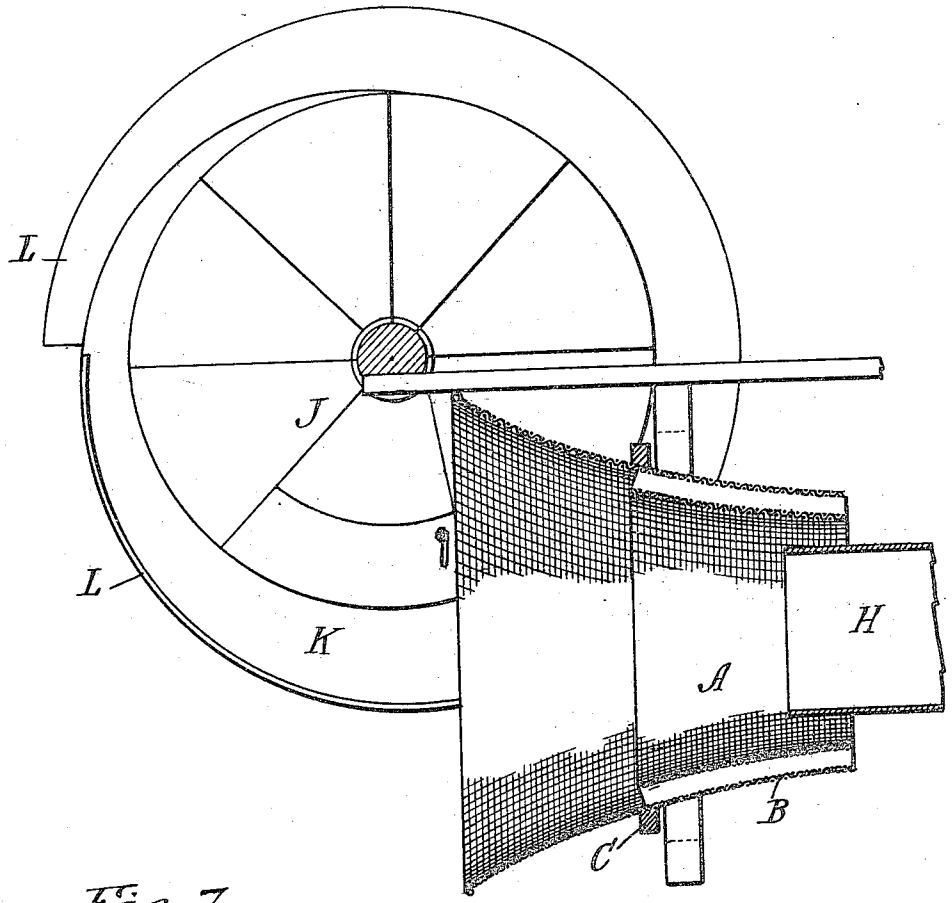
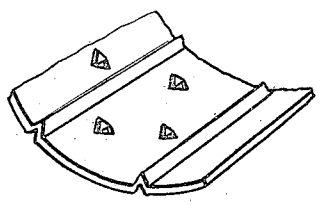


Fig. 7.



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4 SHEETS—SHEET 4.

Fig. 4.

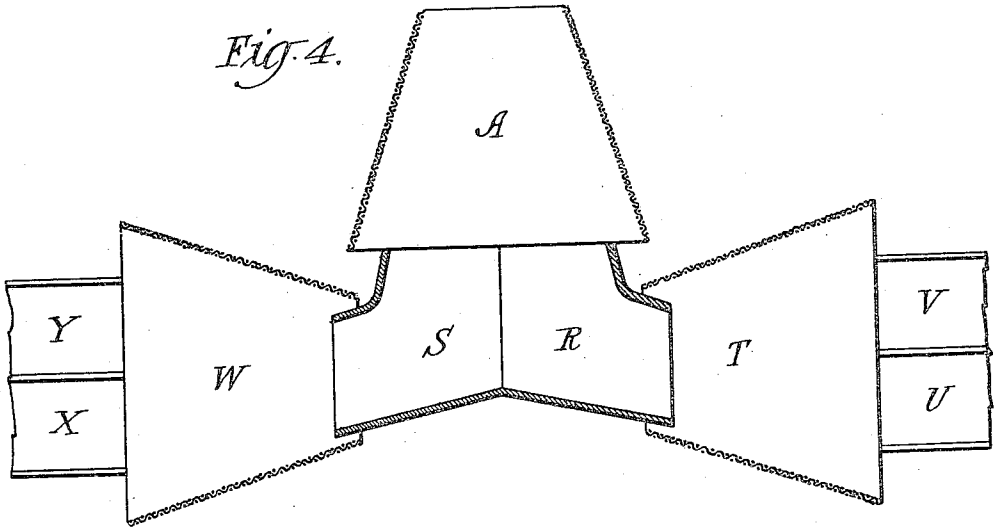


Fig. 5.

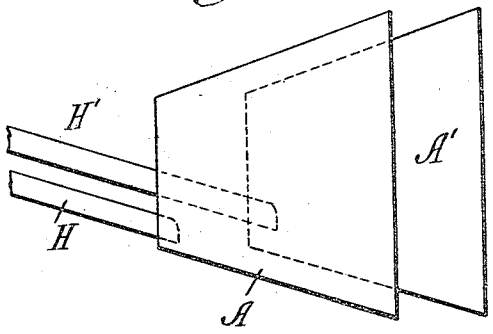
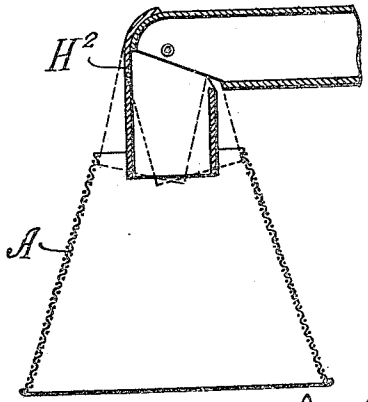


Fig. 6.



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1,259,435. Specification of Letters Patent. Patented Mar. 12, 1918.

Application filed August 22, 1917. Serial No. 187,509.

To all whom it may concern:

Be it known that I, FRANK PARDEE, a citizen of the United States, residing in Hazleton, Pennsylvania, have invented certain new and useful Improvements in Separators, of which the following is a specification.

My invention aims to provide an improved apparatus adapted for separating or classifying various materials and especially for effecting a separation between anthracite coal and the rock and slate which are mixed with it as it comes from the mines. For this purpose I use a rotating drum open at opposite ends for admission and discharge of the material.

Preferably the drum is cone shaped, though it may be of various other shapes in cross section and in longitudinal section and still serve in a greater or less measure to effect the desired separation as hereinafter described. The cone or rotating drum separator may be used to effect the entire separation desired or it may be used for only partial separation, the products therefrom being further separated in a subsequent separator. The accompanying drawings illustrate an embodiment of the invention, comprising the combination of a shortened spiral separator of known type with a drum or cone separator; and other embodiments hereinafter described.

Figure 1 is a side elevation showing the cone separator in longitudinal section;

Fig. 2 is a front elevation;

Fig. 3 is a plan with the cone separator in horizontal section.

Figs. 4, 5 and 6 illustrate modifications, Figs. 4 and 6 being longitudinal sections and Fig. 5 a side elevation.

Fig. 7 is a detail view showing a ribbed or roughened surface which may be used in the separating drum.

Referring to the embodiment of the invention illustrated, a double drum is illustrated consisting of an inner drum A and an outer drum B of woven wire, perforated sheet metal, or other reticulated metal, the two being rigidly fastened together and being concentric with each other, and the outer drum having a portion B′ which projects beyond the discharge end of the inner drum A. An annular rail C is attached to the drum and is engaged by three flanged rollers, a pair of bottom supporting rollers D and a top guide roller E, one of the rollers D being mounted on a shaft F which is driven by a belt pulley G (Fig. 1), so that the cone is continuously rotated. The smaller end of the cone is the admission end. The mixed coal and slate is fed thereinto from a chute H and is discharged from the larger end onto a spiral separator of known type having a double thread; an inner thread J for slate and an outer thread K for coal, the latter being formed with the outer flange L (which is partly broken away in the drawings for the sake of clearness).

The cone rotates in the direction of the arrow x, (Fig. 2). The lower portion of its inner surface is inclined downward, preferably on a curved line of gradually increasing descent as indicated. The inner surface, being a surface of revolution about a horizontal axis, will be trumpet shaped as shown, and the lowermost line will always lie in the same direction. The effect of feeding the coal and rotating the drum continuously is to pull the material sidewise and to give to the forces acting on it a lateral component which depends on the friction with which the particles engage the carrying surface. The friction of the slate being greater than that of the smooth hard coal, the slate will be deflected from the original straight direction y along which it enters and will be discharged in an oblique direction z while the coal will be deflected only slightly and will be discharged in a nearly straight direction z'.

The gradually increasing rate of descent (in a longitudinal direction) of the lowermost element of the inner surface of the drum produces a gradually increasing velocity of the material. The conical shape of the drum also produces a very rapidly increasing lateral pull on the material as it nears the discharge end. To get an increased rate of acceleration the drum may be flared to a greater extent, giving a more rapid lateral separating pull on the material; and the rate of advance in the axial direction may remain unchanged, using the lowermost element of the surface as the fixed line, and inclining the axis upward at its outer end. This is possible only within a limited range since under such circumstances the lateral movement becomes at the same time a partial backward movement. And, vice versa, the lateral component of the force exerted may be diminished by reducing the comparative diameter at the dis-

charge end until the surface becomes cylindrical, or even with a smaller discharge than admission end, maintaining the lower element fixed in the position required to give the necessary rate of descent. Conversely, while maintaining a certain desired lateral pull on the material, the forward component of the force may be determined as desired by inclining the lowermost element accordingly. Also instead of a true surface of revolution, such as the cones and cylinders above referred to, the surface may be pyramidal or that of a parallelepipedon or even an unsymmetrical surface giving an intermittently varying separating and feeding effect. And various expedients known in other apparatus in this art, may be adopted for increasing the grip of the material on the surface of the separating drum; such as punching, ribbing, and otherwise roughening the surface, as shown in Fig. 7.

In the construction illustrated the principal separation is performed by the outer drum B which by its reticulated construction gets a better grip on the particles and which is also the faster moving portion of the drum. This construction serves also to screen out any fine powder.

The feed to the cone may be of any usual or suitable type such as the ordinary shaking chute to insure a steady feed and a certain speed to the material entering the cone, and preferably a chute of adjustable type should be used so that for different materials the feed chute could be adjusted to give the speed which would insure the best separation in the cone.

With certain classes of material and in certain conditions, the cone separator illustrated makes an almost perfect separation. In other conditions the separation is not so perfect, the slate or refuse carrying with it more than a fair quantity of coal, and under these circumstances the cone separator should be supplemented by additional means acting at least on the slate or refuse and preferably on both the refuse and the coal, to effect a further separation. I have shown for this purpose a double spiral separator of known type. The combination of the drum separator and spiral separator can be made of much less height than a spiral separator alone designed to secure the same degree of separation; and this saving in head room is an important advantage of the combination.

Referring to Fig. 2, the coal discharged in the direction of the arrow z' travels down the spiral K, its smoothness and the centrifugal force serving to hold it on the upper outer portion of the spiral, and any particles of slate therein being retarded and dropping inward toward the center of this chute. The slate following the arrow z runs onto the inner inclined spiral chute J. In the course of its travel the particles of smooth coal carried along with it are gradually freed and thrown to the outer part of the chute, some of them going over to the edge and falling on to the coal chute.

The protecting flange L on the outside of the outer chute K extends only far enough to guard against the escape of particles which may be thrown against it by reason of their entrance velocity. When the coal has traveled about one-quarter turn along the spiral K the particles of slate mixed therewith, or particles of combined slate and coal, will go so slowly that there is no danger of their being thrown outward beyond the edge of the spiral. The particles of pure coal, however, will be thrown to the outer edge of the spiral, and the flange L is removed from this point down to the lower end. The particles of pure coal will then be thrown over the edge by centrifugal force and will drop onto a third spiral M with an outside flange N, this spiral extending about one-half a revolution as shown in Figs. 1 and 2 and discharging all its contents into a bin or other receptacle for pure coal. The spiral K has its lower end extended slightly beyond the spiral M and shaped to provide an outwardly and downwardly inclined surface O which will discharge coal into the proper bin and an inwardly and downwardly inclined surface P which will discharge slate into another bin, the end flange Q serving to prevent the coal from traveling farther along the spiral. The inner spiral J terminates a little shorter of the end of the spiral K and is similarly ridged to provide outwardly and inwardly inclined surfaces which guide the coal and the slate respectively onto the surfaces O and P of the spiral K and thence into the proper bins.

Instead of the spiral separator shown, separators of various other types may be used, for example, in Fig. 4 a pair of drum separators are used instead of the spiral separator shown in Figs. 1, 2 and 3. The first drum A discharges into the pair of chutes R and S, the former carrying material which is mostly coal to a secondary drum T where a further separation is effected and the material conveyed to coal and slate chutes U and V; and the second chute S conveying the material to a secondary drum W which effects a further separation and discharges into coal and slate chutes X and Y respectively. In some cases this combination of cones will effect all separation desired. In other cases, further separating operations may be necessary and for this purpose additional spiral or drum or other separators may receive the material from the secondary drums T and W or from either of these alone.

The material should be spread thinly on

the separating cone so that each piece will be in contact with the surface of the separator. In order to increase the capacity without taking up too much room two or more cones may be nested in each other as shown for example in Fig. 5, where the first cone A has a second cone A′ located therein, the two cones receiving their supplies from separate chutes H and H′ respectively. They may both discharge on the same spiral or other secondary separator, or on different secondary separators or into separate chutes or bins as may be desired.

The material entering the drum may enter in a central direction or obliquely as desired and for this purpose the feed chute may be pivoted as indicated at H^2 in Fig. 6. The swinging of this chute to the right or to the left will cause a greater percentage of the material to pass to one or the other of the chutes or secondary separators into which the drum A discharges. The drum also may be arranged to swing to the right or left or upward or downward to suit different grades of material, and the separating surface of the cone may be either of metal as described or of stone, cement, terra cotta or other suitable material.

Though I have described with great particularity of detail certain embodiments of my invention, yet it is not to be understood therefrom that the invention is restricted to the particular styles shown. Various modifications may be made by those skilled in the art without departing from the invention.

What I claim is:

1. A separator for coal or the like comprising a rotating drum having a trumpet shaped inner surface flared to accelerate the centrifugal action upon the material being separated, in combination with a spiral separator having two frictionally differentiated parts arranged in position with relation to the discharge end of said drum to receive different classes of materials from said drum and to make a further separation of at least one of said classes.

2. A spiral separator having two frictionally differentiated parts and a flared rotating drum open at opposite ends for admission and discharge respectively for feeding materials of different classes to frictionally different parts of said spiral separator.

3. A spiral separator including a plurality of different parts having receiving portions arranged to receive material of different classes and rotary means located in juxtaposition to the receiving portions for feeding separate classes of material to said receiving portions.

4. A separator for coal or the like including rotary means for effecting an initial separation in combination with a spiral separator having two frictionally differentiated parts for effecting a further separation and receiving portions located to receive different classes of material from said rotary means.

5. A separator for coal or the like including a rotary drum for effecting an initial separation in combination with a spiral separator, said spiral separator having two frictionally differentiated parts and receiving portions located to receive from circumferentially displaced portions of the discharge end of said drum.

In witness whereof, I have hereunto signed my name.

FRANK PARDEE.

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