

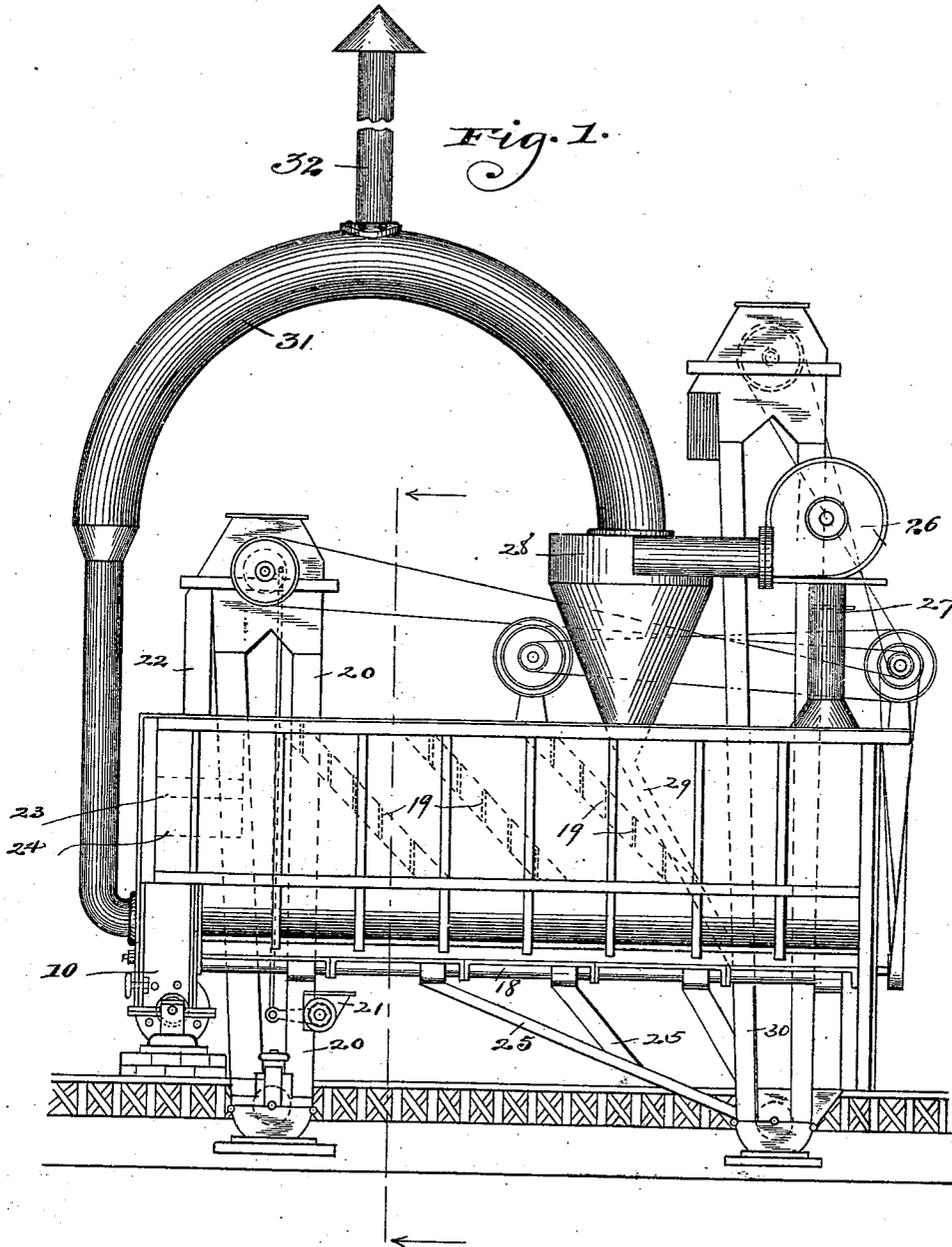
(No Model.)

5 Sheets—Sheet 1.

G. & A. RAYMOND.
COMBINED PULVERIZER AND SEPARATOR.

No. 551,787.

Patented Dec. 24, 1895.



Witnesses,
J. Mann
F. Goodwin

Inventors,
George Raymond
Albert Raymond
By Effield, Fowler & Lutherman
Attys.

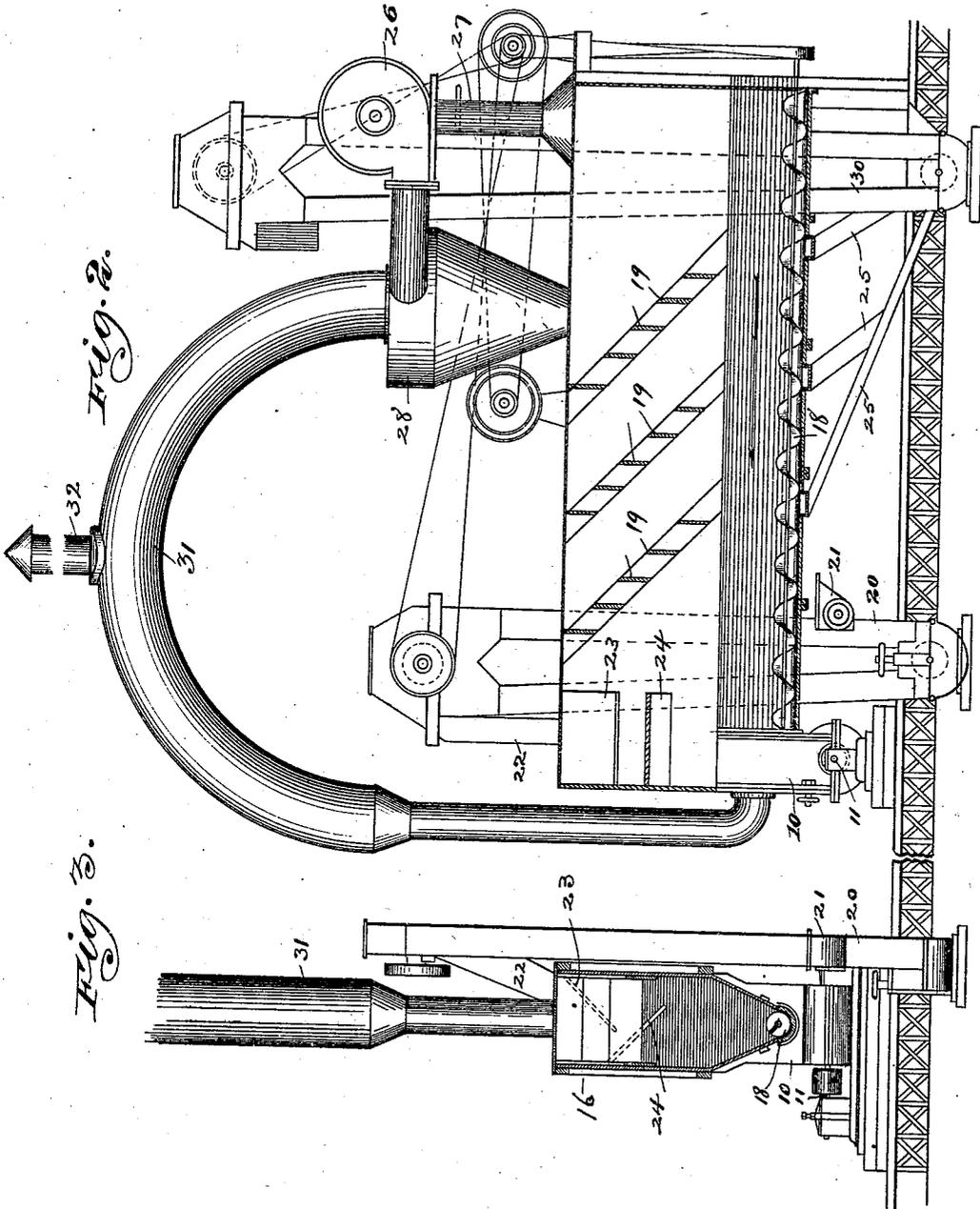
(No Model.)

5 Sheets—Sheet 2.

G. & A. RAYMOND.
COMBINED PULVERIZER AND SEPARATOR.

No. 551,787.

Patented Dec. 24, 1895.



Witnesses,
J. D. Mann,
F. C. Goodwin

Inventors,
George Raymond,
Albert Raymond,
By *Field, Fowler & Luthicum*
Attys.

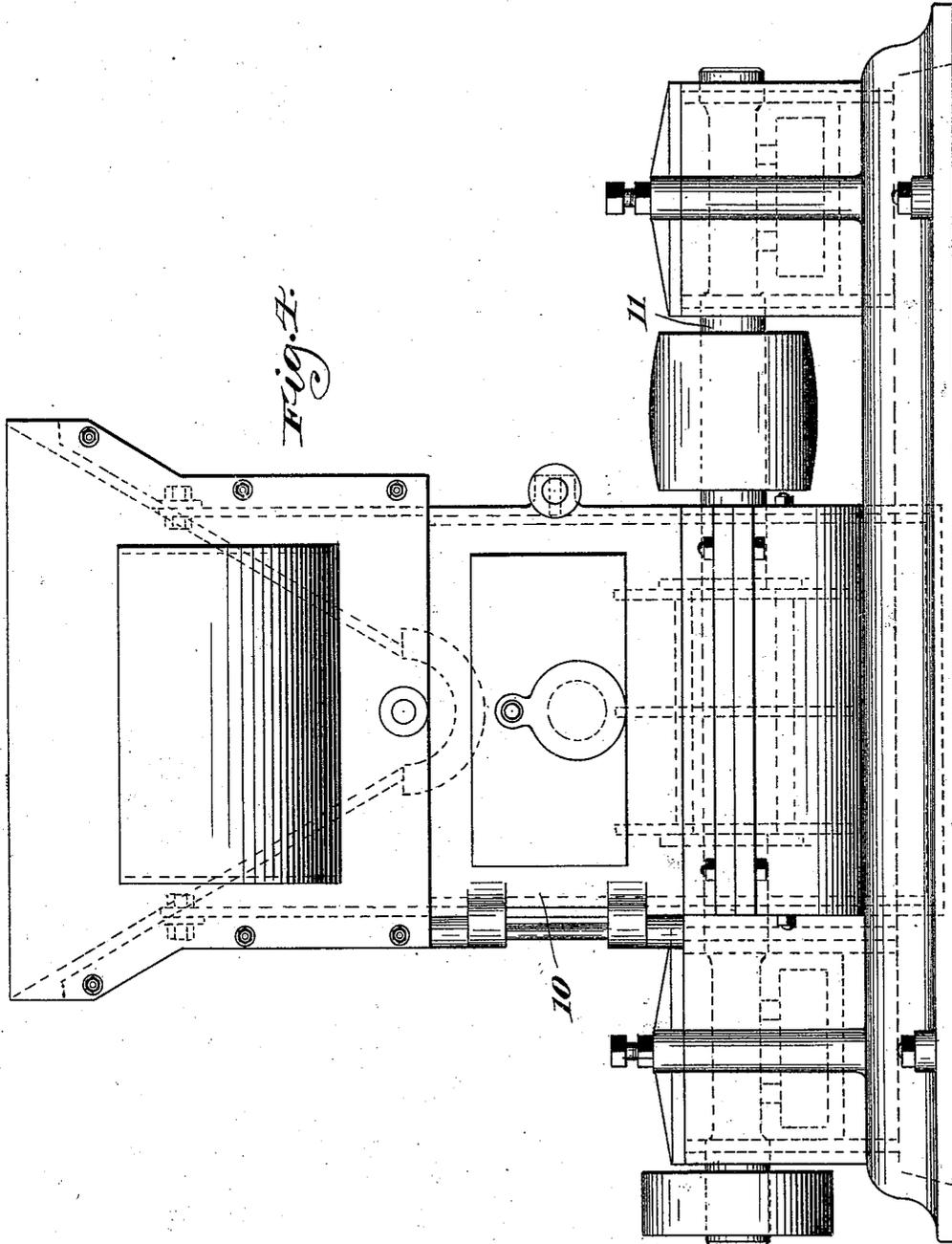
(No Model.)

5 Sheets—Sheet 3.

G. & A. RAYMOND.
COMBINED PULVERIZER AND SEPARATOR.

No. 551,787.

Patented Dec. 24, 1895.



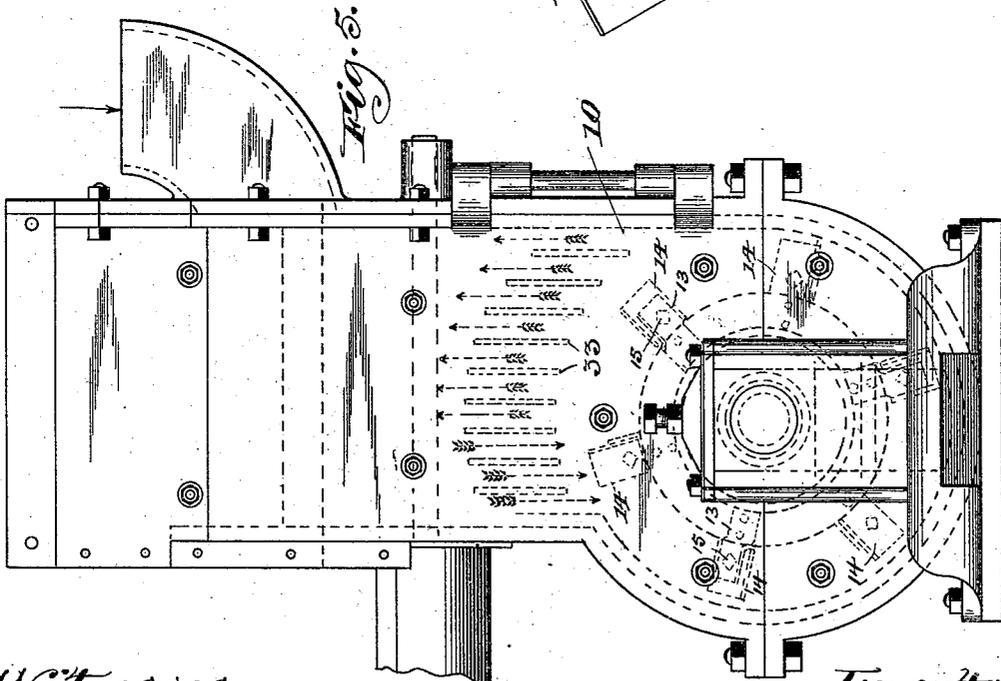
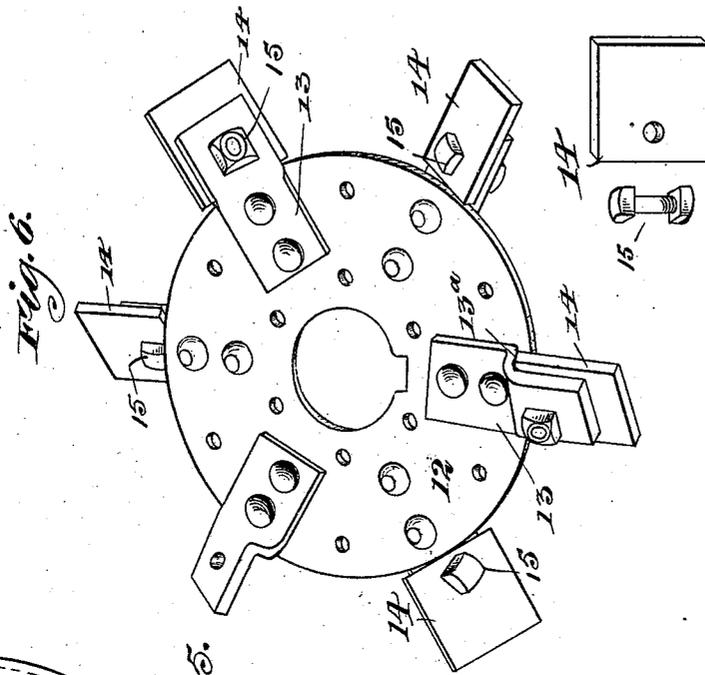
Witnesses:
J. J. Mann,
J. B. Gordon

Inventors:
George Raymond,
Albert Raymond,
 By *Field, Fowler & Hutchinson,*
Attys.

G. & A. RAYMOND.
COMBINED PULVERIZER AND SEPARATOR.

No. 551,787.

Patented Dec. 24, 1895.



Witnesses,
J. S. Mann.
F. B. Goodwin

Inventor:
George Raymond
 By *Albert Raymond*
Field, Fowler & Hutchinson
Attys.

(No Model.)

5 Sheets—Sheet 5.

G. & A. RAYMOND.
COMBINED PULVERIZER AND SEPARATOR.

No. 551,787.

Patented Dec. 24, 1895.

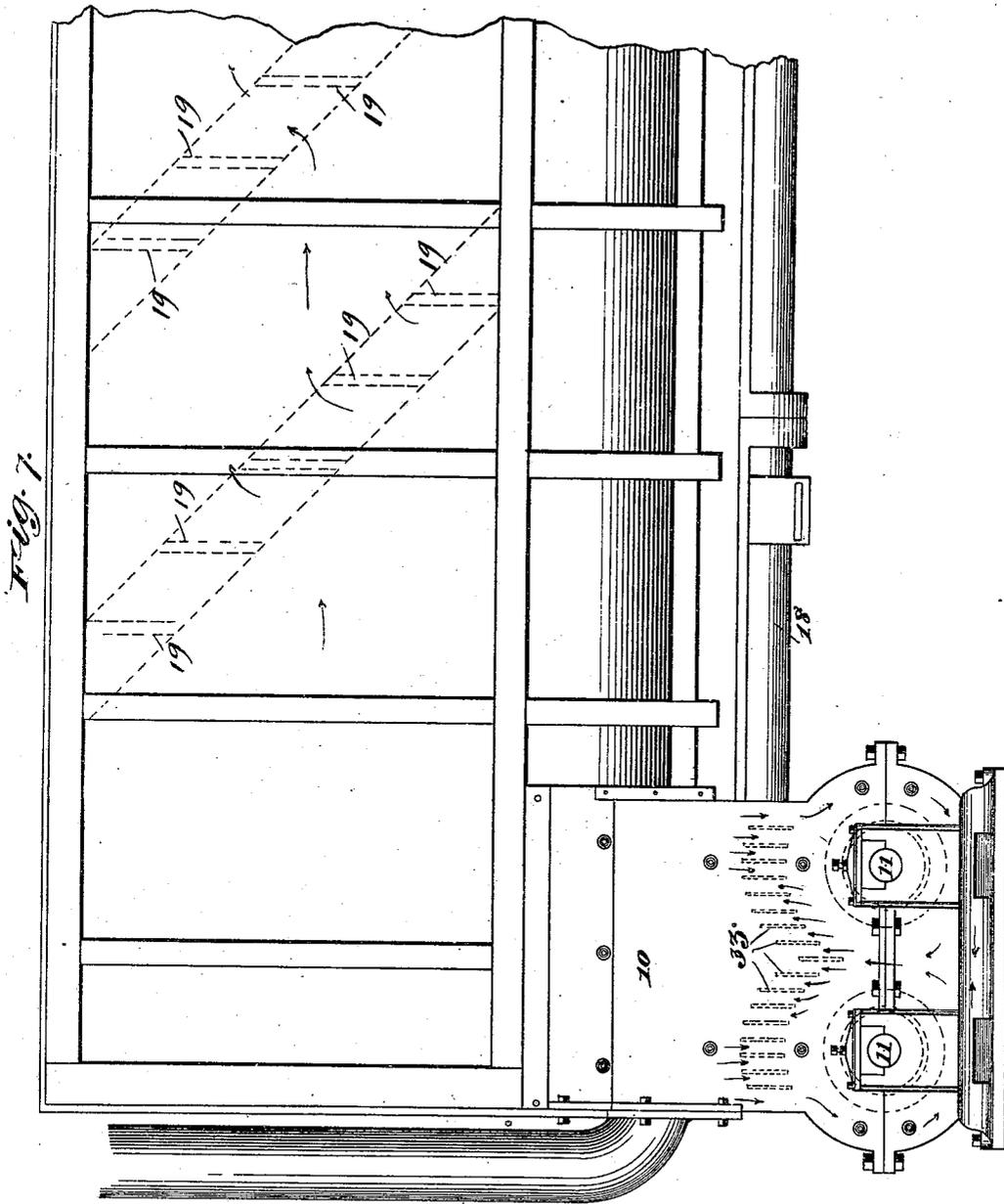


Fig. 7.

Witnesses,
E. Mann,
J. C. Goodwin

Inventor,
George Raymond
By Albert Raymond
Effield, Fowler & Luthicium
Attys.

UNITED STATES PATENT OFFICE.

GEORGE RAYMOND AND ALBERT RAYMOND, OF CHICAGO, ILLINOIS.

COMBINED PULVERIZER AND SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 551,787, dated December 24, 1895.

Application filed March 9, 1893. Serial No. 465,306. (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 a Combined Pulverizer and Separator, of which the following is a specification.

This invention relates to a method of and apparatus for pulverizing ores, minerals and other materials. The method involves the reduction of the material in the presence of a continuously-moving air-current from which the pulverizer draws its supply of air and into which the material is cast from the pulverizer and from which air-current the reduced material is separated either by settling or by the use of a centrifugal separator.

The apparatus comprises, in the preferred construction, a pulverizer of any suitable construction, but preferably a pulverizer of the character described in our Patent No. 415,421, and dated November 19, 1889; a separating-chamber having arranged therein deflectors through which a current of air may pass; means for supplying the material to the pulverizer, which are preferably so arranged as to receive from the separating-chamber any material which has not been sufficiently reduced to pass off with the air-current, and a suction-fan which moves the air with the reduced material through the chamber and delivers it to a centrifugal separator wherein the material is separated from the current of air, such material being delivered outside the machine and the air-current being returned into the separating-chamber so as to pass directly over the pulverizer which is constantly casting up the material into the returning air-current. The pulverizer is closed to the external atmosphere, so that the current of air is continuous and draws its air from the separating-chamber. The same air is therefore not only used continuously, but the air-current instead of being returned to the pulverizer as in previous constructions is returned to the separating-chamber from which the pulverizer draws air, and therefore back-pressure is obviated. The invention therefore operates upon what may be called a "closed" or "sealed" circulation. Any excess of air which may be drawn into the system escapes by a relief-pipe arranged in connection with the discharge from the centrifugal separator.

The separating-chamber is hopper-bottomed and delivers to a conveyer, so that the unreduced material may be conveyed back to the pulverizer. The conveyer-trough is provided with discharge-spouts at suitable intervals, and by closing or opening said spouts the material may be taken off at different points along the conveyer, depending upon the degree of fineness of product desired.

In the accompanying drawings, Figure 1 is a side elevation of the apparatus complete. Fig. 2 is a similar view, sectional through the separating-chamber. Fig. 3 is a transverse sectional elevation through the separating-chamber, showing the elevator in elevation. Fig. 4 is an enlarged view of the end of the pulverizer-chamber and a side elevation of the pulverizer. Fig. 5 is an end view in elevation of the pulverizer. Fig. 6 shows perspective detail views of the beaters of the pulverizer, and Fig. 7 is a broken side elevation showing the application of double pulverizers.

In the drawings, 10 represents the casing of the pulverizer through which extends the beater-shaft 11 on which are mounted one or more beaters. These beaters may consist of the disks 12 which are secured with the shaft and bear radial arms 13 which, as shown in Fig. 6, are of peculiar construction. Each of said arms is preferably formed of a steel plate twisted transversely at its middle, one end being riveted to the disk and the other end standing at an angle of approximately forty-five degrees to the face of the disk and having secured thereto the removable plate 14 which has a bearing on the shoulder or offset 13^a of the arm 13 and also upon the edge of the disk, as clearly shown in Fig. 6. A single fastening-bolt 15 secures the removable plate to the arm.

16 represents a separating-chamber which may be of rectangular form with a hopper bottom. One end of this chamber is in open communication with the upper end of the pulverizing-chamber, and at the apex of the hopper bottom is located a conveyer 18 which is run so as to carry the material to the pulverizing-chamber.

Arranged transversely across the upper portion of the pulverizing-chamber are the deflectors 19, which consist of a number of plates

vertically disposed to provide openings between them and arranged in a diagonal line inclining from the top of the chamber and away from the pulverizer.

20 represents an elevator into one leg of which the feed-hopper 21 delivers material, and this hopper may be provided with a roller-feed, as indicated in the drawings. From the top of the elevator a spout 22 delivers the material to the upper portion of the separating-chamber and discharges it preferably upon the spreaders 23 24 which may be solid or perforated, their purpose being to scatter or spread the material so that the air may the better act upon any fine particles thereof and carry them off. The conveyer-trough is provided at suitable intervals with spouts 25 for taking off different grades of material. When they are all closed the product of the machine will all be handled by the air-current.

26 represents a fan whose suction-pipe 27 communicates with the separating-chamber, preferably at its end opposite that at which the pulverizer is located. The discharge from the fan delivers to the centrifugal separator 28, and this separator works on the well-known principle of separating the materials carried upon an air-current by centrifugal force which acts upon the specifically heavier particles carried upon the air-current and masses them upon the peripheral walls of the chamber, the shape of the chamber being such that these separated particles are gradually moved toward the axis of the machine and discharged at the tip of the conical portion thereof through the discharge-pipe 29 which leads to the elevator 30. The product is lifted by the elevator and may be discharged into a storage-bin or other receptacle. From the top of the centrifugal separator the air escapes through the pipe 31 and is conducted back and discharged into the separating-chamber and preferably directly above the beaters. The air-pipe 31 is provided with the escape-pipe 32 by which an excess of air-pressure will be relieved.

The operation of the apparatus above described is briefly as follows: The pulverizer, fan and moving parts of the elevator being suitably driven the material which is fed to the machine through the hopper 21 is carried up by the elevator and discharges upon the spreaders above the pulverizer. From the lower end of these spreaders it passes into the throat of the pulverizer, whose beaters being rapidly revolved generate a strong current of air. The material is carried around the central shaft by the action of these beaters, and by the blows therefrom and the attrition of the particles upon each other, as well as by their contact with the walls of the chamber, its minute reduction is rapidly effected, but the material is also continually cast up through the throat of the pulverizer upon one side of a line passing through the center of the shaft and returns on the opposite side of

said line, inducing an air-current with such returning and fresh incoming material. The action of the machine therefore is to constantly draw into the pulverizing-chamber upon one side a stream of material while discharging it upon the opposite side, and the material reduced and unreduced is thus continually cast up into the separating-chamber, through which also the material is fed. To break up the mass of material entering and discharging from the machine we preferably arrange in the throat thereof the vertical partitions 33, which are separated to provide openings for the passage of the material and air-currents. The fan being in motion a strong suction is created in the separating-chamber, and this acts upon all parts of such chamber and of the pulverizer which is in open communication therewith. The fine material which is cast up by the action of the beaters, as well as the fine material which is discharged from the elevator, is picked up by the moving air-current and withdrawn from the separating-chamber into the fan. The coarser particles either drop down by virtue of their specific gravity or being deflected by the deflectors 19 drop into the conveyer, by which they are carried back to the pulverizing-chamber; or if desired they may be carried back to the elevator or drawn off at any of the spouts 25 which intervene between their place of deposit and the pulverizing-chamber. The fine material which is withdrawn by the fan is discharged under blast into the centrifugal separator, is separated from the air-current and disposed of as previously described, the air freed from dust passing back into the separating-chamber again.

From the above description it will be seen that a continuous air-current is maintained and the air is not permitted to escape from the machine, and as the pulverizer takes the air from the separating-chamber into which it delivers the product there is therefore an equalization of air-pressure in the various parts of the apparatus which effectually obviates what is known as "back-pressure."

Fig. 7 illustrates the application of two pulverizing-machines whose beater-shafts run in opposite directions, so as to cast the material up in a plane midway between and parallel to the vertical axis.

We claim—

1. The herein-described apparatus for the reduction of material, which comprises in combination a pulverizer, a separating chamber into which the material is cast from the pulverizer and by the action thereof, an exhaust fan whereby to induce a current of air through said separating chamber, a separator into which the laden current is delivered and in which it is freed from the reduced material, and a pipe for delivering the air freed from the reduced material from the separator back into the chamber, substantially as described.

2. In an apparatus for reducing material, the combination with a pulverizer adapted to discharge the material into a closed chamber, a suction fan for inducing a current through said chamber whereby to carry off the reduced material, a centrifugal separator into which the reduced material is delivered, and a pipe to return the air freed from the reduced material from the separator back to the closed chamber, substantially as described.

3. In an apparatus of the class described, the combination with a pulverizer, a closed chamber into which the material is cast by the pulverizer, an elevator for delivering the material into the upper portion of said chamber above the throat of the pulverizer and provided with a feed hopper, a suction fan for inducing a current of air through said closed chamber, a separator into which the laden current is delivered and in which it is freed from the material carried thereby, and a pipe or passage for returning the purified current back to the closed chamber above the pulverizer, substantially as described.

4. In an apparatus of the class described, the combination with a pulverizer, a closed chamber into which the material is cast by the pulverizer, an elevator for delivering the material into the upper portion of said chamber above the throat of the pulverizer and provided with a feed hopper, a suction fan for inducing a current of air through said

closed chamber, a separator into which the laden current is delivered and in which it is freed from the material carried thereby, a pipe or passage for returning the purified current back to the closed chamber above the pulverizer, and a conveyer for returning the material requiring further reduction to the pulverizer, substantially as described.

5. In an apparatus of the class described, the combination with a pulverizer, of a closed chamber into which said pulverizer is adapted to cast the material, said chamber having deflectors arranged therein substantially as described, a suction fan for inducing a current through said chamber, a separator and a pipe or passage for returning the air from the separator back to the closed chamber, substantially as described.

6. The combination with a pulverizing head or disk, of beater arms secured thereon, said arms having their outer ends offset from the plane of the attached ends and plates secured to said outer ends and having a bearing on the edge of the disk or head and on the offset or shoulder of the arms, substantially as described.

GEORGE RAYMOND.
ALBERT RAYMOND.

Witnesses:

C. C. LINTHICUM,
N. M. BOND.