F. PARDEE.

APPARATUS FOR SEPARATING COAL, ORE, &c.

APPLICATION FILED MAY 2, 1913.

1,149,463.

Patented Aug. 10, 1915.

3 SHEETS—SHEET 1.

Fig. 1.

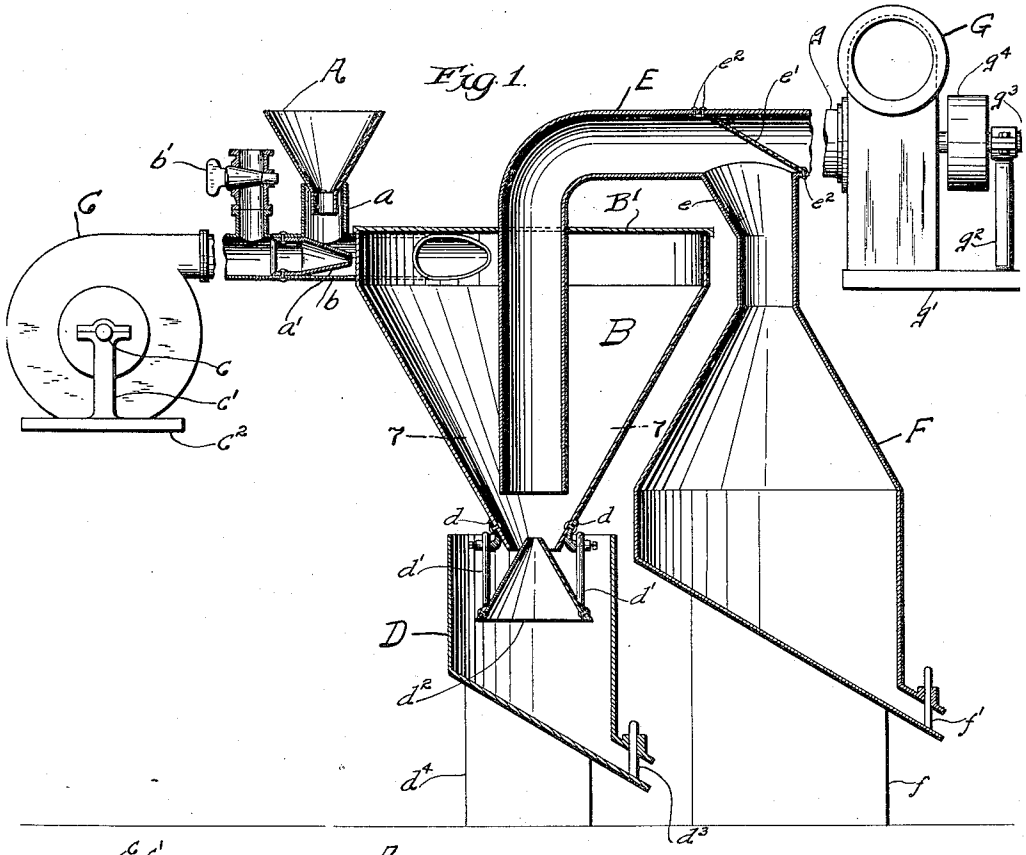
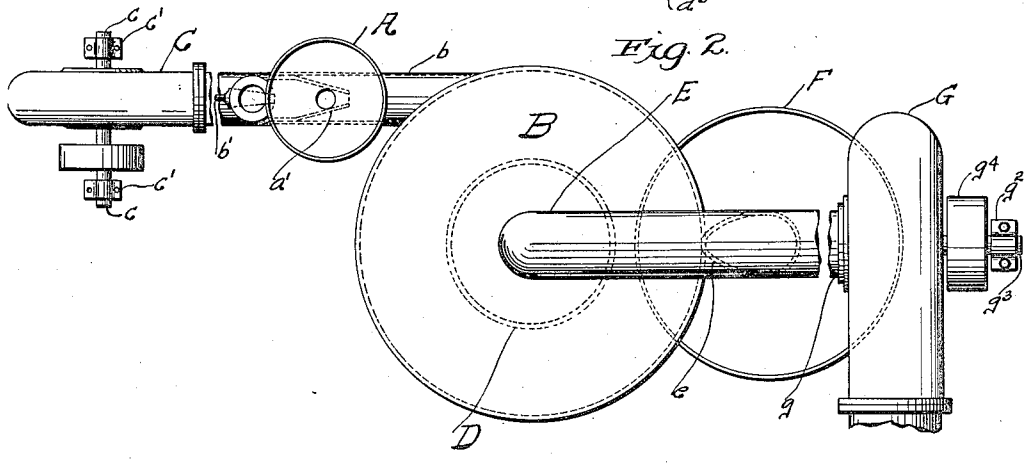


Fig. 2.



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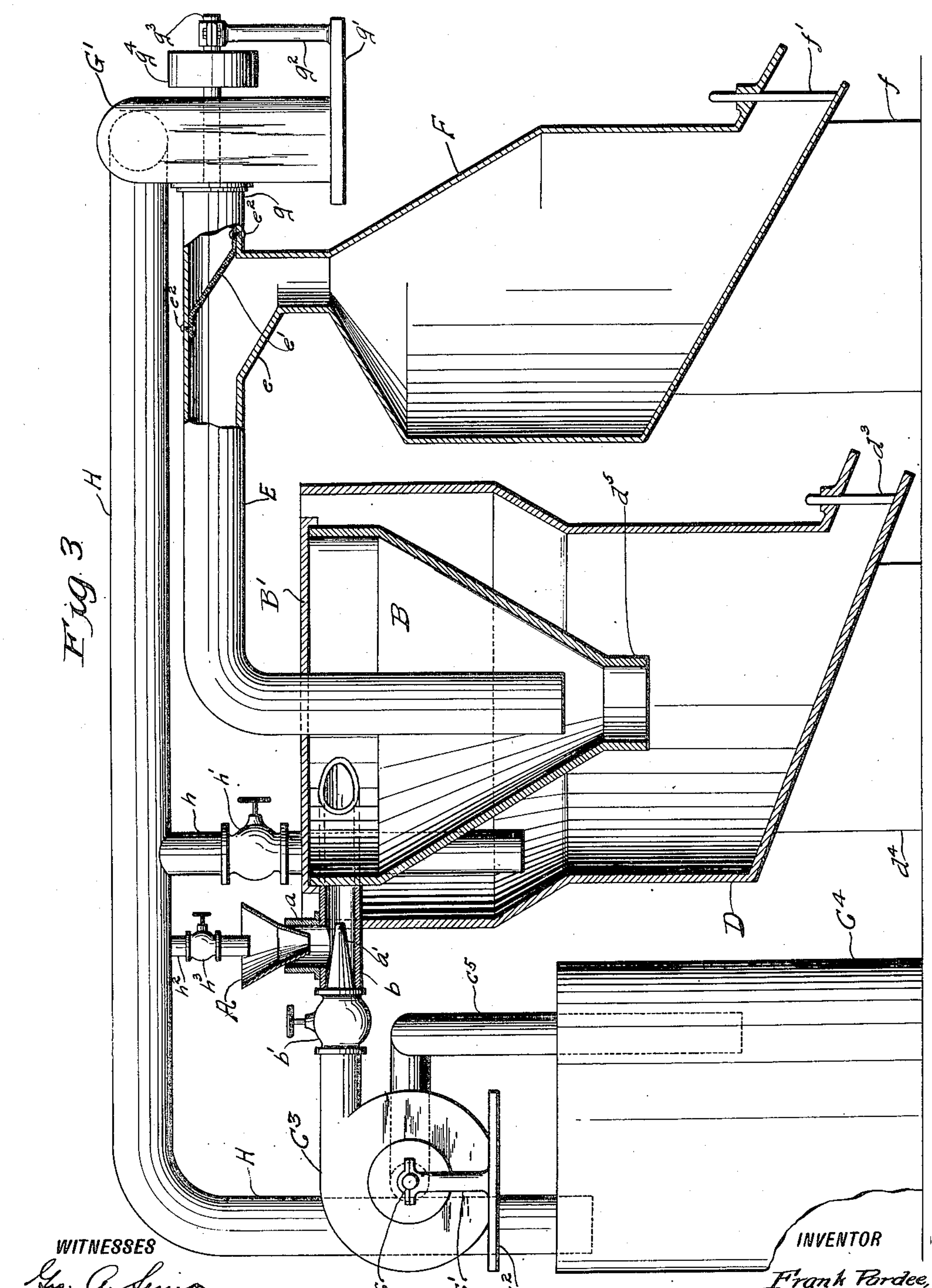

Fig. 3

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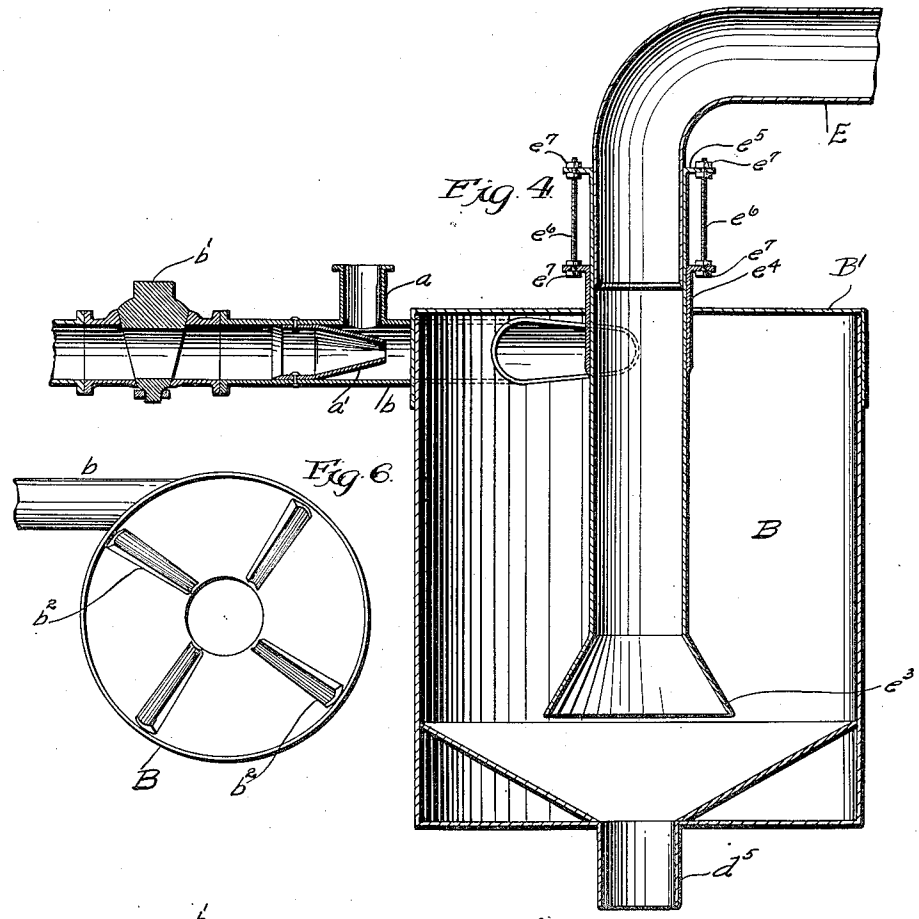

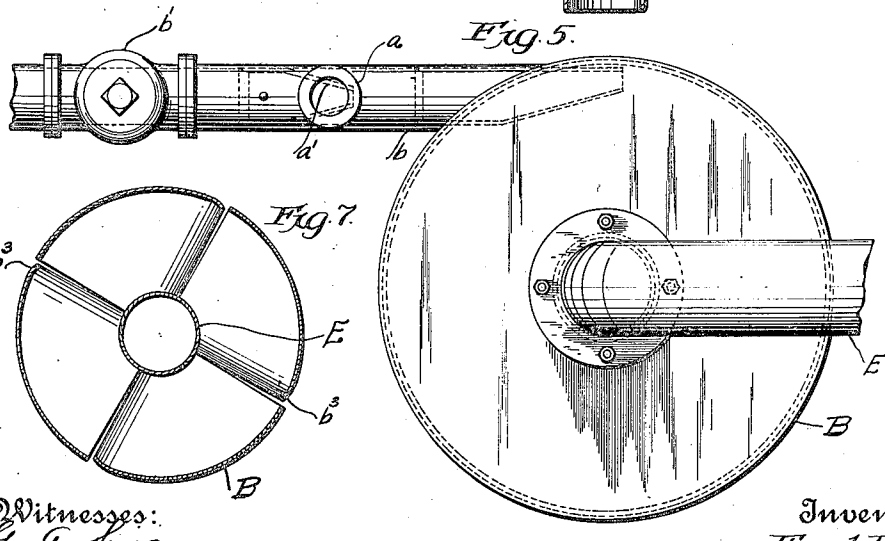

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APPARATUS FOR SEPARATING COAL, ORE, &c.

1,149,463. Specification of Letters Patent. Patented Aug. 10, 1915.

Application filed May 2, 1913. Serial No. 765,170.

To all whom it may concern:

Be it known that I, FRANK PARDEE, a citizen of the United States, and a resident of the city of Hazleton, in the county of Luzerne and State of Pennsylvania, have discovered or invented certain new and useful Improvements in Apparatus for Separating Coal, Ore, &c., of which the following is a specification, reference being had to the accompanying drawings.

The improvements relate to apparatus for separating solid substances of different specific gravity and weight.

The means comprised by the discovery or improvement are of such a character as to give a varied scope to the uses thereof, and it is especially adapted for separating some of the commercial sizes of coal from bone and slate; it is also useful in separating various kinds of ores from rock or other foreign substances and impurities.

The invention consists of a separating chamber wherein material is suspended in fluid, the chamber having a discharge opening at its lower end, in combination with means for delivering the material under regulated fluid pressure tangentially to the upper part of the separating chamber which is provided with an axially depending suction tube extending into proximity with the lower end of the chamber, and controllable means for supplying additional fluid to the chamber upwardly and axially toward the suction tube and across the path of descending material, as hereinafter described and stated in the several combinations claimed.

Figure 1, of the drawings is an elevation of the apparatus adapted to carry the separating operation into effect by the use of air as the fluid or medium for causing the separation, some of the parts being shown in section. Fig. 2, is a plan view of the same. Fig. 3, is an elevation, partly in section, of an apparatus adapted for the use of water as the fluid or medium for causing a separation of the substances by the operation herein set forth. Fig. 4, is a sectional elevation of a modified form of hydraulic separating receptacle detached from the receiving chambers, and shows one style of valve for adjusting the pressure in the feed-pipe and means for adjusting the length of the exhaust outlet-pipe for the lighter materials. Fig. 5, is a plan view of the device seen in Fig. 4. Fig. 6, is a plan view of a conical separating chamber provided with vanes or ribs along the interior thereof, and Fig. 7, is a transverse section taken on the line 7, 7, of Fig. 1, showing the lower part of a conical pneumatic separating chamber provided with inlets or slots for admitting air.

A centrifugal differential movement is imparted to the mixed materials by the use of air or water, as the physical agent or separating medium. In either case the action on the materials is such as to cause convolutions and eddies in the fluid and retard the downward passage of the materials fed from above, while giving an inward movement to those of lighter weight. These lighter substances gravitate to a plane or series of planes whereby they are held in suspension in the fluid and are then drawn by a separating vortex and draft to a different outlet from that to which the heavier materials drop by their superior weight or gravity.

The materials to be separated may be fed through a hopper A, leading into a stand-pipe a, connecting with a horizontal feed-pipe b, which opens into the upper part of a separating chamber or receptacle B, having a tight fitting cover B′. The stand-pipe a, leads into the pipe b, above, near or in front of an ejector or nozzle a', in the feed-pipe b. A cock or valve b', is used to regulate the pressure in the pipe b, behind the nozzle a', by letting out air or admitting more water if desired in the hydraulic form. In the pneumatic apparatus (Figs. 1, and 2) the blower C, journaled at c, on the support c', extending up from the base c^2, causes the pressure on the fluid by which the mixed materials are drawn or forced through the pipe b, and fed into the upper part of the separating receptacle B, which is preferably conical as shown in Fig. 1. In the hydraulic form of the apparatus (Fig. 3) the water is drawn by a pump C^3, from the tank C^4, through the connecting pipe c^5, and forced out of the nozzle a', in the feed-pipe b, so as to carry the mixed materials coming from the hopper A, into the upper part of the separating chamber B.

The conical separating receptacle B, of Fig. 1, has an opening at its lower end of sufficient diameter to allow the heavier materials to drop or discharge from the peripheral surface of this chamber into a receiving chamber D.

Near the lower or discharge end of the receptacle B, of Fig. 1, provision is made by

brackets d, d, for the support of hangers or straps d', d', by means of which a small inverted funnel or cone d^2, is suspended. The straps d', d', and their connections permit an adjustment of the height at which the cone d^2, is set. The heavier materials slide from the outside of this cone into the receiver D, shown as having, though it need not have, a sloping bottom for the withdrawal of accumulated substances by opening the gate d^3. When the receiving chamber is made with a sloping bottom the foundation or support d^4, on which it rests will also have a sloped upper face or surface to correspond with it.

A pipe E, passes down into the separating chamber B, so as to depend and terminate somewhat above the lower end of the chamber and above the small inverted cone d^2, of the pneumatic separator, or a suitable distance above the lower end or spout d^5, of the hydraulic separating chamber of Fig. 3. The pipe E, passes out at the top of the separating chamber B, and connects with the neck e, of a receiving chamber F, shown with a sloping bottom resting on a support f, having an inclined upper surface. The receiving chamber F, has a gate f', for permitting a discharge of the lighter materials drawn into it during the process of separation. Above and extending beyond the neck e, of the receiver F, there is a screen e', shown as being secured within the pipe E, by rivets e^2, e^2, and the pipe E, continues to and connects at g, with the eye of the exhaust-fan G of Fig. 1 or with the pump G' of Fig. 3, the fan and pump being indicated as having a base g', and upright support g^2, by which the shaft g^3, is supported at one end and is driven by a pulley g^4, for operating the exhaust-fan or pump.

In the hydraulic apparatus a pipe H, passes from the pump G', back to the water tank C^4, so as to allow a complete circulation of water throughout the system. This pipe H, has a branch connection h, provided with a valve or cock h', so as to admit water into the upper part of the receiving chamber D, and thereby act on the water coming from the regular feed-pipe b, to aid in causing eddies or convolutions for retarding and giving the lighter substances an inward movement toward the pipe E, while the heavier materials are carried to the periphery or outside. The pipe H, also has a branch connection h^2, provided with a valve or cock h^3, for admitting water into the feed-funnel A, and may be used in regulating the speed or flow of the mixed materials into the feed-pipe b.

Assuming materials of different specific gravity to pass through the funnel or hopper A, into the feed-pipe b, and the blower C, or pump C^3, to be set in operation, the mixed substances will be forced under suitable pressure through the feed-pipe b, into the separating chamber B, and whirl around spirally making various convolutions while descending. The exhaust-fan G or pump G', being also set in motion produces an upward current of air or water through the pipe E, which causes a separating vortex and draft near the lower end of the exhaust-pipe E. During the descent in the separating chamber the lighter materials will be drawn inwardly while the momentum caused by the centrifugal force acting on the heavier ones has a strong tendency to carry them to the periphery or inner surface of the separator B. The superior force of gravity acting on the heavier substances causes them to pass the separating vortex and escape the exhaust draft, so as to drop or slide into the receiving chamber or receptacle D. The lighter materials will cease to descend and come to an equilibrium or suspension in the fluid, and they will be diverted by the separating vortex and draft so as to take the course of the vacuum produced by the exhaust-fluid and will finally be delivered into the receiver F. The screen e, prevents the materials intended for the receiver F, from passing farther toward the exhaust-fan G or pump G', thus insuring their entrance into that receiver.

The inverted supplementary cone or funnel d^2, of Fig. 1, affords a convenient surface for the escape of the heavier materials into the receiver D, of the pneumatic separator; it also causes a concentration of the ascending air and aids in regulating the force or power of the exhaust current. The effect on the lighter substances may also be regulated to some extent by the open apex of the inverted cone d^2, and its distance from the lower end of the pipe E. The air admitted from below opposes the descending spiral currents and aids in forming eddies or vortices which serve to weigh and separate the lighter substances from the heavier ones, while passing through the chamber or receptacle B, and also tends to force them axially toward the main vortex and suction tube at, near or below the lower end of the pipe E, thus increasing the carrying capacity of the exhaust forces.

In Fig. 4, the exhaust-pipe E, of the hydraulic separating cylinder B, is shown as being provided with a lower flare or spreading conical end e^3, which causes an outward sweep of the water which carries the lighter substances around the lower end of the pipe E, and into the main vortex or maelstrom. The pipe E, is also made adjustable as to the distance of its lower end from the terminus or spout d^3, of the receptacle B. In this case the part of this pipe E, which enters the receptacle B, is made separate from and larger than that part which leads to the exhaust pump G', so

that the upper end of the section which extends into the separating chamber may receive the lower end of the section extending to the pump. In this modification the upper end of the chamber B, is provided with a flanged coupling connection e^4, through which the lower section of the pipe E, flanged at e^5, or its upper end, passes, and adjustment screws e^6, e^6, connect with the flanges e^4, and e^5, so that by the turning of nuts e^7, e^7, the lower end of the exhaust pipe E, may be regulated to a suitable distance above the bottom of the separating chamber B, which will have an effect on the power or force of the exhaust current.

In Fig. 6, the separating chamber is shown with vanes or ribs b^2, b^2, which may be formed or secured so as to extend along any portion of the interior surface and in any desired direction. These vanes or ribs act on the lighter substances and turn them inward or prevent such outward tendency as they may for any reason have or be given.

In Fig. 7, the diverting vanes or ribs in the lower end or part of a pneumatic separating chamber, are shown as being formed by making slits in the wall of the chamber and turning the metal inward, as at b^3, for the admission of outside air near the lower end.

The air openings made near the bottom of a pneumatic separating chamber may be of a variety of shapes, but the best results seem to come from having the entering air move in lines suited for causing currents from different directions to form eddies or vortices by which the lighter substances will be buoyed up or retarded and finally balanced and held for an instant in suspension and then passed into the main vortex and exhaust-pipe in which they follow the course of the vacuum and draft produced by the exhaust fluid. The mode of operation is substantially the same in the separator whether it be pneumatic or hydraulic; but an apparatus intended especially for hydraulic action is made the subject matter of another application filed by me on even date herewith, Serial No. 765,171, and no specific claims are herein made as to features which are not applicable to both the pneumatic and hydraulic types.

Having thus described the discovery or invention, what I claim as new and desire to secure by Letters Patent is:

1. A separating chamber wherein material is suspended in fluid, said chamber having a discharge opening at its lower end in combination with means for delivering the material under regulated fluid pressure tangentially to the upper part of the separating chamber; an axially depending suction tube in the chamber extending into proximity with the lower end of the chamber, and controllable means for supplying additional fluid to the chamber upwardly and axially toward the suction tube and across the path of descending material.

2. A separating chamber wherein material is suspended in fluid, said chamber having a downwardly tapering lower part and a discharge opening at its lower end, in combination with means for delivering the material under regulated fluid pressure tangentially to the upper part of the separating chamber; an axially depending suction tube in the chamber extending into proximity with the lower end of the chamber, and controllable means for supplying additional fluid to the chamber upwardly and axially toward the suction tube and across the path of the descending material.

3. A separating chamber wherein material is suspended in fluid, said chamber having a discharge opening at its lower end, in combination with means for delivering the material under regulated fluid pressure tangentially to the upper part of the separating chamber; an axially depending suction tube in the chamber extending into proximity with the lower end of the chamber; an inverted cone beneath the lower end of said tube, and controllable means for supplying additional fluid to the chamber upwardly and axially toward the suction tube, against said inverted cone and across the path of the descending material.

4. A separating chamber wherein material is suspended in fluid, said chamber having a discharge opening at its lower end, in combination with means for delivering the material under regulated fluid pressure tangentially to the upper part of the separating chamber; an axially depending suction tube in the chamber extending into proximity with the lower end of the chamber, means for regulating the pressure in said suction tube and means for supplying additional fluid to the chamber upwardly and axially toward the suction tube and across the path of descending material.

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