

(No Model.)

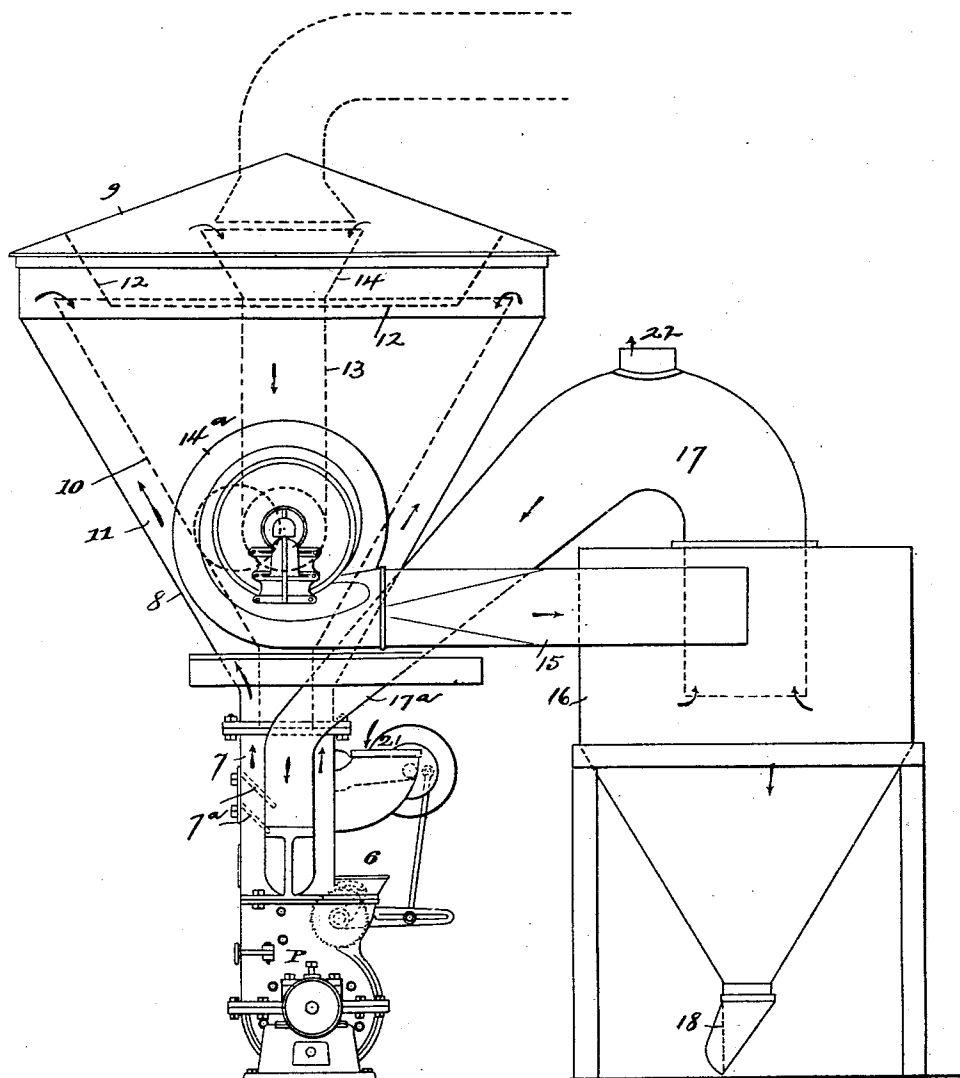
5 Sheets—Sheet 1.

G. & A. RAYMOND.
PNEUMATIC SEPARATOR.

No. 580,145.

Patented Apr. 6, 1897.

Fig. 1.



Witnesses,
F. J. Mann,
Frederick Goodrum

Inventors,
George Raymond
Albert Raymond
By *Officed. Soule & Lathrop,*
Attys.

(No Model.)

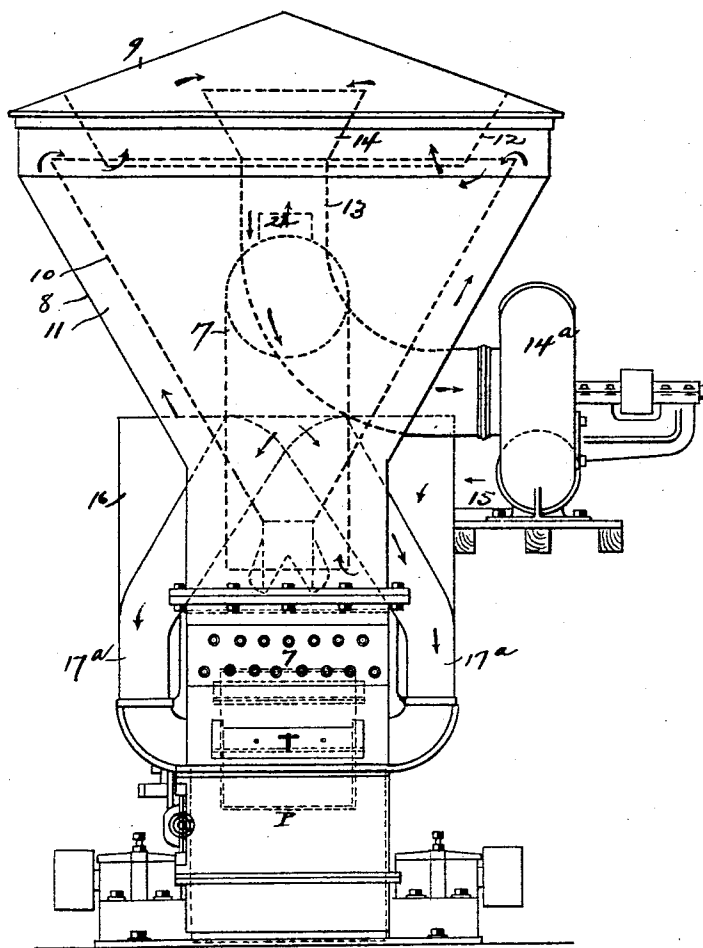
5 Sheets—Sheet 2.

G. & A. RAYMOND.
PNEUMATIC SEPARATOR.

No. 580,145.

Patented Apr. 6, 1897.

Fig. 2.



Witnesses,
F. D. Mann,
Frederick F. Goodwin

Inventors,
George Raymond
Albert Raymond
By *Official Seal & Signature,*
Atty.

(No Model.)

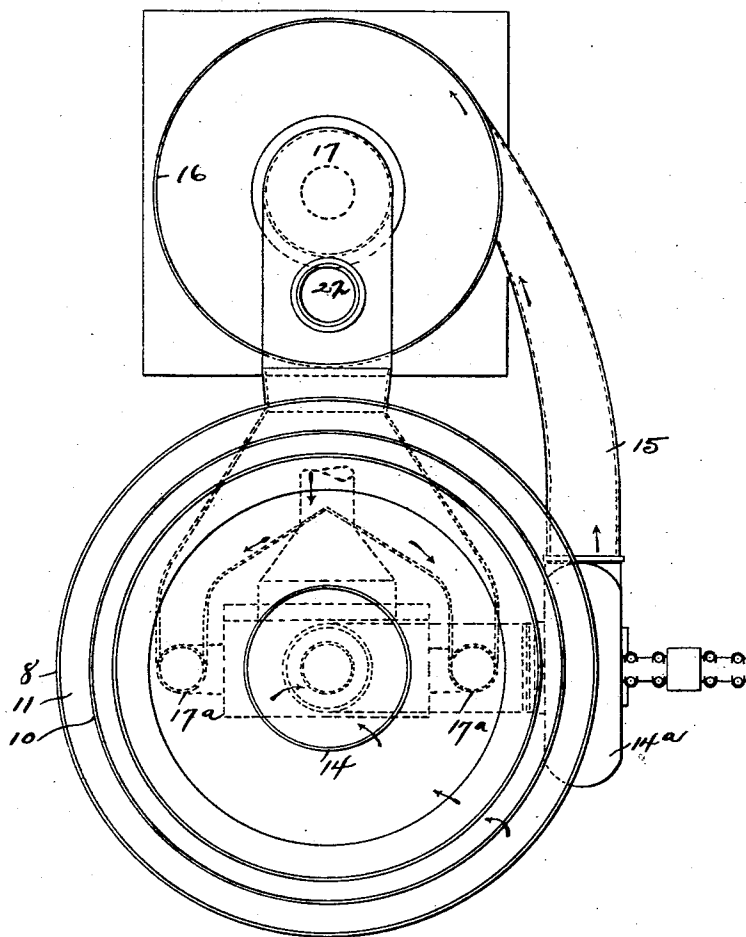
5 Sheets—Sheet 3.

G. & A. RAYMOND.
PNEUMATIC SEPARATOR.

No. 580,145.

Patented Apr. 6, 1897.

Fig. 3.



Witnesses,

F. D. Mann
Frederick Goodrum

Inventors.

George Raymond
Albert Raymond
By *Offield, Smith & Zutterlin,*
Attys.

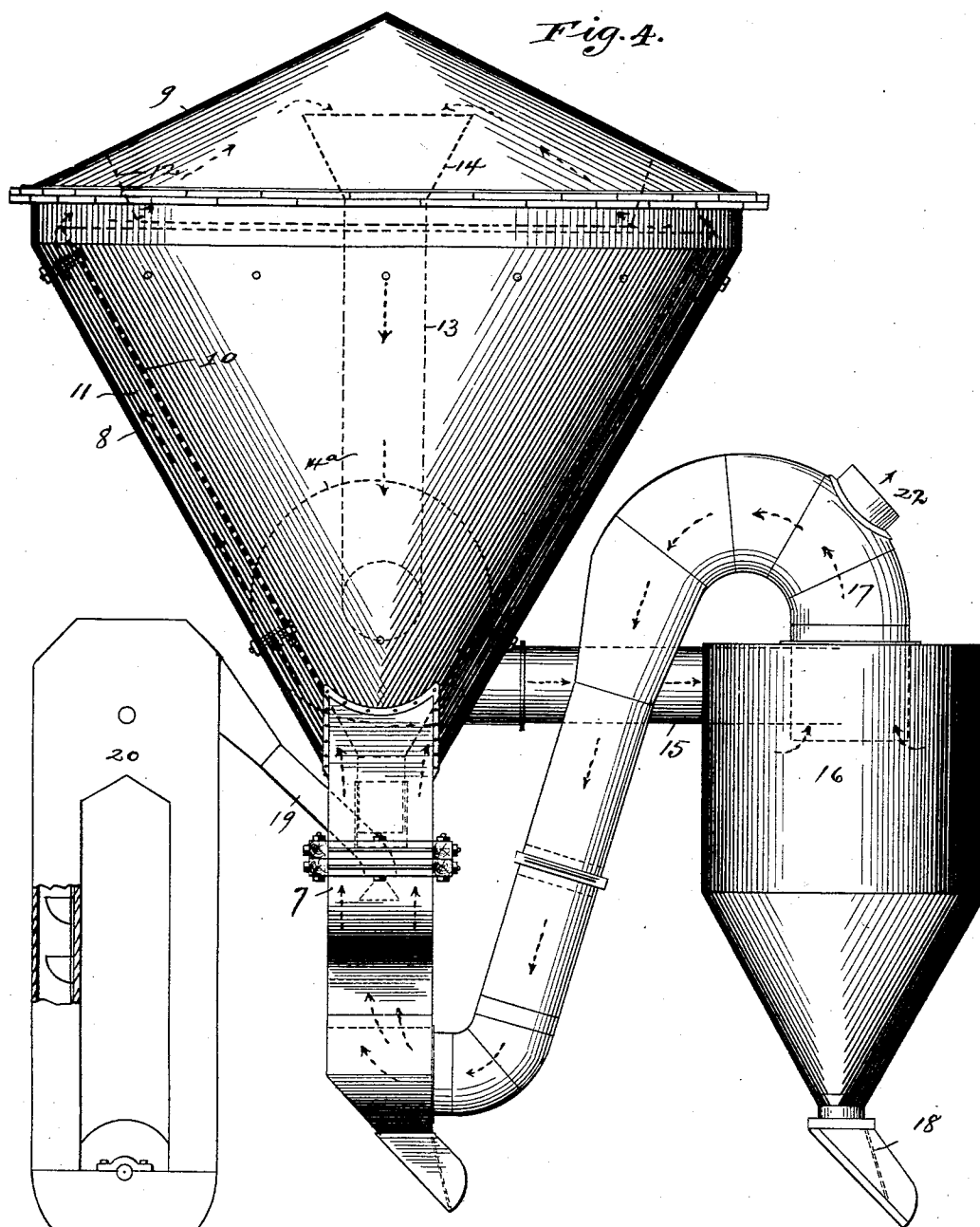
(No Model.)

5 Sheets—Sheet 4.

G. & A. RAYMOND.
PNEUMATIC SEPARATOR.

No. 580,145.

Patented Apr. 6, 1897.



Witnesses,
J. D. Mann,
Frederick Goodrum

Inventors,
George Raymond
Albert Raymond
By *Offield, Sault & Pittman,*
Attys.

(No Model.)

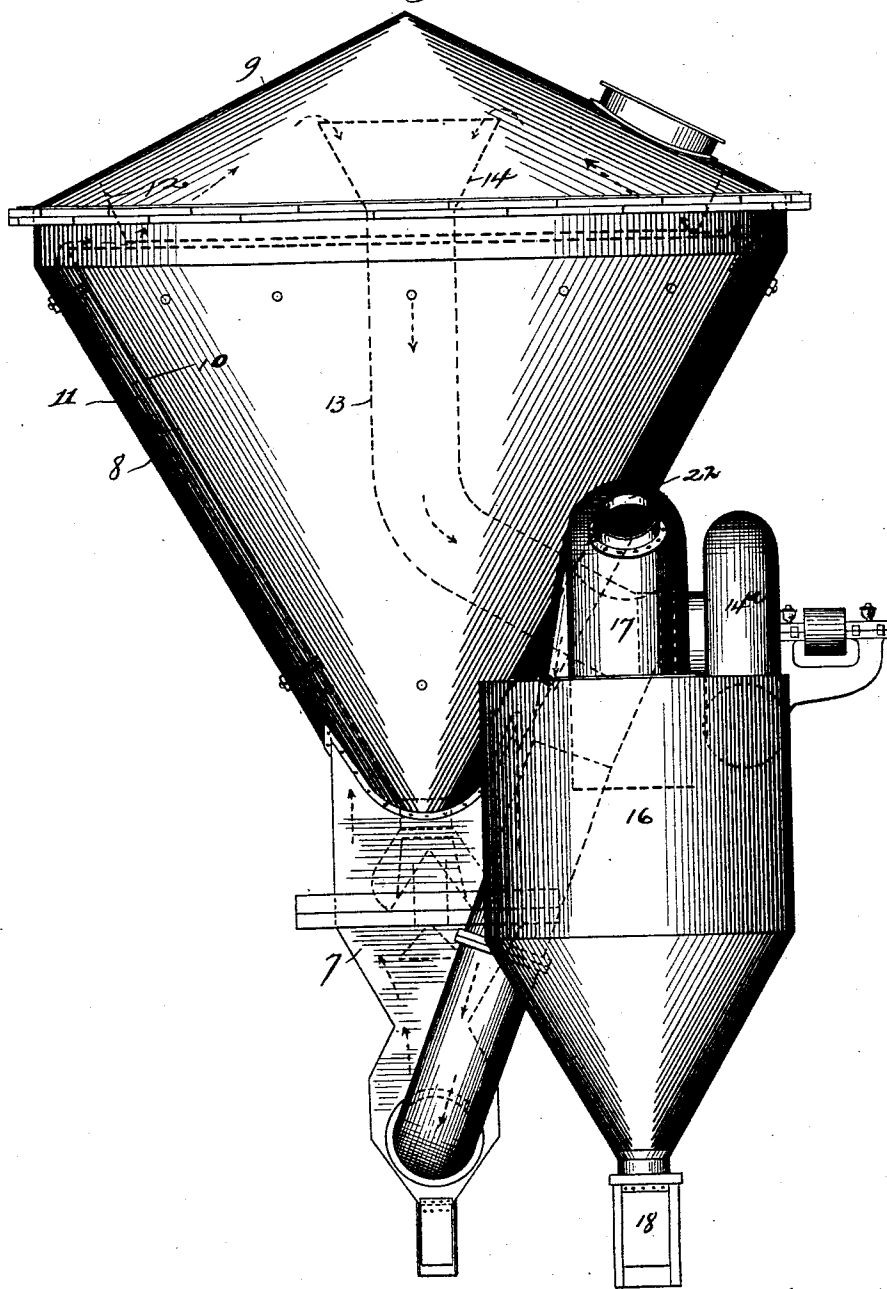
5 Sheets—Sheet 5.

G. & A. RAYMOND.
PNEUMATIC SEPARATOR.

No. 580,145.

Patented Apr. 6, 1897.

Fig. 5.



Witnesses,

J. S. Maun,
Frederick Goodwin

Inventors,

George Raymond
Albert Raymond
By *Offield, Smith & Finkbeiner,*
Attys.

UNITED STATES PATENT OFFICE.

GEORGE RAYMOND AND ALBERT RAYMOND, OF CHICAGO, ILLINOIS,
ASSIGNORS TO THE RAYMOND BROTHERS IMPACT PULVERIZER
COMPANY, OF SAME PLACE.

PNEUMATIC SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 580,145, dated April 6, 1897.

Application filed September 21, 1896. Serial No. 606,508. (No model.)

To all whom it may concern:

Be it known that we, GEORGE RAYMOND and ALBERT RAYMOND, of Chicago, Illinois, have invented certain new and useful Improvements in Pneumatic Separators, of which the following is a specification.

This invention has relation to a separator in which the material to be separated is carried by a moving air-current and the separation is effected by gravity; and the invention is particularly adapted for use in connection with the treatment of materials wherein the finished product, or one grade thereof, is in the form of a impalpable powder.

We have shown our invention in one form embodied in an apparatus in which a pulverizer is employed for grinding or comminuting the material, such pulverizer having an upward discharge communicating through a stack or trunk with our improved separator. An exhaust-fan is connected with the separator and an air-current, laden with the finely-divided material, is caused to pass through such separator in which the gravity separation is effected. The fan, as shown, carries the finest material into a dust-collector of known construction, wherein such fine material is collected and the purified air escapes back into the pulverizer. In another form the pulverizer is omitted and the material is delivered into the separator by means of an elevating-conveyor.

In the accompanying drawings, Figure 1 is a side elevation of the apparatus described. Fig. 2 is an end elevation, and Fig. 3 a plan, showing our separator used in connection with a pulverizer. Figs. 4 and 5 show our improvements as used without the pulverizer, the material being delivered to the separator by an elevating-conveyor.

It will be understood that our invention is applicable for use in connection with any kind of pulverizing or grinding machinery, and we will not therefore particularly describe the construction of pulverizer, that shown being of a type invented by us and described in our Patent No. 415,421, dated November 19, 1889. Such a pulverizer is indicated at P.

The material to be reduced is delivered into the pulverizer through the hopper 6 and is discharged upwardly into the stack or trunk 7 by the rotation of the beaters of the pulverizer. The material is thus cast mechanically upward for some distance into said stack or trunk, the coarser particles being arrested by the fingers 7^a and returning to the pulverizing-chamber to undergo further reduction. These fingers also scatter the material, and thus enable it to be acted upon by the air.

To the upper end of the stack 7 is attached our separator, consisting of the outer conical shell 8, having the closed cover 9 and the inner conical shell 10, arranged concentric to the shell 8 and forming therewith an annular upwardly-expanding chamber 11. The walls of the inner and outer conical shells are substantially parallel to each other, as shown, and are inclined to a considerable degree upward and outward from the lower contracted portion, thereby giving to the annular chamber 11 a constant and material increase in horizontal area. The upper end of the cone 10 terminates slightly below the cap or cover 9, and from the latter depends a conical deflector 12, the lower edge of which is preferably carried slightly below the upper edge of the cone 10. Said deflector may be made adjustable.

A suction-pipe 13 has a flared opening 14 communicating with the interior of the separator just below the cap or cover 9 and centrally of the chamber. The open end of this pipe 14 is preferably above the lower edge of the conical deflector 12 and the upper edge of the cone 10. The suction-pipe 13 extends through the cones 10 and 11, as shown in Fig. 2, and is connected with the eye of an exhaust-fan 14^a. The latter is connected by the discharge-pipe 15 with a dust-collector 16, which may be of the "cyclone" or centrifugal type. The purified air from this dust-collector is discharged through the pipe 17, having branches 17^a, which lead back to the pulverizer and deliver into the stack or trunk 7 near its base, so that the material cast up by the beaters is thrown above the returning air-

currents. The dust-collector may be provided with a trapped discharge 18 for the separated material.

In the form of construction shown in Figs. 4 and 5 the pulverizer is omitted and the material is delivered into the stack or trunk 7 through an inlet-spout 19, to which is connected the elevator-conveyer 20. A single separator may thus be connected to a series of pulverizers or the material may be fed from a hopper by gravity, the inlet for the material being in this construction above the returns from the fan.

The operation of the apparatus may now be understood. In the construction wherein the separator is connected directly to the pulverizer the material being fed in through the hopper 6 is caught by the rotating beaters operating within the pulverizing-chamber and is broken, ground, or comminuted, the material, both coarse and fine, being cast upwardly into the stack or trunk 7. Of course the rotation of the beaters generates a strong current of air, which is admitted through the crevices of the machine, if any there be, but preferably through the independent supply-pipe 21. The material which is too large to be carried upon an air-current returns to the pulverizing-chamber for further reduction, and the fan 14^a being also in motion induces a strong current of air through the separator. This current coöperates with the current produced by the rotation of the beaters and tends to lift the material from the pulverizing-chamber, causing it to pass into the gradually enlarging or expanding chamber 11. The current is strongest, of course, in the lower or narrowest portion of this chamber, and as the current gradually expands the heavier particles drop out and return down the inclined walls of the separator to the pulverizer, while the finer materials pass up with the air-current over the edge of the cone 10, under the edge of the deflector 12, and thence over the edge of the expanded mouth 14 and into the pipe 13, thence through the eye of the fan and to the dust-collector. The current, as before stated, becomes weaker in its upward passage through the chamber 11, owing to the gradual increase in the area of said chamber, and said current, as it passes therefrom over the upper edge of the cone and under the deflector, becomes rarefied, owing to the large area of this portion of the shell as compared with the area of the chamber 11, and also to the tendency to a vacuum, created by the action of the suction-fan through the suction-pipe 13. The air as it passes from the chamber 11 into the upper portion of the shell is laden with the particles, but on becoming rarefied or thinned, as previously stated, said particles are acted upon by gravity and fall from the air-current.

It will be understood that a gradual separation is taking place from the time that the material borne on the air-current enters the

lower end of the separating-chamber 11 of the separator, and that this separation continues, the coarse particles being first dropped out, and as the current continues to expand its carrying power becomes less and the separation proceeds until when the current reaches the top of the cone and is thence deflected under the depending deflector 12 and passes up into the pipe 13 all of the material except that which has been reduced to a powder has been separated by gravity.

The particles as they are returned to the separator are delivered at that point where the blast is the strongest, and any small particles remaining therewith will be removed by the second manipulation.

The walls of the chamber 11, in which is effected a partial separation, are, as previously stated, in substantial parallelism, and the expansion of said chamber is due, therefore, to the employment of conical shells, which provide a constant and material increase in the horizontal area of the chamber and insure a gradual weakening of the ascending air-current without fluctuation.

Now it will be understood that the fineness of the separation will depend upon two conditions—first, the diameter of the cone, and, second, the volume of air which is moving through the separator. The walls of the chamber 11 are necessarily arranged at such angle as to carry the coarse material back into the pulverizer and the volume of the air-current will be proportional to the degree of fineness desired of the reduced material. For example, if it be desired to save the material under treatment in the form of an impalpable powder, then the fan will be adjusted by means of a wind-gate or other familiar appliance, so as to move only a small volume of air and at a low velocity through the chamber 11 and the pipe 13. In its passage from the chamber to the pipe the air-current will part with all of the material except that which is of the fineness desired. By increasing the volume of air a slightly coarser material can be separated, and so on to any desired degree of fineness. The current which passes over into the dust-collector and through the fan contains one grade of material which it is desired to save, and all that falls within the cones 10 and 11 may be returned to the pulverizer, or that which falls within cone 10 may be trapped off and delivered outside of the separator. The trapped discharge (indicated at 21 in Fig. 2) prevents the air from entering through the tip of the cone. The reduced material is separated by centrifugal force within the collector 16 and is discharged through the trap 18 into a suitable receptacle. The purified air is discharged at the upper end of the collector through the pipe 17 and branches 17^a back into the pulverizer.

It will be understood that instead of having the pipe 13 pierce the walls of the separator said pipe might be connected with the

top of the separator, as indicated by the dotted lines in Fig. 1. The purified-air discharge 17 is provided with an opening at 22, which may deliver into a closed separating-chamber, so as to trap any dust which is not separated or caught in the separator 16. The major portion of the air-current, however, returns to the air-chamber through the pulverizer or tailing-spout, the opening 22 serving to relieve the system from surplus air taken in through the pipe 19 and through the shaft-bearings or other crevices of the apparatus.

Our improved separator may be used with other forms of pulverizer and with other means for taking care of the finished product; as, for example, our separator may be applied to various kinds of grinding-machines, and instead of the dust-collector shown other types of collectors or separators may be employed. It is essential, however, to our system to employ some means for inducing an air-current through the separator, which air-current serves to carry the material in suspension and effect its gradual separation by the expansion of said current, this expansion being carried on until only material of the desired fineness is capable of being supported by the current. Our invention has therefore to do principally with what may be termed a "vacuum" or "gravity" separation, and while the apparatus before described is arranged so as to use the same current of air continuously if it were possible to separate the finished material from the carrying air-current without loss this continuity of current would not be essential or even desirable.

Our invention, it will be further observed, works with an induced current of air, and it would not be practicable to use a blast-fan instead of a suction-fan to carry the material through the separators. Furthermore, the air-current is in all cases returned below the material.

We claim—

1. A pneumatic separator consisting of an outer conical shell having a closed head and an opening in its lower contracted portion into which the material to be separated is delivered, and an air-supply opening below said delivery-point, an inner conical shell concentric with and substantially parallel to the outer shell and providing a gradually-expanding annular separating-passage communicating with the air-supply and material-delivery openings, said inner shell being open at its top and terminating below the said closed head, a deflector depending from the closed head, a separating-chamber in the inner shell the area of which is in excess of that of the passage with which it communicates, a discharge-outlet at the lower end of said chamber, a suction-pipe connected to the latter at or near its upper end, and an exhaust-fan connected to said pipe for inducing a

current through said passage and chamber substantially as and for the purpose set forth.

2. A pneumatic separator consisting of an outer conical shell having a closed head and an opening in its lower contracted portion into which the material to be separated is delivered, and an air-supply opening below said delivery-point, an inner conical shell concentric with and substantially parallel to the outer shell and providing a gradually-expanding annular separating-passage communicating with the air-supply and material-delivery openings, said inner shell being open at its top and terminating below the said closed head, a deflector depending from the closed head and having its lower end in or near the plane of the top of the inner shell, a chamber in the inner shell the area of which is in excess of that of the passage with which it communicates, a discharge-outlet at the lower end of said chamber, a suction-pipe connected to the latter at or near its upper end, an exhaust-fan connected to said pipe, and a centrifugal separator or dust-collector into which the suction-fan discharges, substantially as described.

3. A pneumatic separator consisting of an outer conical shell having a closed head and an opening in its lower contracted portion into which the material to be separated is delivered, and an air-supply opening below said delivery-point, an inner conical shell concentric with and substantially parallel to the outer shell and providing a gradually-expanding annular separating-passage communicating with the air-supply and material-delivery openings, said inner shell being open at its top and terminating below the said closed head, a deflector depending from the closed head and having its lower end in or near the plane of the top of the inner shell, a chamber in the inner shell the area of which is in excess of that of the passage with which it communicates, a discharge-outlet at the lower end of said chamber, a suction-pipe connected to the latter at or near its upper end, an exhaust-fan connected to said pipe, and a centrifugal separator or dust-collector into which the suction-fan discharges, and a return-pipe for returning the air-current from the dust-collector back to the separator at its air-supply opening aforesaid, substantially as described.

4. The combination with a pulverizer having an opening leading upward from the pulverizing-chamber, a pneumatic separator mounted upon the pulverizer and communicating with the said chamber, said separator consisting of two conical shells concentrically disposed and having their walls in substantial parallelism, the outer shell having a closed head and an opening in its lower contracted portion into which the material to be separated is delivered from the pulverizing-chamber, the inner shell terminating below said closed head and providing a gradually-expanding annular separating-passage, a separating-

chamber in the separator the area of which is
in excess of that of said passage with which
it communicates, a discharge-outlet at the
lower end of said chamber, a suction-pipe con-
5 nected to the latter at or near its upper end,
an exhaust-fan connected to said suction-pipe,
a centrifugal separator or dust-collector into
which the fan discharges, a pipe for returning
the air from the dust-collector back to the

pulverizing-chamber, and a pipe or passage to
from the inner shell back into the pulverizing-
chamber, substantially as described.

GEORGE RAYMOND.
ALBERT RAYMOND.

Witnesses:

C. C. LINTHICUM,
FREDERICK C. GOODWIN.