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AIR SEPARATOR.

APPLICATION FILED JAN. 24, 1920.

1,367,635.

Patented Feb. 8, 1921.

2 SHEETS—SHEET 1.

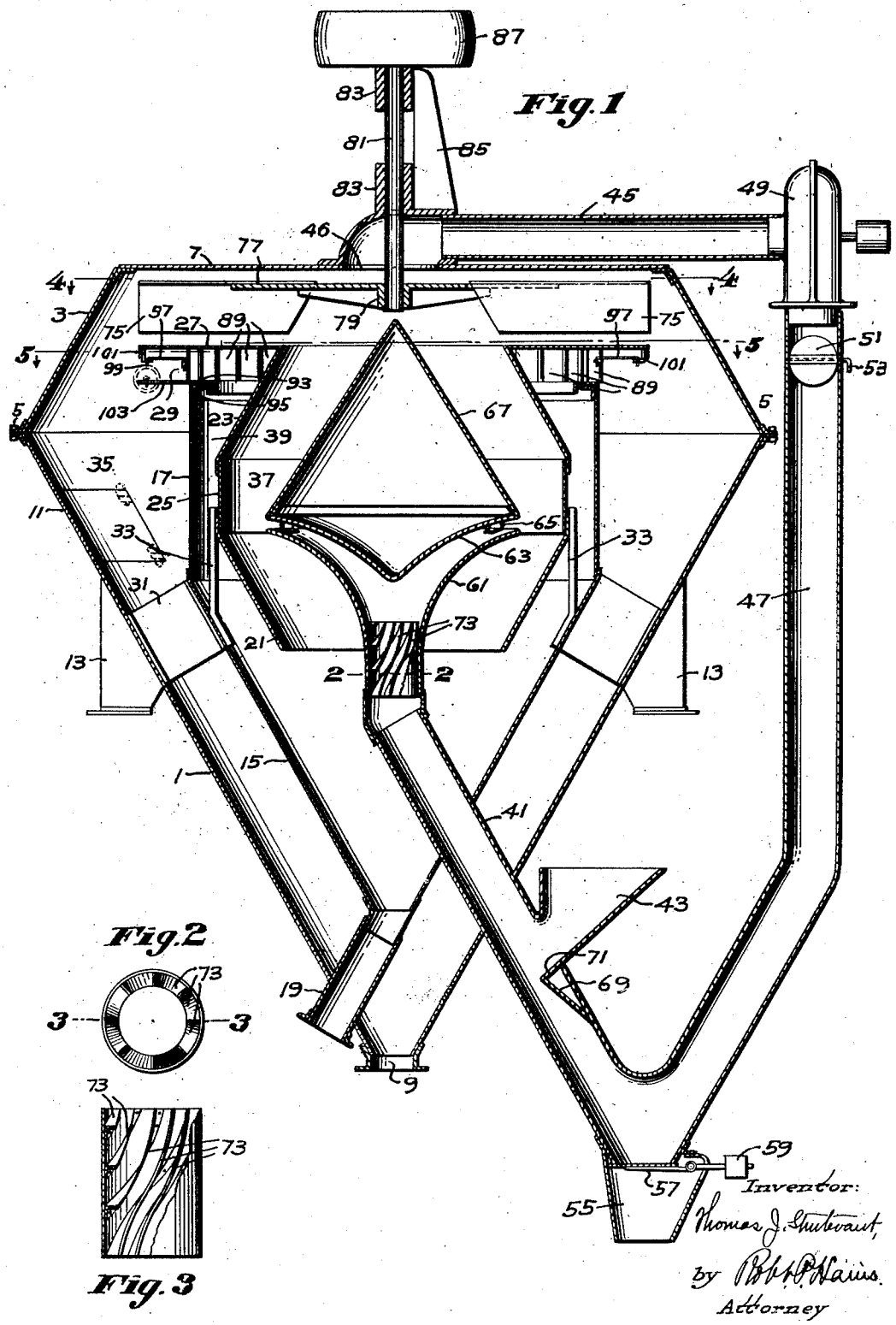


Fig. 1

Fig. 2

Fig. 3

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2 SHEETS—SHEET 2.

Fig. 5

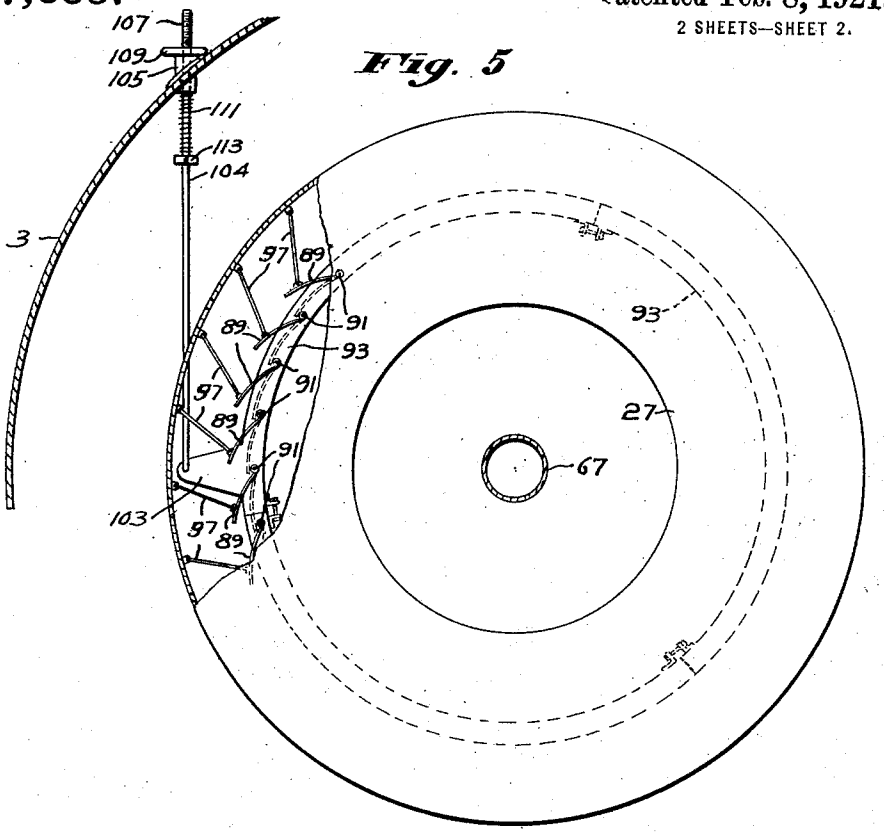
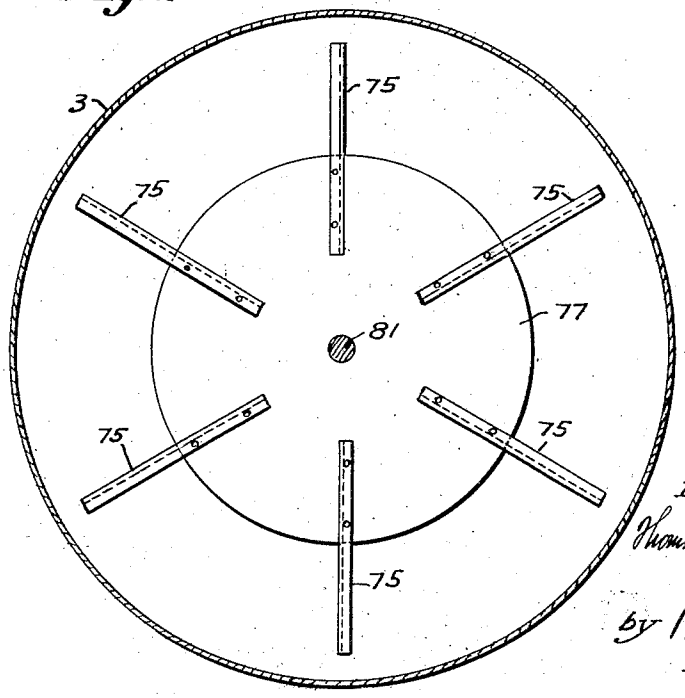


Fig. 4



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UNITED STATES PATENT OFFICE.

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AIR-SEPARATOR.

1,367,635. Specification of Letters Patent. Patented Feb. 8, 1921.

Application filed January 24, 1920. Serial No. 353,689.

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. In separators of this type, a casing is provided having chambers or passages through which an air current is caused to circulate, and the materials to be graded are introduced into the path of the rising air current. The lighter particles are carried along with the air current, while the heavier particles gravitate down through the air current, and the particles thus classified are delivered from the casing through separate outlets.

One of the purposes of the present invention is to provide pneumatic means for feeding the materials to be graded into the casing. In the present instance, this is accomplished by piping constructed and arranged to deliver the materials to be graded upward into the casing.

It is desirable that the materials to be graded and the air current for feeding the same into the casing shall receive a whirl which will generate a centrifugal force tending to cause the materials to move laterally outwardly in a whirling path. The extent of the outward movement of the particles of the materials will vary depending upon the character of the materials. Thus, the materials receive an initial separation which causes them to move in different radial paths. As a consequence, tendency of the heavier particles or tailings to impinge upon and pull down the smaller particles or fines is materially reduced. The whirl of the air current causes the particles to move in spiral paths, thereby prolonging their travel through the separating chamber, and causing the same to pass therethrough in a much longer path of travel than if the materials were caused to move directly vertically through the separating chamber. This allows the air to have a prolonged action upon the particles, and enables more efficient cleaning of the fines from the tailings than would be possible if the particles were caused to move directly vertically through the separating chamber.

Suitable means may be provided to cause the pneumatic current for feeding the materials into the casing to have its whirling character and centrifugal effect upon the particles. In the present instance, this means is in the form of a rifling or spirally disposed ribs projecting inwardly from the wall of the tube through which the materials are forced pneumatically into the separator.

Another purpose of the invention is to provide the pneumatic means for feeding the materials to be graded into the separator with provision for scalping the materials or separating fines from tailings as they pass upwardly through the feeding-in pipe into the separator.

Another purpose of the invention is to provide a fan or blower for feeding the materials to be graded pneumatically into the casing, and another fan or blower for causing an air current to rise upwardly through the separating chamber to grade the materials, said fans or blowers being driven at differential speeds so that the pneumatic feed fan or blower will have a higher air pressure effect than the other fan or blower.

The air for feeding the materials into the separator may move in a closed circuit, passing the fan for producing the rising air current in the separating chamber, the construction being such that the latter fan will generate a centrifugal force tending to carry the particles out of the air current returning to the pneumatic feed fan, thereby to clean or free the returning air from materials.

The lighter particles separated may be carried by the air current into an outer chamber and be delivered therefrom through one outlet, and the heavier particles gravitating through the separating chamber may be delivered therefrom through another outlet, and the heavier particles separated by the pneumatic feeding-in means may be delivered through still another outlet, the construction being such that the materials may be separated into three grades. Another purpose of the invention is to provide valve means between the separating chamber and the outer chamber for regulating the

strength of the air current returning from the outer chamber into the separating chamber, and in some instances this valve means may be closed so that the air current will have a circuit through the pneumatic feeding-in means and through the separating chamber past the fan for producing the upward current of air through the separating chamber.

Another purpose of the invention is to provide fans or means for producing separate air currents which may combine in the casing for the purpose of effecting pneumatic separation of the materials, and the construction may be such that materials may be subjected to the action of both currents in succession.

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 of means for carrying the invention into practical effect, shown in the accompanying drawings, wherein:

Figure 1 is a vertical section through the separator selected as one embodiment of the invention;

Fig. 2 on an enlarged scale is a horizontal section taken on line 2—2 of Fig. 1;

Fig. 3 is a vertical section taken on line 3—3 of Fig. 2;

Fig. 4 is a horizontal section taken on line 4—4 of Fig. 1; and

Fig. 5 is a horizontal section taken on line 5—5 of Fig. 1.

Referring to the drawings, the separator shown therein as one good form of the invention, comprises an outer casing having a lower conical wall 1 and an upper conical wall 3 having outturned flanges which may be detachably connected by bolts 5 disposed at suitable intervals, the upper and lower walls diverging from their juncture for a purpose to be described. The upper end of the casing may be provided with a head 7 secured to the upper edge of the upper conical wall 3. The lower end of the casing may have an outlet 9 for discharging the finest particles therefrom, as more fully hereinafter described. A door 11, preferably sufficiently large to admit a man to the interior of the casing, may be provided in the lower conical wall 1. Suitable means may be provided to support the outer casing, in the present instance, in the form of brackets or feet 13 secured to the outer casing and adapted to rest on beams or other supporting means (not shown).

Mounted within the outer casing and spaced a substantial distance therefrom is an inner casing comprising a conical wall 15 and a cylindrical wall 17 above and secured thereto. The lower end of the conical wall may be connected to a chute 19 entered through the lower conical wall 1 of the outer casing, and adapted to discharge the finer tailings from the casing, as more fully hereinafter described.

Mounted within and spaced from the inner wall is a lower conical wall 21 and an upper conical wall 23 connected by an intermediate cylindrical wall 25. Secured to and projecting outwardly from the upper edge of the upper conical wall 23 is a ring plate 27 spaced a substantial distance beneath the head 7 of the outer casing, and spaced a substantial distance above the upper edge of the cylindrical wall 17 of the inner casing to afford an opening 29 between them. Suitable means may be provided to support the walls 15, 21, 23 and 25, in the present instance, in the form of brackets 31 between the walls 1 and 15 opposite the brackets 13, and brackets 33 between the walls 15 and 21. The walls described provide an outer chamber 35, an inner or separating chamber 37, and an intermediate chamber or passage 39 affording communication between the outer and inner chambers.

The pneumatic means for feeding the materials to be graded in the separator, in the present instance, comprises a pipe 41 projecting toward the inner chamber and preferably disposed obliquely. The materials to be graded may be introduced into the pipe 41 through a mouth or hopper 43, in the present instance, communicating with the pipe 41 adjacent the lower end of the casing. A horizontal pipe 45 may be mounted on the top of the head of the outer casing and communicating with the interior of the latter through an opening 46 in said head. An upright pipe 47 may have its upper end in communication with the horizontal pipe 45, and its lower end may be in communication with the pipe 41 at a point a substantial distance beneath the hopper 43. Suitable means may be provided for causing an air current to flow through said pipes, in the present instance, in the form of a fan or blower 49 conveniently located at the juncture of the horizontal pipe 45 and the upright pipe 47. Since this fan or blower may be of a construction well known in the art, it is unnecessary to show and describe the same in detail herein. The air current passing through the pipes may be regulated by a valve 51 conveniently mounted in the upright pipe 47 and having a handle 53 accessible externally of said pipe. The coarser tailings may be discharged from the pipe 41 through an outlet 55 normally cut off from communication with the pipe 41 by a valve or gate 57 provided with a weight 59 tending to close said valve. The construction is such that when a sufficient weight of the coarser tailings has accumulated on the valve or gate 57, it will cause

the same automatically to open to discharge the tailings through the outlet 55. Thereupon, the weight will automatically close the valve again.

Mounted on the upper end of the feeding-in pipe 41, a wall or mouth 61 may be provided preferably flaring upwardly and outwardly. Above, opposed to and spaced from this flaring mouth, an inverted cone 63 may be provided secured to said mouth by brackets 65 disposed at suitable intervals and so small that they do not offer substantial obstruction to the flaring annular passage between said mouth and cone. Mounted upon the inverted cone 63, and spaced from the conical wall 23 referred to, an upright cone 67 may be provided, the wall 23 and the cone 67 affording an annular passage for directing the air current and particles upwardly and inwardly, as more fully hereinafter described.

When the fan or blower 49 is rotated, it will cause an air current to flow in a closed circuit through the pipes 47 and 41, thence upward through the flaring annular passage between the throat 61 and the inverted cone 63, and thence upward to the horizontal pipe 45 back to the fan. As the air current passes the hopper 43, it will pick up the materials flowing downward therethrough and carry the finer tailings upward through the pipe 41 into the separating chamber 37. The coarser tailings will gravitate downward beneath the hopper through the pipe 41, and will be delivered through the outlet 55 as described. To direct the air current upward past the hopper 43 and tend to prevent driving materials upward through the hopper, baffle means may be provided conveniently in the form of an inclined wall 69 meeting an extension 71 of the lower end of the hopper.

As stated, one of the purposes of the invention is to provide means for causing a whirl of the air current passing upward through the separating chamber. This means, in the present instance, comprises a rifling or series of ribs 73 projecting inwardly from the base of the throat with an inclined or spiral disposition such that the air current on passing the same, has imparted thereto a pronounced whirl effect. This whirling air current passes thence upward through the flaring passage into the separating chamber, and generates a centrifugal force effect on the particles causing some to move outward nearer to the walls 25 and 23 than others, depending upon the character of the particles. As a consequence, the heavier and lighter particles tend to move downward and upward respectively in different paths, and the tendency of the heavier particles to impinge upon the lighter particles and carry the same downward is materially diminished. The air current will whirl upward through the separating chamber in a prolonged spiral path, allowing the air current time efficiently to clean the finer particles from the heavier particles. The finer particles will be carried on upward and outward into the outer chamber, while the heavier particles will gravitate downward through the separating chamber, and they will be delivered through the outlets 9 and 19 respectively.

As stated, it is desirable to provide a second fan or blower for causing the air current to move upward through the separating chamber. This fan or blower, in the present instance, comprises a series of vanes 75 carried by a circular plate 77 having a hub 79 mounted on a shaft 81 projecting upward through the opening 46 in the head of the outer casing. This shaft may project upward beyond the horizontal pipe 45 and be journaled in bearings 83 carried by a standard 85 mounted on the head. The shaft may have a pulley 87 at the upper end thereof adapted to be driven by a belt from any suitable source of power. The circular plate 77 of the fan may have a radius or area such that it may project a substantial distance outward beyond the opening 46 in the head of the outer casing to direct the lighter particles outwardly between the vanes of the fan and tend to prevent return of the lighter particles through the horizontal pipe 45 to the pneumatic feeding-in fan 49. The fan vanes 75 will cause the air current to circulate upward through the separating chamber, and generate a centrifugal force effect which will tend to cause the materials to pass outward between the vanes into the outer chamber, and will tend to clear the air returned through the pipe 45 from the particles. Thus, air current rising upward through the separating chamber is developed both by the feeding-in fan 49 and the fan 75, the current developed by the former uniting with the current developed by the latter in the separating chamber, and both contributing to the air current rising through the separating chamber for grading the materials.

The air current delivered by the fan 75 into the outer chamber, may return through the opening 29 and the chamber 39 back into the separating chamber. Suitable valve means may be provided to control or regulate the air current passing through said opening. This valve means, in the present instance, comprises a series of vanes 89 which may be mounted on shafts 91 rising upwardly from an angle ring 93 resting on an angle ring 95 secured to the upper edge of the cylindrical wall 17. Each of these vanes 89 may be connected by a link 97 with a lug 99 on a circular flange 101 depending from the periphery of the ring plate 27 referred to. To adjust the vane carrying ring

93 circumferentially with respect to the ring 95 on which it rests, an arm 103 may be provided on the ring 93, and may be connected to one end of a rod 104, the opposite end of which projects through a sleeve 105 mounted on the outer casing. A threaded portion 107 of the rod 103 projects outward beyond the sleeve 105, and a hand nut 109 may be mounted thereon. A coil spring 111 may be confined between a collar 113 on the rod 104 and the inner end of the sleeve 105. The construction is such that adjustment of the hand nut will shift the rod, and through the arm 103 will adjust the vane supporting ring 93 circumferentially of the ring 95 on which it rests, and thereby bodily move the vanes 89 and enable variation of the openings between said vanes, or allow closure of said vanes as desired. This valve means may be substantially the same as that shown, described and claimed in my copending application Serial No. 351,403, filed January 14, 1920.

In operation, the materials to be graded are introduced into the hopper 43 and flow downward into the pipe 41, where they are caught by the air current and the coarser tailings will gravitate downward and be discharged through the outlet 55, while the finer tailings will be carried up through the pipe 41 and into the separating chamber, where they will receive further separation, the finer tailings gravitating downward through said chamber and out through the outlet 19, while the fines are carried upward through the separating chamber past the fan 75 into the outer chamber 35, and are discharged through the outlet 9. A portion of the air current may pass outward around the edge of the fan plate 77 and thence inward and upward through the opening 46 to the pipe 45 leading to the fan 49, and a portion of the air may pass outward between the blades of the fan into the outer chamber 35, and thence through the opening 29 past the vanes 89 downward through the intermediate chamber 39, and thence upward through the separating chamber. Thus, when the vanes are adjusted to open position, two air circuits may occur in the operation of the separator, one passing through the pneumatic feed pipes and the separating chamber, and the other passing through the outer chamber, the intermediate chamber and the separating chamber.

In some instances, the vanes 89 may be adjusted completely to close the opening 29 between the outer and inner chambers, and then merely one air current circuit occurs and passes through the pneumatic feed pipes and the circulating chamber.

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 chambers therein, means for causing an air current to circulate in a circuit through said chambers, and pneumatic means for feeding materials to be graded in the path of said air current, and having provision for causing a whirl of the feeding-in air current to develop centrifugal force tending to cause the materials to move transversely of the first mentioned air current.

2. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, a pipe having its opposite ends connected to the opposite ends of said separating chamber, means to admit materials to be graded into said pipe, means to generate an upward air current in said pipe to carry the materials upward into said separating chamber, and means for imparting a whirling movement to the air current as it is delivered to the separating chamber.

3. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, means including a pipe for conducting air from the separating chamber and returning the air thereto in the form of an upwardly directed current, means to introduce materials to be graded into said pipe, and means for imparting a whirling movement to the air current as it is delivered to the separating chamber.

4. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, a pipe having a flaring mouth projecting toward said separating chamber, means for conducting air from the separating chamber and forcibly returning the same to the separating chamber through said pipe, means to admit materials to be graded into said pipe, and means for imparting a whirling motion to the air and materials carried thereby as they pass from the flaring mouth to the separating chamber.

5. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, a fan for causing an air current to pass upwardly through said separating chamber, a pipe communicating with said casing above said fan and having a portion projecting upward into the casing beneath said fan, and a second fan for causing an air current to flow through said pipe and carry materials to be graded upward into said separating chamber, said first fan operable to disperse materials from the entrance to said pipe.

6. A air separator for grading materials,

comprising, in combination, a casing having a separating chamber therein, means to cause an air current to pass upward through said separating chamber and carry materials to be graded therein, and a fan located in the path of said air current for forcing materials therefrom and preventing return of materials to said separating chamber.

7. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, a pipe communicating with the upper end of said casing and having a portion projecting upwardly into said casing, a fan for causing an air current to flow through said pipe and separating chamber in a closed circuit, means to introduce materials to be graded into said pipe to be lifted by said air current into said separating chamber, and a fan for causing an air current to move transversely to said first-named air current to drive materials therefrom and prevent return thereof to said pipe.

8. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, means for causing an air current to flow upwardly through said separating chamber, and means to generate an air current for feeding materials upwardly into said separating chamber and having provision for scalping the coarser tailings from the materials.

9. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, a pipe projecting upwardly into said casing, means to admit materials to be graded into said pipe, means to cause an air current to flow through said pipe and carry finer materials up into said separating chamber, and means to allow coarser materials flowing through the air current in said pipe to escape therefrom.

10. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, a fan in said casing for causing an air current to rise through said separating chamber, a fan located externally of said casing, means extending from said external fan to said separating chamber to conduct air current from said external fan to said separating chamber, and means to admit materials into said conducting means, that the air current therein may lift the materials up into said separating chamber into the path of the rising air current therein.

11. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, and means including a pair of fans for causing an air current to pass upwardly through said separating chamber, one of said fans adapted to generate a stronger air current than the other and the other fan positioned to deflect materials from the path of the air current produced by the stronger fan.

12. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, conducting means projecting upwardly into said casing having a flaring mouth, means to conduct air from the separating chamber and forcibly return the same thereto upwardly through said conducting means and mouth into said separating chamber, means for introducing materials to be graded into said conducting means and means in said conducting means for causing the air current to whirl as it issues from said mouth and generate centrifugal force tending to carry the materials outwardly as they pass upwardly through said separating chamber.

13. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, a fan adjacent the upper end of said chamber for causing an air current to rise therethrough, means for taking air above said fan and forcing the same upwardly into said separating chamber, and means to admit materials to be graded into the path of the air thus delivered upward into the separating chamber.

14. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein provided with an outlet, a pipe projecting upwardly into said casing toward said separating chamber, and having an outlet located externally of said casing, means to admit the materials into said pipe above the outlet therein, and means to cause an air current to flow upwardly through said pipe and carry finer particles into said separating chamber for delivery through the outlet thereof, and allow coarser particles to gravitate downward through said pipe for delivery from the outlet thereof.

15. An air separator for grading materials, comprising, in combination, a casing having outer and inner chambers therein, a pipe projecting upwardly toward said inner chamber, said chambers and pipe having outlets therein, means to admit materials to be graded into said pipe above its outlet, and means to cause an air current to pass upwardly through said pipe to carry finer tailings into said inner chamber and fines into said outer chamber for delivery into the outlets of said chambers, and allow coarser tailings to gravitate through said pipe for delivery through the outlet thereof.

16. An air separator for grading materials, comprising, in combination, a casing having outer and inner chambers therein, a fan for causing air current to move in a circuit upward in said inner chamber and downward in said outer chamber, and pneu-

matic means for conducting materials to be graded into said inner chamber in the path of the rising current therein.

17. An air separator for grading materials, comprising, in combination, a casing having outer and inner chambers therein, a fan for causing an air current to rise upward in said inner chamber and downward in said outer chamber, a pipe having ends above and beneath said fan in communication with said inner chamber, a fan for causing an air current to flow through said pipe upward into said inner chamber past the fan above the latter and back through said pipe to said inner chamber in a closed circuit, and means to introduce materials to be graded into said pipe, that they may be lifted by the air current therein into said inner chamber.

18. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, means including a pipe to conduct an air current in a closed circuit through said separating chamber, means to admit materials to be graded in the path of said air current as the latter passes through the pipe, that they may be lifted into said separating chamber, and means tending to clean the materials from the air current on leaving the separating chamber.

19. An air separator for grading materials, comprising, in combination, a casing having outer and inner chambers therein with an opening between them, a fan for causing an air current to pass upward in said inner chamber, downward through said outer chamber, and thence through said opening to said inner chamber, and pneumatic means for feeding materials to be graded in the path of the current rising in the inner chamber.

20. An air separator for grading materials, comprising, in combination, a casing having outer and inner chambers therein with an opening between them, means for causing an air current to pass in a closed circuit upward through said inner chamber, means to admit materials to be graded in the path of the air current that they may be elevated into the path of said air circuit, and valve means for said opening to allow the air current to pass from the outer chamber back to the inner chamber, or prevent such passage of the air current at will.

21. An air separator for grading materials, comprising, in combination, a casing having a separating chamber therein, a pipe for taking air from the upper end of said separating chamber and conducting the same upward into said chamber, a fan for causing the air to flow through said pipe, valve means for regulating the flow of air through said pipe, and means for admitting materials to be graded into said pipe to be elevated by the air current therein into said separating chamber.

22. An air separator for grading materials, comprising, in combination, a casing having outer and inner chambers therein, pneumatic means for causing air to whirl upwardly through said inner chamber and conduct materials to be graded therein, and a fan for causing whirling air currents to force the lighter materials from the first-named current outward into the outer chamber, while the heavier materials gravitate downward through the air current rising in the inner chamber.

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

THOMAS J. STURTEVANT.