

No. 629,595.

Patented July 25, 1899.

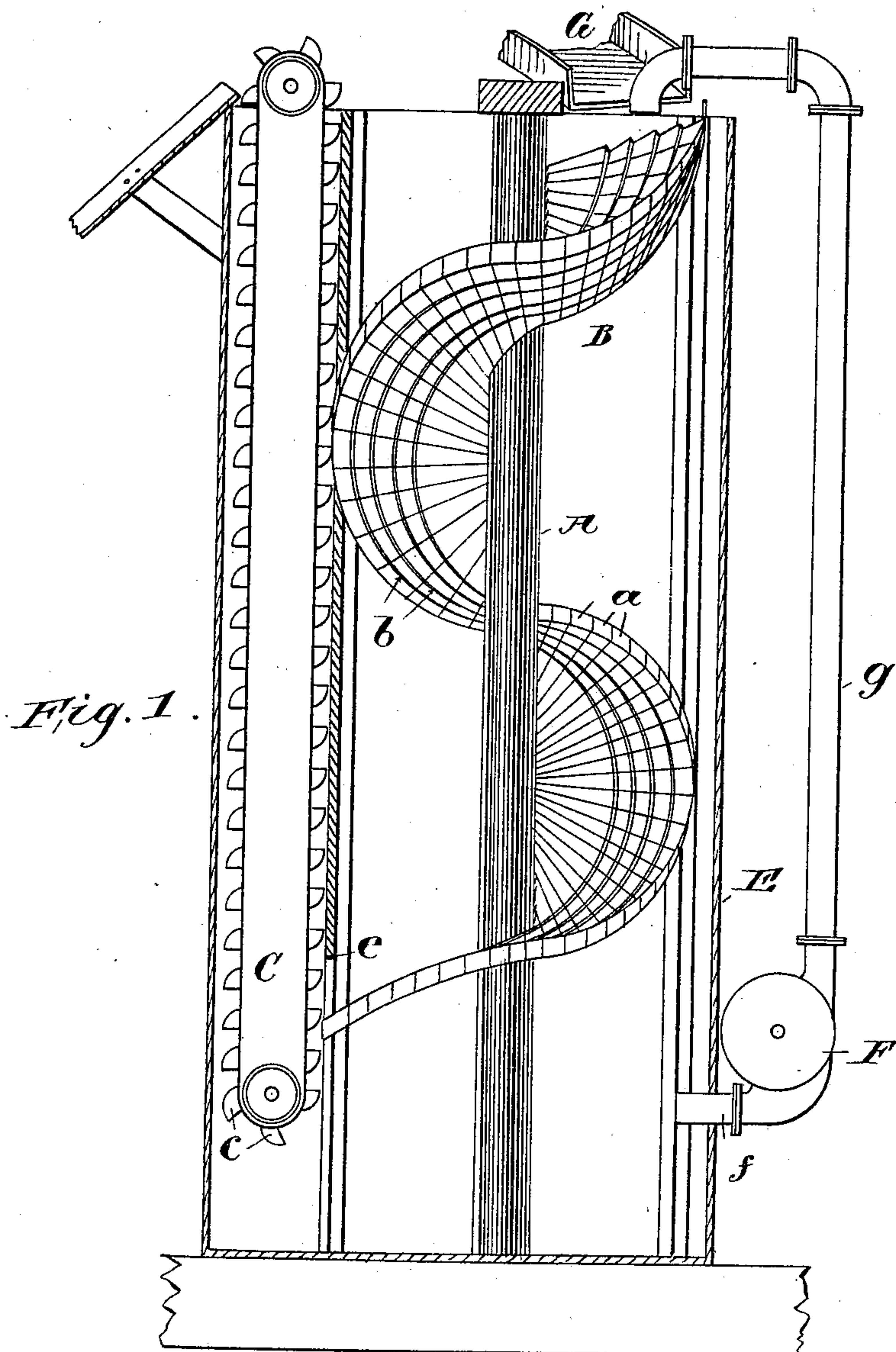
F. PARDEE.

SEPARATOR FOR ORE, COAL, &c.

(Application filed Nov. 18, 1898.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses:  
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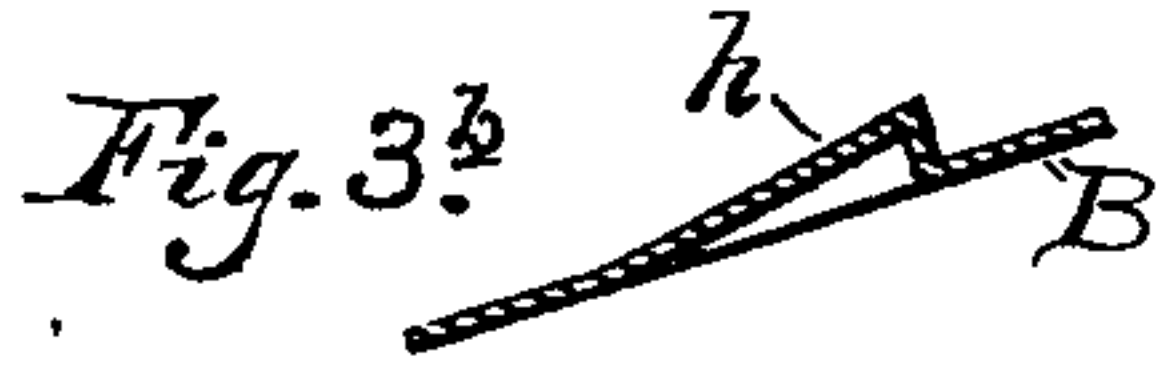
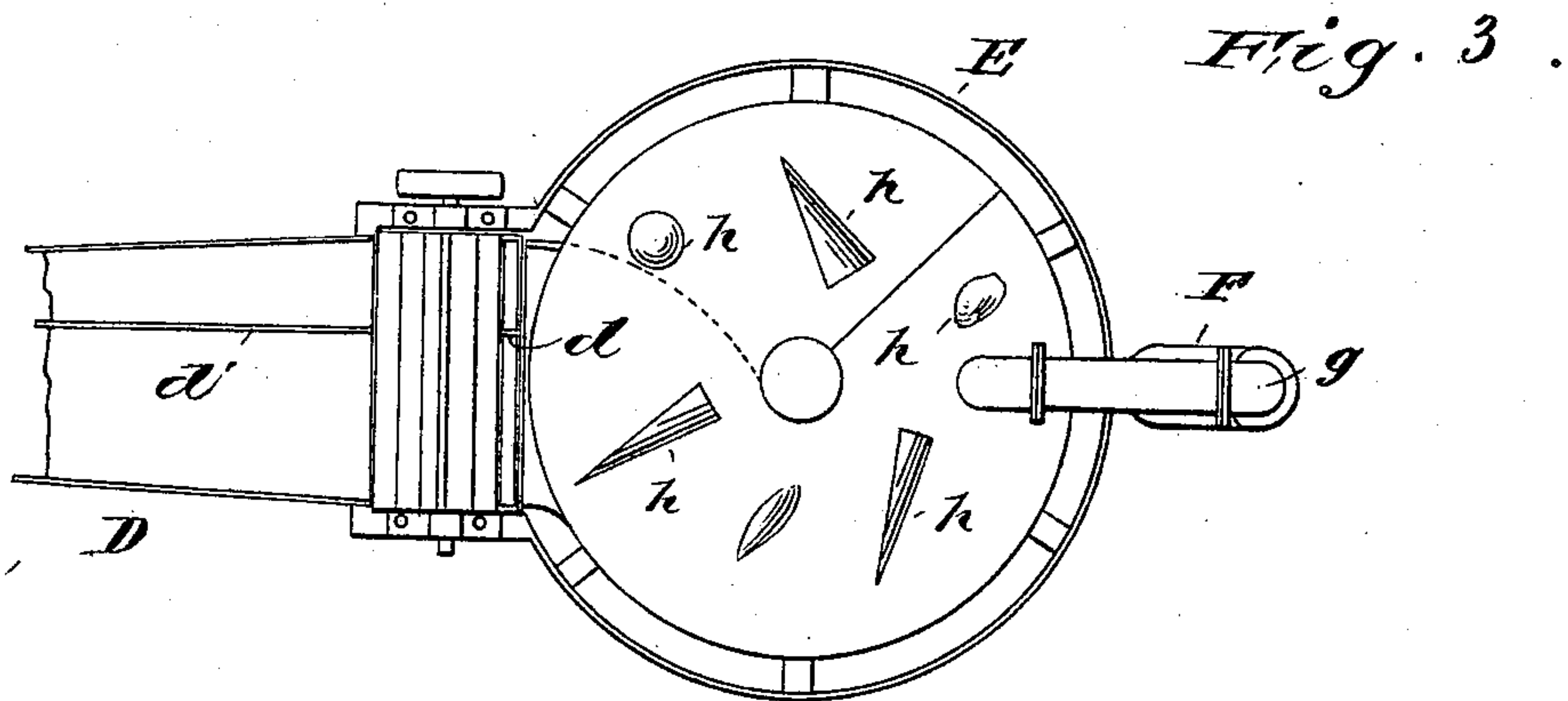
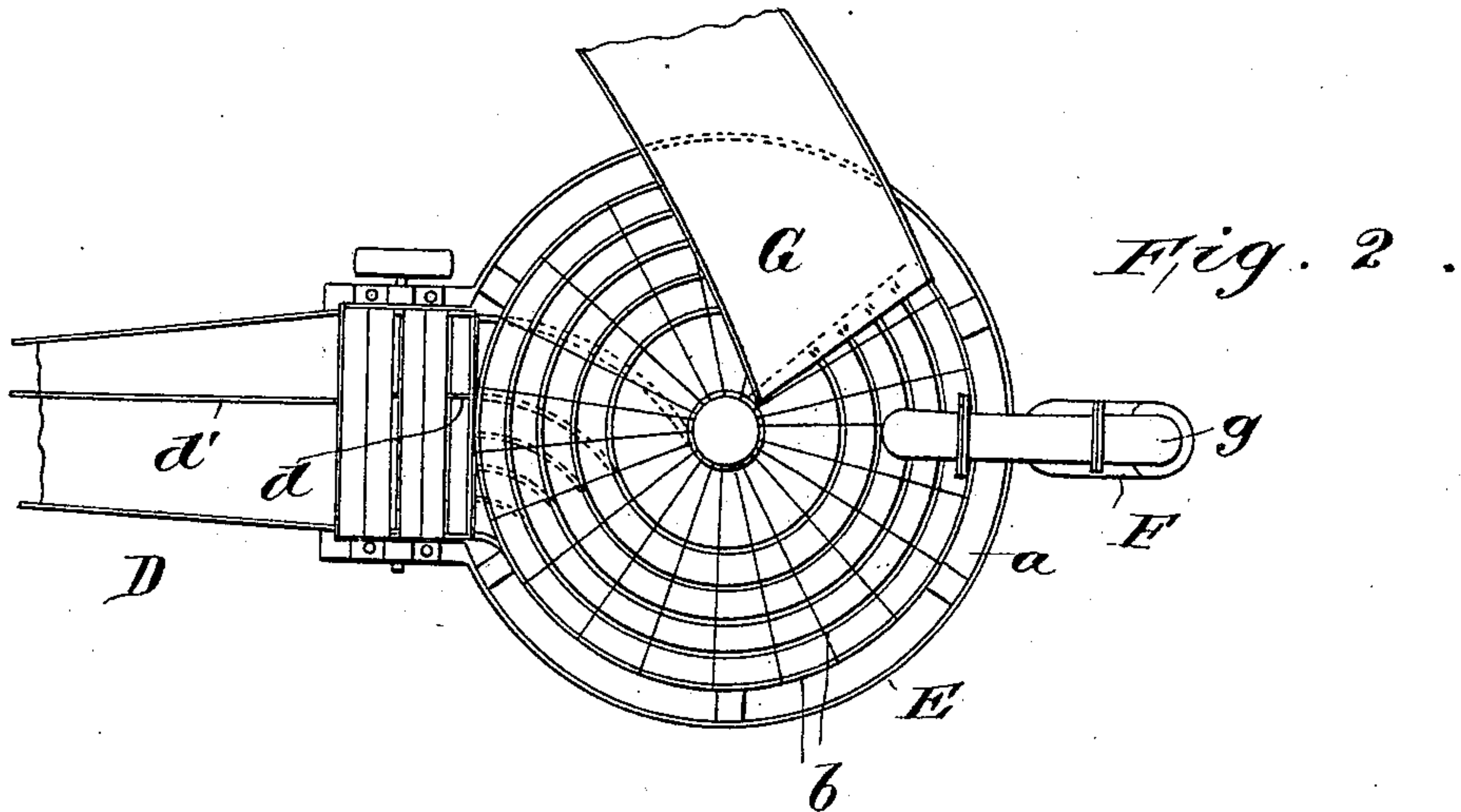
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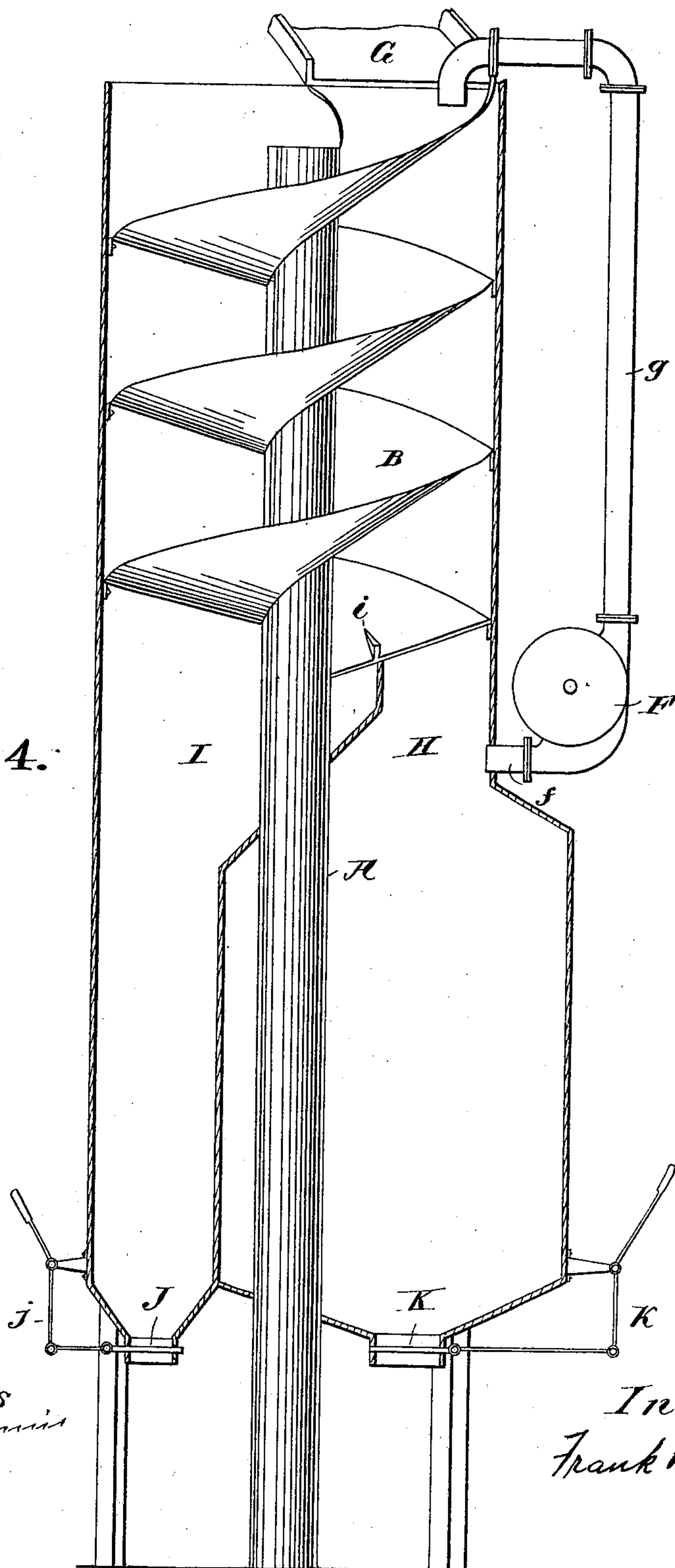
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3 Sheets—Sheet 3.

Fig. 4.



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# UNITED STATES PATENT OFFICE.

FRANK PARDEE, OF HAZLETON, PENNSYLVANIA.

## SEPARATOR FOR ORE, COAL, &c.

SPECIFICATION forming part of Letters Patent No. 629,595, dated July 25, 1899.

Application filed November 18, 1898. Serial No. 696,765. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK PARDEE, a citizen of the United States, and a resident of Hazleton, in the county of Luzerne and State of Pennsylvania, have invented certain new and useful Improvements in Separators for Ore, Coal, &c., of which the following is a specification.

The invention relates to separators for ore, coal, &c., operating by centrifugal action; and the objects are to provide such a separator with a spiral way which will act to turn certain substances inwardly while others pass outwardly thereon and also to use in connection therewith a water-current for aiding the separation, and, further, to make provision for receiving the separated substances as they pass from the outlet of the spirals.

When coal is taken from the mines, it is mixed with more or less rocky substances, usually designated as "slate," which contain silica or other gritty matter possessing a peculiar frictional resistance when moving over other solid substances. This resistance is such during the passage of the mixed substances along the spirals of a centrifugal separator as to cause the slate to move slower than the pure coal or that which contains thin layers of slate and known as "bone." The centrifugal action causes the coal to glide with more rapidity, and as it meets with less resistance from the surface over which the several substances are made to travel it passes to the outer edge of the spirals, the bone being next and the slate nearest the center. The difference in the nature and action of the substances makes centrifugal action available for purposes of separating substances of different specific gravity and frictional resistance, though it is not wholly to be relied upon; nor should the centrifugal motion be so rapid as to overcome the resistance, which can be made to operate against the speed of the slate and bone when moving over another solid surface. Under these conditions the resistance can be taken advantage of by mechanical means for changing the course of the substances possessing such property for causing them to proceed nearer the center of a spiral way and come within the proper limits before emerging from the machine. If to such action there be added a flow of water for wash-

ing the materials on the spirals and floating the lighter particles, still better results may in many instances be obtained.

To attain the object stated, the invention consists of a separator having a spiral way adapted by means of inclines or by undulating or raised surfaces of any desired form to act differently on the movements of substances differing in specific gravity and frictional resistance, the spiral being also adapted to receive a water-current flowing in the direction of the termination of the outlet thereof, and in the combination and arrangement of the devices and parts, as hereinafter more fully described, and pointed out or indicated by the claims.

In the accompanying drawings, Figure 1 is an elevation, partly in section, of a separator embodying the invention. This figure shows a spiral way having continuous ridges or ledges on the inner face of the spiral, which is shown as being inclosed by a water-tank, with pump connection for producing a flow or circulation. It also shows an elevator for receiving the separated substances from the spirals and conveying them to a chute which leads from the machine. Fig. 2 is a plan view of the same. Fig. 3 is a plan view of a similarly-constructed machine, but having its spiral provided with humps or other forms of non-continuous undulating surfaces. Figs. 3<sup>a</sup>, 3<sup>b</sup>, and 3<sup>c</sup> are detail sectional views showing the construction of the respective retarding-surfaces. Fig. 4 is an elevation, partly in section, of a machine the floor formed by the spirals of which is inclined or pitched toward the center and toward the outlet and receptacles for receiving the separated substances at the bottom of a tank inclosing the spiral way and which is shown as having pump connections for producing a flow or current of water in the same manner as in Fig. 1.

In the drawings, A represents a central support or axial column or shaft around which the spiral way B is constructed, so as to form a floor along which the substances to be separated may pass. In Figs. 1 and 2 the spirals are shown as being made up of sections or segments *a a*, provided with undulating surfaces in the form of ridges or ledges *b b*, which come into alinement, so as to form continuous ways, terminating in such relation to



the pockets or buckets *c c* of an elevator or conveyer *C* as to discharge the separated substances therein. This conveyer may have one or more partitions, as *d*, for keeping the substances apart while being carried from the spirals to chutes *D*, separated one from another by partitions *d'*, as shown in Figs. 2 and 3.

The spiral way is shown as being surrounded by a tank *E*, having a wall or partition *e*, which separates it from the elevator, but through which an opening is made for permitting the separated substances to pass to the elevator without materially affecting the circulation of the main body of water. A pump *F* connects with the tank by a pipe *f*, leading therefrom at a point opposite or below the termination of the spirals. The water drawn from the tank by this pump is conducted by a pipe *g*, connected with the discharge thereof, to the upper end of the tank or spirals, at which the substances to be separated are fed to the machine from a chute *G* or otherwise, as desired. The operation of the pump will produce a circulation or flow of water in the form of a current along the spirals in the direction of their termination or outlet.

In Fig. 3 the undulating surfaces are shown in the form of short ridges or protuberances *h h*; but they may vary in size, shape, position, or direction, and, if desired, depressions or valleys may be made for causing the substances having the greatest frictional resistance to turn inwardly while others pass outwardly on the spirals.

In Fig. 4 the spiral is shown without either continuous or non-continuous undulating surfaces, in which form the pitch or incline of the perimeter toward the center and toward the outlet acts on the substances differing in frictional resistance, so as to impede the outward progress and change the course of some inwardly, while others pass outwardly a greater distance up the inclines.

In connection with this form of the machine the water-tank and pump connections are shown as being the same as in the preceding illustrations; but instead of an elevator for taking the separated substances from the machine provision is made by a short guide *i* for directing them into compartments *H* and *I*, where they may remain until the accumulation is such as to require their removal. For this purpose gates *J* and *K*, closing openings in the bottom of the compartments, are connected with levers *j* and *k*, by which they may be opened whenever occasion requires.

The operation is as follows: The pump being started, so as to produce a flow or current of water, and the elevator, if the machine has one, being also put in operation, the mixed substances are admitted to the spiral, in which they are rapidly whirled by the centrifugal action and the force of the water-current. As they progress the substances having the greatest frictional resistance will be turned in-

wardly and course along the central part of the spiral, while those of less frictional resistance and specific gravity will be forced or carried to the outer part of the same. When they reach the termination or outlet, the substances thus separated will pass therefrom to whatever means are provided for receiving or taking care of them.

The action of the water-current is especially advantageous as an agent for aiding in the separation of certain mixed substances—such, for example, as ores or bituminous coal—and where its action on substances differing in specific gravity is conjoined with that of a spiral way adapted to act differently on the substances by reason of their difference in frictional resistance the result is an improvement in the efficiency of the machine.

While the water-current has been described in connection with the means illustrated for producing it in a tank, so that the same water may be used over and over, it is obvious that where the water-supply is such that it forms no object in the economic operation of the machine the tank may be dispensed with and a continuous flow over and away from the spiral way substituted therefor, if so desired.

I do not herein claim the features of construction of spiral separators which are made the subject-matter of the application filed by me on May 17, 1898, Serial No. 680,987, nor do I herein claim the features of such a machine which form the subject-matter of the several applications filed by me on November 18, 1898, Serial Nos. 696,761, 696,762, 696,763, 696,764, 696,766, and 696,767, respectively, to which reference is hereby made.

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

1. A machine for separating ore, coal, &c., by gravitation, centrifugal action and frictional resistance, having a spiral way forming a floor over which the substances may pass, said floor being provided with an incline the plane of which pitches toward the center and toward the outlet of the machine, whereby the course of the substances of greatest frictional resistance may be changed inwardly, and said machine being adapted to receive a water-current passed over the floor during operation, and means for feeding the material to be separated to the upper end of the spiral floor.

2. A machine for separating ore, coal, &c., by gravitation, centrifugal action and frictional resistance, having a spiral way forming a floor along which the substances may pass, said floor being provided with undulating surfaces for changing the course of the substances of greatest frictional resistance inwardly and being adapted to receive a water-current substantially as and for the purposes set forth.

3. A machine for separating ore, coal, &c., by gravitation, centrifugal action and frictional resistance having a spiral way forming



5 a floor, said floor being provided with continuous ledges or ways for turning certain substances inwardly and for receiving and conducting others separated therefrom, said way being adapted to receive a water-current flowing in the direction of the outlet thereof.

10 4. In a machine for separating ore, coal, &c., by gravitation, centrifugal action and frictional resistance a spiral way forming a floor, said floor being provided with continuous ledges or ways for turning certain substances inwardly and for receiving and conducting others separated therefrom, said way being adapted to receive a water-current flowing in the direction of the outlet thereof, in combination with a conveyer located to receive the separated substances therefrom.

15 5. A machine for separating ore, coal, &c.,

by gravitation, centrifugal action and frictional resistance, having a spiral way forming a floor over which the substances may pass, said floor being provided with an incline the plane of which pitches toward the center and toward the outlet of the machine, whereby the course of the substances of greatest frictional resistance may be changed inwardly, means for feeding the material to be separated to the upper end of the spiral floor, a tank inclosing said way for retaining water around the same, means for circulating the water in the said tank, and means for receiving the separated substances from said way.

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Witnesses:

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