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AIR SEPARATOR.

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1,367,637. Patented Feb. 8, 1921.

Fig. 1

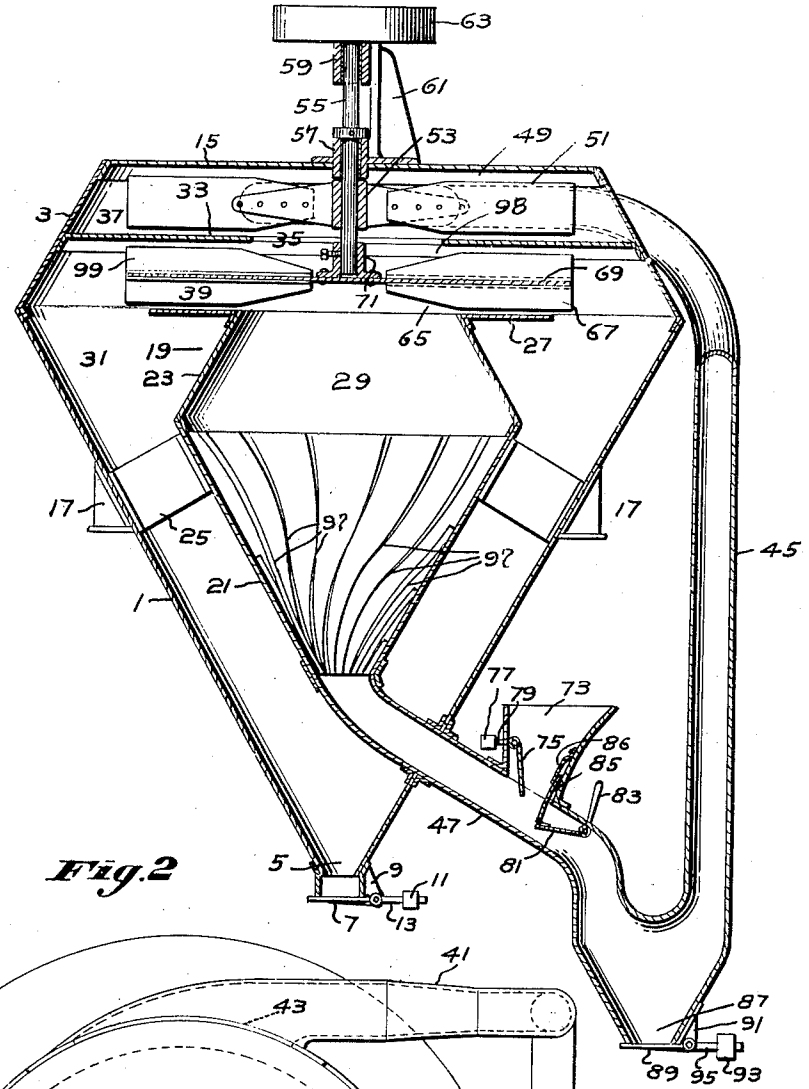
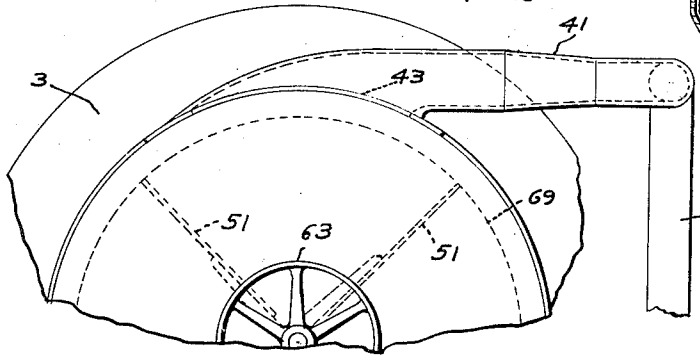


Fig. 2



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AIR-SEPARATOR.

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To all whom it may concern:

Be it known that I, THOMAS J. STURTEVANT, a citizen of the United States, residing at Wellesley, in the county of Norfolk and State of Massachusetts, have invented an Improvement in Air-Separators, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

The invention to be hereinafter described relates to air separators for grading materials. Separators of this type may have a separating chamber and a collecting chamber. A fan is provided for causing an air current to move upward in the separating chamber into the collecting chamber. The materials to be graded may be introduced into the path of the upward moving air current, and the heavier particles or tailings may gravitate downward through the air current, while the lighter particles or fines are carried along with the air current into the collecting chamber. The tailings are discharged through one outlet, and the fines are discharged through another outlet.

One of the purposes of the present invention is to provide pneumatic means for feeding the materials to be graded into the separating chamber. In the present instance of the invention, the air current is conducted upward through the separating chamber and thence from the upper end thereof through a by-pass or passage back to the lower end of the separating chamber in a closed circuit, and the materials to be graded are introduced into the by-pass or passage so as to be caught by the air current and be fed thereby into the separating chamber. In the present instance of the invention, the air is forced through the by-pass or passage by a fan which is mounted in the separator casing at a point intermediate the upper end of the separating chamber and the upper end of the by-pass or passage for conducting the materials back to the separating chamber.

Another purpose of the invention is to provide a fan for promoting the upward movement of the air current through the separating chamber, and for producing a whirl of the air current, so that the latter will pass upward in a spiral path through the separating chamber and whirl thence outward into the collecting chamber. This whirl of the air current develops a centrifugal force which tends to cause the materials to be graded to move outward toward the walls of the separating chamber as they pass upward therethrough, and certain of the particles will be thrown outward farther than others depending on the relative weights and other characteristics of the particles. As a consequence, the heavier particles will tend to move downward in a different path from the upwardly moving lighter particles, and the effect is to tend to prevent the heavier particles from impinging upon and pulling downward the lighter particles. This tends to increase the separating efficiency.

The fan for promoting the upward whirl of the air current through the separating chamber may desirably be located adjacent the fan for forcing the air through the by-pass or passage for feeding the materials to be graded into the separating chamber, and in a sense the feeding fan and the separating fan may be regarded as having a compound effect on the air current, since both assist in causing the air current to move upward through the separating chamber and around through the by-pass back to the separating chamber in a closed circuit.

It is desirable that the fines carried by the air current from the separating chamber into the collecting chamber shall not be returned through the by-pass back to the separating chamber. Another purpose of the invention, therefore, is to provide a fan which will generate a whirl of the air and a centrifugal force effect which will tend to prevent the particles on entering the collecting chamber from passing along with the air current through the by-pass back to the separating chamber. In the present instance of the invention, this fan which may be referred to as the air current cleaning fan, may be located intermediate the separating fan and the feeding fan.

Another purpose of the invention is to provide a rifling or series of spirally disposed ribs projecting internally from the wall of the separating chamber to contribute to the whirling of the air current as it passes upward through the separating chamber.

Another purpose of the invention is to provide valve means for the by-pass or passage located preferably adjacent the point

where the materials to be graded are introduced into the by-pass or passage, said valve means being adjustable to different fixed positions to tend to maintain a constant air current at the point in the passage where it picks up the materials to be graded.

With the aforesaid and other purposes in view, the character of the invention may be best understood by reference to the following description of one good form thereof shown in the accompanying drawing, wherein:

Figure 1 is a vertical section through a separator shown herein as embodying the invention; and

Fig. 2 is a plan view of a portion of the separator.

Referring to the drawing, the separator shown therein as one good form of the invention, may be provided with a suitable casing, in the present instance, comprising a lower conical wall 1 and an upper conical wall 3 meeting and diverging from their juncture for a purpose to be described. At the lower end of the lower conical wall 1 is an outlet 5 which may be provided with a valve or gate 7 pivotally connected to a bracket 9 on said wall and normally urged to closed position by a weight 11 on an arm 13 connected to said valve. The construction is such that when a sufficient weight of materials has accumulated on the valve, it will overcome the weight 11, and the materials will be discharged through the outlet 5. Thereupon, the weight 11 will automatically close the valve.

The upper end of the conical wall 3 may be provided with a head 15 secured to the upper edge of said wall. Suitable means may be provided to support the outer casing described. In the present instance, for this purpose it is provided with feet 17 adapted to rest on beams or other appropriate support.

Mounted within the outer casing is an inner casing 19 comprising a lower conical wall 21 and an upper conical wall 23 meeting and diverging from their juncture. The inner casing may be supported by brackets 25 intermediate the lower conical wall 1 of the outer casing, and the lower conical wall 21 of the inner casing, and preferably directly opposite the casing supporting brackets 17. At the upper edge of the upper conical wall 23 of the inner casing is a ring plate 27 secured to said wall and projecting a substantial distance outward therefrom. The inner casing divides the outer casing into a separating chamber 29 and a collecting chamber 31.

Intermediate the ring plate 27 and the head 15 of the casing, an annular partition 33 may be provided, conveniently having its periphery secured to the upper conical wall 3 of the outer casing, and having a central opening 35. This partition serves to divide the space between the ring plate 27 and the head 15 into an upper fan chamber 37 and a lower fan chamber 39. The latter may serve as a passage affording communication between the separating chamber 29 and the collecting chamber 31.

Suitable means may be provided to conduct the air current from the fan chamber 37 back to the separating chamber 29. This means, in the present instance, is in the form of a by-pass or passage comprising a pipe 41 projecting laterally from the upper conical wall 3 of the outer casing, and communicating with the fan chamber 37 through an opening 43. This pipe 41 may communicate with a vertical pipe 45 projecting downwardly preferably somewhat beneath the lower end of the outer casing where it communicates with an inclined pipe 47 projecting through the lower conical wall 1 of the outer casing and secured to and communicating with the lower end of the separating chamber 29.

To force the air current through the by-pass pipe, a fan 49 may be provided in the upper fan chamber 37, and comprising a series of vanes 51 secured to a hub 53 on a vertical shaft 55 journaled in bearings 57 and 59 on a bracket 61 mounted on the outer casing head 15. Fast on the upper end of the shaft 55 is a pulley 63 which may be driven by a belt from any suitable source of power.

To promote the upward movement of the air current through the separating chamber, and cause the same to whirl therein and to whirl outwardly into the collecting chamber, a fan 65 may be provided in the lower fan chamber 39, and comprises a series of vanes 67 secured to a disk 69 mounted on a hub 71 secured to the lower end of the vertical shaft 55 which may project downward from the upper fan chamber 37 through the opening 35 into the lower fan chamber 39.

The feed fan 49 and the separating fan 65 will have a desirable compounding action, and both may coöperate and assist in causing the air current to move upward through the separating chamber, thence outward into the collecting chamber and around the periphery of the fan disk 69 radially inward through the fan chamber 39, and upward through the opening 35 into the fan chamber 37. The air current will pass thence through the by-pass pipe downward and thence upward into the separating chamber in a closed circuit.

Suitable means may be provided for introducing the materials to be graded into the by-pass pipe or passage. To accomplish this, in the present instance, a hopper 73 may be provided communicating with the inclined pipe 47 conveniently at a point adjacent the lower conical wall 1 of the outer casing. This hopper may be provided with

a valve or gate 75 pivotally mounted on the hopper and urged to closed position by a weight 77 on an arm 79 connected to said gate. The construction is such that materials flowing down through the hopper will overcome said weight and open said gate sufficiently to allow the materials to flow into the inclined pipe 47, and said gate will tend to prevent the air current from flowing upward through said hopper.

Suitable means may be provided to tend to maintain a constant velocity or strength of the air current as it passes through the inclined pipe 47 beneath the lower end of the hopper 73. This means, in the present instance, is in the form of a valve gate 81 pivotally mounted on the pipe 47 and provided with a control handle 83. A curved shield 85 may be hinged to and project upward from the outer edge of the gate 81 into the hopper somewhat, and thereby prevent the materials from being pocketed above the gate between the latter and the upper wall of the pipe 47. The gate 81 may be adjusted by the handle 83 to furnish the degree of opening desired, and may be held by the friction of its pivotal mounting in its different positions of adjustment. A spring 86 may hold the shield against a wall of the hopper.

The construction is such that the air current passing through the by-pass pipe upward through the inclined pipe 47 will pick up the materials discharged by the hopper into said inclined pipe and carry the same upward into the separating chamber. The heavier particles or tailings will gravitate downward through the air current in the inclined pipe 47 toward the lower end thereof, where they may be discharged through an outlet 87. This outlet may be normally closed by a valve or gate 89 pivotally mounted on a bracket 91 on the pipe, said valve being urged to its closed position by a weight 93 on an arm 95 connected thereto. When a sufficient weight of tailings has accumulated on the gate 89, it will overcome the weight 93 and allow discharge thereof through the outlet 87. Thereupon, the weight 93 will automatically return the valve to its closed position.

To contribute to the whirl of the air current as it passes through the separating chamber, the lower conical wall 21 thereof may be provided with a rifling or a series of spirally disposed ribs 97 projecting inward from said wall. The upwardly moving air current will engage these ribs and be directed in an upward whirl through the separating chamber. Also, the heavier particles or tailings thrown outward by the centrifugal effect of the whirling air current will engage these ribs, and the tendency will be to check the upward movement of the heavier particles so that the latter may flow downward between the ribs and into the inclined pipe 47. They will gravitate thence downward through the air current past the air velocity control gate 81 to the outlet 87, and be discharged therefrom as described.

The fines, on the other hand, will be carried upward by the air current, outward between the vanes of the fan 65 through the fan chamber 39 into the collecting chamber 31. The centrifugal force effect of the whirling air current will drive the fines outward against the upper inclined wall 3 of the outer casing. They will be deflected by the latter downward toward the lower conical wall 1 of the outer casing, and flow downward along said wall and be discharged through the outlet 5 as described.

As stated, the air current on leaving the fan chamber 39 will flow into the collecting chamber and thence around the periphery of the disk 69 radially inward and upward through the opening 35 in the annular partition 33. The air feed fan 49 will force the air thence through the by-pass pipe downward and back upward into the separating chamber.

To tend to prevent the lighter particles or fines from being carried along with the air current around the periphery of the disk 69 into the upper fan chamber 37, a fan 98 may be provided comprising a series of vanes 99 conveniently mounted on the upper side of the disk 69 for the separating fan referred to. The vanes 99 may conveniently be of the same radius and area as the vanes 67 of the separating fan. The construction is such that three fans are provided, one located in the chamber 37, and two in the chamber 39, and in the present instance the fans 65 and 98 within the chamber 39 are formed by securing blades to the opposite sides of the disk 69.

The separating fan and the fan 98 both tend to cause the air current to move outward, and since they are of the same radius and area, and driven at the same speed, the fan 98 tends to neutralize the effort of the separating fan to force the air into the upper fan chamber 37. This neutralizing effect of the fan 98 will, therefore, tend to prevent the lighter air particles or fines from passing from the collecting chamber through the opening 35 in the partition 37 into the upper fan chamber, and will thus have a desirable cleaning effect on the air.

It will be noted that the air feed fan and the separating fan have the same radius and rotative speed as the air cleaning fan. As a consequence, the air feed fan and separating fan will cause the air current to flow around the periphery of the disk 69 between the vanes 99 of the air cleaning fan against the opposition of said vanes to such movement of the air current. In other words, the air feed fan and the separating fan coöperate

and have in a sense a compounding action tending to feed the air current from the separating chamber into the upper fan chamber, while the cleaning fan opposes such movement of the air current. The opposition to the air current by the cleaning fan, therefore, serves to check the air current and produces a centrifugal effect tending to blow the fines outward from the air current flowing around the periphery of the disk 69, and this desirably serves to tend to clean the air current returning through the upper fan chamber 37 and through the by-pass pipe to the separating chamber.

The operation of the separator described will be readily understood. The materials to be graded are fed into the hopper 73 and fall into the path of the air current moving upward in the inclined pipe 47, and thence upward through the separating chamber. The heavier particles will gravitate downward through the air current and be discharged through the outlet 87, while the lighter particles will be carried upward with the air current, and outward into the collecting chamber, where they will flow downward and be discharged through the outlet 5.

The rifling or ribs 97 on the wall of the separating chamber and the separating fan will coöperate to produce a whirl of the air as it passes upward through the separating chamber and outward into the collecting chamber. This whirl of the air current will develop a centrifugal force effect which will tend to throw the tailings outward farther than the fines. As a consequence, they will tend to move in different paths, and the tailings will not impinge upon and pull down the fines therewith. This will materially contribute to efficient classification of the materials.

It will be noted that the separating and collecting chambers are substantially unobstructed, so that there is no opposition to the upward whirling movement of the air current in the separating chamber, and substantially no opposition to the downward movement of the fines in the collecting chamber. This further contributes to efficient classification of the materials.

It will be understood that the invention is not limited to the specific embodiment shown, and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What is claimed is:—

1. An air separator for grading materials, comprising, in combination, a casing having a separating chamber and a collecting chamber therein, a by-pass passage for conducting air delivered from the upper end of the separating chamber back to the lower end thereof, means to introduce materials to be graded into said passage in the path of the air current therein, an air feed fan for causing the air to move through said passage upwardly into said separating chamber, a separator fan for whirling the air from the separating chamber into the collecting chamber, and a fan located intermediate said air feed fan and separator fan for cleaning materials from the air as it passes from the collecting chamber to said passage.

2. An air separator for grading materials, comprising, in combination, a casing having a separating chamber and a collecting chamber therein, means to conduct air from the upper end of the separating chamber to the lower end thereof in a closed circuit, means to introduce materials to be graded into said air conducting means, that they may be lifted by the air current in the latter into the separating chamber, a fan for causing the air current to move in said circuit, and a fan for cleaning materials from the air current in the course of its transit from the separating chamber to said conducting means.

3. An air separator for grading materials, comprising, in combination, a casing having an inner wall therein dividing the same into a separating chamber and a collecting chamber, a fan for causing air current to move upwardly through the separating chamber, means to introduce materials to be graded into the separating chamber, a fan for whirling the air from the separating chamber into the collecting chamber, and a fan for cleaning materials from the air current as it leaves the collecting chamber.

4. An air separator for grading materials, comprising, in combination, a casing having a separating chamber, a collecting chamber, and upper and lower fan chambers therein, a passage leading from the upper fan chamber to the lower end of the separating chamber, a fan in the upper chamber to force air through said passage into the separating chamber, means to introduce materials to be graded into the air current moving upwardly in the separating chamber, a fan in the lower chamber for whirling the air and the lighter particles from the separating chamber into the collecting chamber, and a fan intermediate the fans referred to, tending to prevent the lighter particles from being carried by the air current into the upper fan chamber.

5. An air separator for grading materials, comprising, in combination, a casing having a separating chamber and a collecting chamber therein, a fan for whirling air from the separating chamber into the collecting chamber, a partition in said casing between the upper end thereof and the separating chamber, and having an opening therein, a conduit leading from the upper end of said casing to the separating chamber, and a fan for drawing air from the collecting chamber through the opening in said partition and

forcing the same around through said conduit into said separating chamber.

6. An air separator for grading materials, comprising, in combination, a separating chamber, a collecting chamber, a passage for conducting materials from the upper end of said separating chamber to the lower end thereof, a vertical shaft above said separating chamber, a fan on said shaft for forcing air through said passage and separating chamber in a closed circuit, a fan on said shaft for whirling the air from said separating chamber into said collecting chamber, and a fan on said shaft for cleaning the air from materials at it passes from the collecting chamber to said passage.

7. An air separator for grading materials, comprising, in combination, a separating chamber, a collecting chamber, a passage for conducting air from the upper end of the separating chamber to the lower end thereof, a fan for causing the air to move in a closed circuit through said passage and separating chamber, a rotary disk above the separating chamber, vanes projecting downward from said disk to whirl the air from the separating chamber into the collecting chamber, and vanes rising from said disk tending to prevent the materials from passing with the air around the periphery of said disk to said passage.

8. An air separator for grading materials, comprising, in combination, a separating chamber, a collecting chamber, means to conduct air to the separating chamber, a fan for causing the air to move through said conducting means into the separating chamber, a fan for causing the air to whirl from the separating chamber into the collecting chamber, and means tending to prevent materials from passing with the air current from the collecting chamber to said conducting means.

9. An air separator for grading materials, comprising, in combination, a separating chamber, a collecting chamber, a passage for conducting air from the upper end of the separating chamber to the lower end thereof, a pair of fans having a compounding action for causing air to move in a closed circuit through said passage and separating chamber, and a fan for cleaning materials from the air as it passes from the collecting chamber to said passage.

10. An air separator for grading materials, comprising, in combination, an outer casing comprising upper and lower conical walls meeting and diverging from their juncture, an inner casing comprising upper and lower conical walls meeting and diverging from their juncture, and dividing the outer casing into a separating chamber and a collecting chamber, a fan above the separating chamber for causing air current to move upward into said separating chamber and into said collecting chamber, and means for conducting the air from the upper end of the collecting chamber to the lower end of the separating chamber, said separating chamber being substantially unobstructed throughout.

11. An air separator for grading materials, comprising, in combination, a casing having a separating chamber and a collecting chamber therein, a passage leading from said collecting chamber to said separating chamber, means to admit materials to be graded into said passage, means to cause air to move in a closed circuit through said passage, separating chamber and collecting chamber, and means tending to maintain a constant velocity of the air current where it meets the materials fed into said passage.

12. An air separator for grading materials, comprising, in combination, a casing having a separating chamber and a collecting chamber therein, a passage leading from said collecting chamber to said separating chamber, means to admit materials to be graded into said passage, means to cause air to move in a closed circuit through said passage, separating chamber and collection chamber, and means adjustable to different positions for varying the strength of the air current where it meets the materials introduced into said passage.

13. An air separator for grading materials, comprising, in combination, a separating chamber, a collecting chamber, a passage for conducting air from said collecting chamber to said separating chamber, a fan for causing the air to move in a closed circuit through said passage, separating chamber and collecting chamber, a hopper for admitting materials to be graded into said passage, and a gate located in said passage adjacent said hopper for regulating the strength of the air current as it meets the materials delivered from the hopper into said passage.

14. An air separator for grading materials, comprising, in combination, a casing, a wall therein dividing said casing into a separating chamber and a collecting chamber, a passage for conducting air from the upper end of said separating chamber to the lower end thereof, means to admit materials to be graded into said passage, and a fan for causing the air to move through said passage and feed the materials up into said separating chamber, the wall of said separating chamber having a series of members projecting inward thereon for causing the air to whirl as it passes upward through said separating chamber.

In testimony whereof, I have signed my name to this specification.

THOMAS J. STURTEVANT.