No. 837,705. PATENTED DEC. 4, 1906.

O. M. MORSE.

SEPARATOR.

APPLICATION FILED MAR. 6, 1906.

3 SHEETS—SHEET 1.

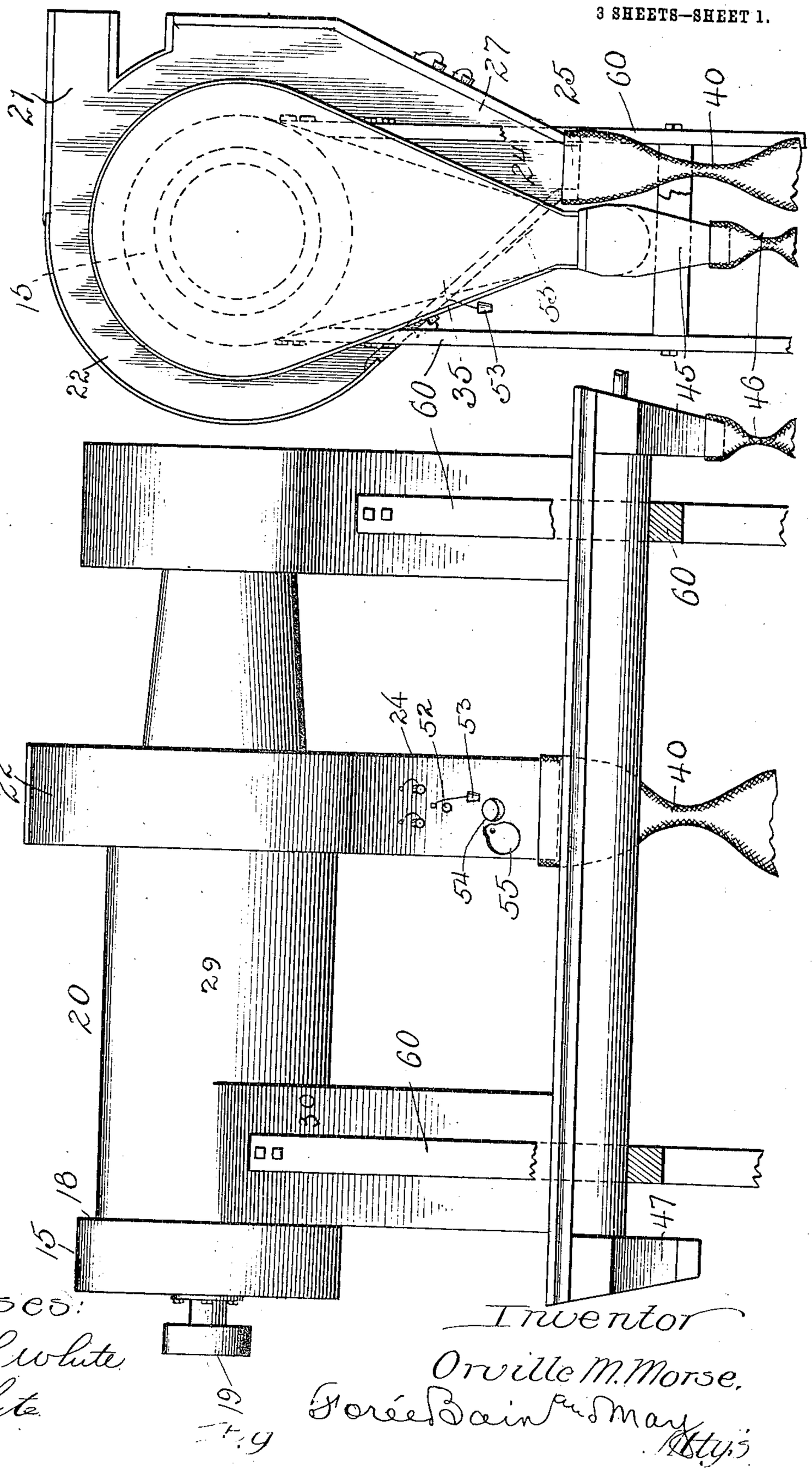

Fig. 1.

Witnesses:
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Ray White

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Orville M. Morse,
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3 SHEETS—SHEET 2.

FIG. 4.

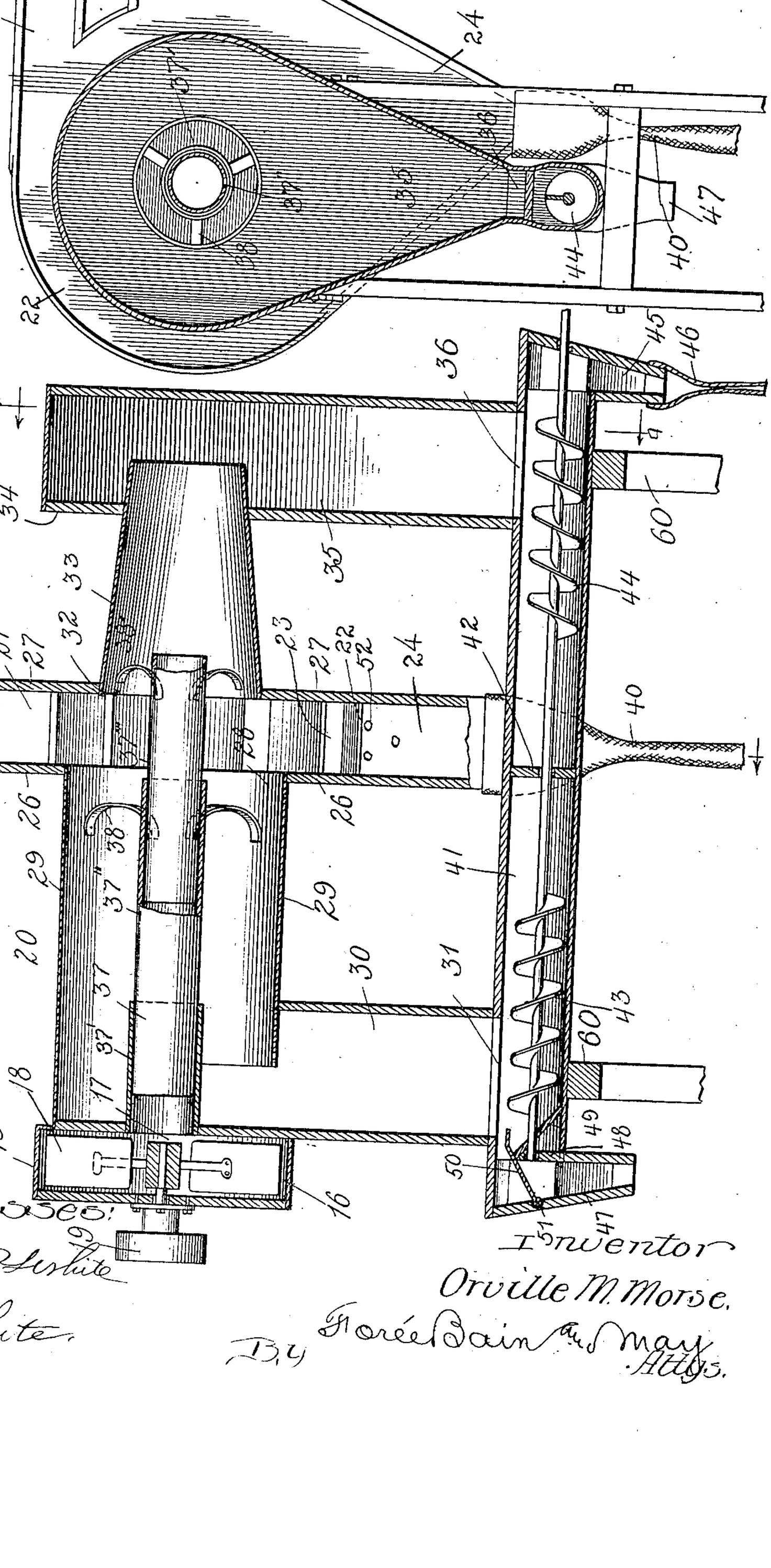

FIG. 3

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3 SHEETS—SHEET 3.

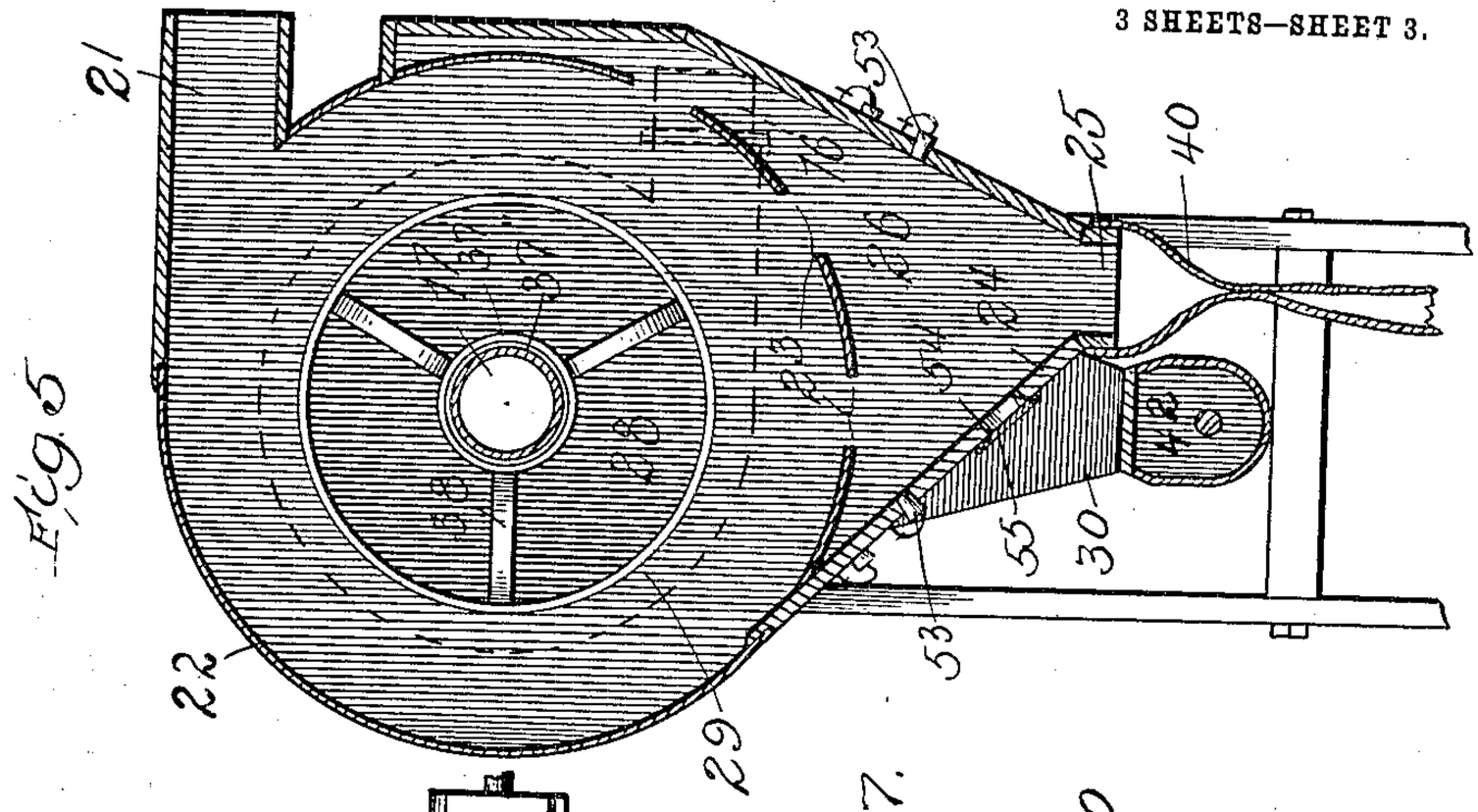

Fig. 5

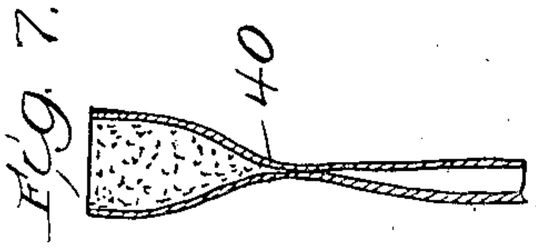

Fig. 7.

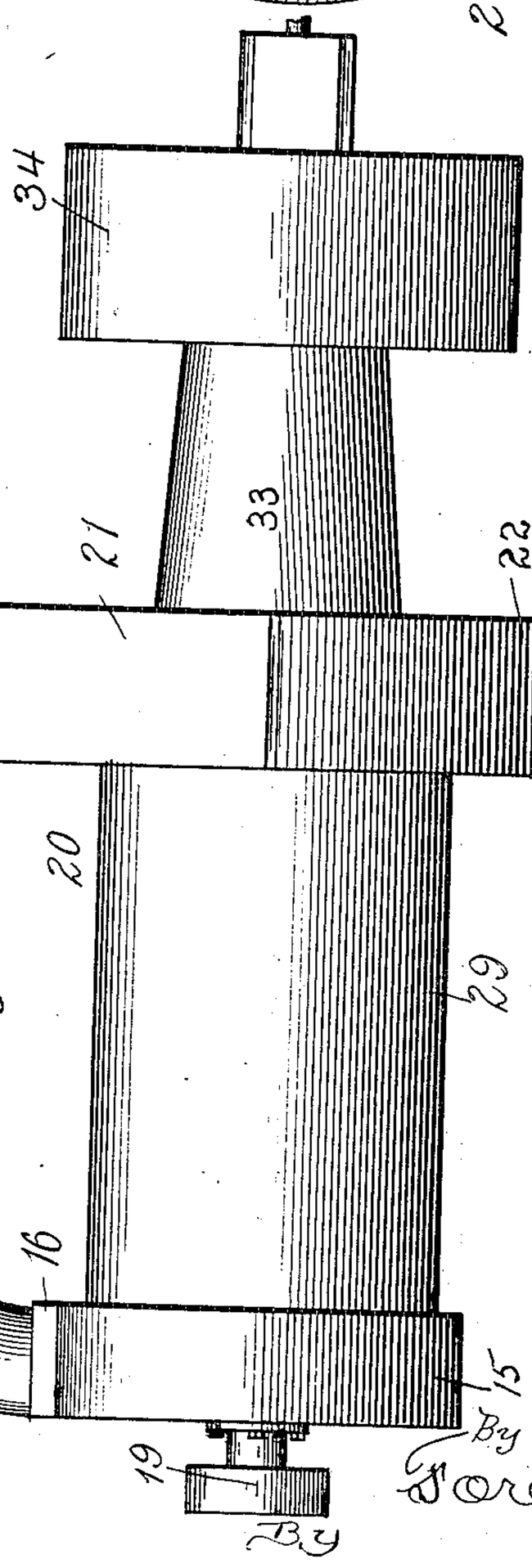

Fig. 6

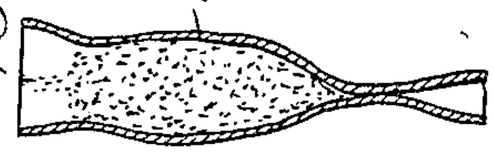

Fig. 8

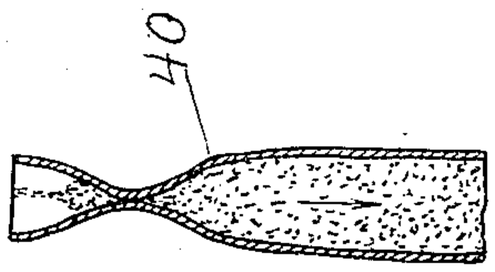

Fig. 9

Witnesses
Harry R. Lubcke
Ray White.

Inventor:
By Orville M. Morse.
Foréed Dain and May
Attys.

UNITED STATES PATENT OFFICE.

ORVILLE M. MORSE, OF JACKSON, MICHIGAN.

SEPARATOR.

No. 837,705. Specification of Letters Patent. Patented Dec. 4, 1906.

Application filed March 6, 1906. Serial No. 304,522.

To all whom it may concern:

Be it known that I, ORVILLE M. MORSE, a citizen of the United States, residing at Jackson, in the county of Jackson and State of Michigan, have invented certain new and useful Improvements in Separators, of which the following is a specification.

My invention relates to separators, and has for one of its objects to provide a separator which will reclaim solid particles of material from a conveying air-current and will separate the material reclaimed to different grades, according to the specific gravity thereof.

Another salient object of my invention is to provide a machine which will reclaim a maximum percentage of solid particles conveyed by the air, including very light particles, such as the "greasy" dust encountered in flouring-mills, and which has heretofore been deemed impossible to separate in an air-machine.

To attain these and other objects of my invention, which may best become apparent to those skilled in the art from the following description, my invention contemplates the provision of a suction apparatus, such as an exhaust-fan, acting to draw air (laden at the time of its entry to the separator with material to be reclaimed) in whirl or rotation through a separator wherein are provided without the path of travel of the flowing air one or more rarefied-air chambers, of which one or more open to the whirl area axially or endwise of the whirl and into which the reclaimable material passes in escape from the air-stream, thereby purifying the air and reclaiming the solid particles.

In the drawings I have illustrated an embodiment of my invention which, among others, I have found to be practically successful in operation.

In the drawings, Figure 1 is a side elevation of the separator. Fig. 2 is an end elevation thereof looking from the right in Fig. 1. Fig. 3 is a central vertical section therethrough. Fig. 4 is a transverse section on line 4 4 of Fig. 3. Fig. 5 is a similar section on line 5 5 of Fig. 3. Fig. 6 is a plan view, and Figs. 7, 8, and 9 are details illustrating a material-trap which I may employ.

In the drawings, 15 indicates in general a centrifugal exhaust-fan, illustrated as of a well-known type, having in its casing an outlet 16 and an axial inlet or eye 17, the blade structure 18 being arranged to be driven through the medium of a pulley 19. The fan is arranged to draw air through a separator-casing, (generally indicated as 20.) The separator-casing is so constructed as to provide an inlet for material-laden air and without the path of traverse of the material-laden air through the casing rarefied-air spaces or chambers, suitable means being provided for causing the air in transit through the casing to rotate.

In the specific construction shown, 21 indicates an inlet opening tangentially into a central enlargement 22 of the casing 20, such enlargement being preferably generally circular in form and communicating freely, as through apertures 23 in the wall thereof, with a rarefied-air chamber without the enlargement, shown as a hopper-like structure 24, having at its base a material-outlet 25.

26 and 27 indicate the side walls of the enlargement 22. The wall 26 has therein an aperture 28, preferably concentric with the casing-axis, with which is connected a cylindrical casing member 29, extending to the fan end of the machine (which I will hereinafter term its "front" end) and constituting a rarefied-air chamber. The casing 29 has communicating therewith, preferably at its lower side, a hopper enlargement 30, terminating at its lower end in a material-outlet 31. In the wall 27 is provided an aperture 32, preferably of less dimension than the opening 28 in wall 26, said opening 32 communicating with the casing member 33, which may, if desired, be tapered somewhat and the rear end of which constitutes a rarefied-air chamber when the machine is in operation. The casing member 33 preferably opens into an enlargement 34 of generally circular form, but extending at its lower side into a hopper 35, having at its lower extremity a material-outlet 36. It will be understood, however, that both casing members 29 and 33 may be made either slightly coniform or truly cylindrical and that either such casing member may communicate at its outer end with either an enlargement or an area of uniform diameter therewith, and it will hereinafter become apparent that the hopper-chambers 30 and 35 are but convenient devices for getting collected material out of the way and may be varied in form and construction to suit the requirements of the particular use.

In the construction illustrated the air is preferably exhausted by the fan from some point adjacent the central enlargement 22, and to this end I provide within the casing an axial pipe or exhaust-passage 37, preferably formed of sections, as 37′, 37″, and 37‴, telescoping one within the other, so that the precise location of the point from which the air is extracted from the casing may be varied at pleasure. For affording support to the free end of the exhaust-pipe 37 I provide spring-spiders 38 38′, bearing against the sides of the adjacent casing members.

Means are provided for trapping the reclaimed material from the several hoppers without admitting air thereto, such means being herein shown as of suitable character to maintain separate the grades of material reclaimed in the respective hoppers. Surrounding the aperture 25 in the hopper 24 is an air-tight flexible tube 40, open at its lower end. The material-outlets 31 and 36 from the hoppers 30 35 communicate with a conveyer-casing 41, air-tight in construction and preferably divided, as by a partition 42, into two compartments, wherein are arranged the oppositely spiral conveyers 43 44, preferably mounted on a common shaft and suitably driven. The rear end of the conveyer-casing opens into an outlet-duct 45, having secured thereto an air-tight flexible tube 46, such as that described in connection with hopper 24. Other means may, however, be employed for trapping the material out, another form of trap being illustrated at the front end of the conveyer-casing 41 and comprising the material-chute 47, having an upwardly-extending wall 48, to which is secured the inclined plate 49, so disposed that material forced forward by the conveyer 43 rides up the incline. A gate 50, pivoted, as at 51, normally closes the chute 47 and projects over the top of the inclined wall 49, with which it contacts. When now sufficient material is propelled forward by the conveyer 43, it raises the trap-gate 50 and falls in the chute 47, the constant pressure of the screw behind the material packing it forward to fill the space between the gate 50 and the wall 49, so that the structure is maintained substantially air-tight.

For purposes which I will hereinafter describe I preferably provide in the hopper 24 regulable air-inlets, and to that end I have shown the hopper as apertured at 52 and provided with plugs 53 for closing said apertures. Apertures, as at 54, provided with pivoted covers 55, may also be provided for admitting larger volumes of air.

It will be understood that the entire casing structure and its associated parts may be supported in any convenient way, as by a framework 60.

In Fig. 6 I have illustrated a source of material-supply at 61 and have indicated by suitable piping 62 that the outlet 16 of the fan may be connected with said source of material-supply, from which extends also the pipe 63 to the inlet of the separator, so that the same air is used over and over again. It will be apparent, however, that the fan might exhaust freely and fresh air be continually drawn from the source of material-supply.

For purposes of a clear disclosure of the operation of my machine I will describe first the results actually obtained in practice and then the action of the structure and reasons for such actions to the best of my knowledge and belief, although it will be understood that certain of the theories advanced and in which I now believe I have not had the facilities for demonstrating scientifically. The fan 18 when set in rotation draws air material-laden into the casing into the inlet 21 and establishes an air-current flow through the exhaust-pipe 37 and a vacuum tendency or rarefied-air condition in the areas of the machine without the path of traverse of the air, the air in transit through the machine being caused to rotate or whirl by means of the tangential arrangement of the inlet or in any other suitable manner. The heavier material particles entering with the current are deposited in the hopper 24, while in the specific machine illustrated lighter material, or that having less specific gravity, is deposited in the hopper 30, and still lighter material, such as the greasy dust encountered in flouring-mills, is deposited in the hopper 36. This action I account for as follows: The air entering the separator at the inlet 21 is under the influence of two forces—a centrifugal action, due to its tangential introduction and inertia, and a centripetal tendency, due to the action of the fan drawing air from the separator-axis. The resultant movement of the air is, I believe, a spiral or helical curve toward the rearward open end of the exhaust-pipe 37, the air then whirling through the axial pipe to the eye of the fan, whence it is discharged through the fan-outlet. The suction of the fan creates without the path of travel of the flowing air—that is to say, at both ends of the casing and at the periphery of the central enlargement thereof—a vacuum tendency or rarefied-air condition of greater or less degree. This result I have demonstrated beyond question by proper vacuum testing apparatus. The heavy particles of material having the greatest specific gravity, it is my belief, are so affected by their tangential entry that their momentum carries them immediately out of the centripetal air-current into the rarefied peripheral area of the central chamber 22. Here being without the path of the conveying air flow they fall to the bottom of the hopper through the openings 23 to be trapped or conveyed out of the machine. Lighter dust particles, however, have not

sufficient momentum by reason of their low specific gravity to immediately overcome the draft or conveying power of the air-current, pass toward the axis of the machine with the air-current and come into the area of the enlargement 22, alining axially with the rarefied area beyond the larger opening 28—that is to say, in alinement with the rarefied chamber constituting the front end of the machine. Here now a different condition prevails. On the one side toward the front of the machine is an area of low pressure, and from all other sides save that one I believe the pressure upon each dust particle to be substantially equal, so that the dust particles of the medium specific gravity under consideration are forced, as it were, between the unbalanced pressures and delivered into the area of lesser pressure close at hand. Their momentum and circular path of entry cause them to pass in a spiral course down the casing-wall 29 into the hopper 30, where, being out of any current flow, they fall to the bottom of the hopper to be trapped or conveyed out. Still lighter material particles carried by the air-current beyond its peripheral zone of opening 28 pass toward the rear of the machine to reach the mouth of the exhaust-pipe 37. Beyond the point where the air bends back into the mouth of the pipe, however, a rarefied area exists, which I believe is the area of greatest rarefaction in the machine. Where now the air turns back, this very light dust, too light to be forced into the rarefied area in the casing portion 29, escapes from the air-current, as its slight momentum tends to carry it rearward beyond the point where the air turns forward toward the fan, and in addition the greatest unbalanced pressure condition in the machine reinforces this tendency and furthers its escape from the air-current.

Thus I am enabled by my present construction to reclaim a character of material which, it is my belief, has never been separated from air in any large proportions in a rotating air-machine, and also to secure a uniform and consistent grading of the material deposited in the several rarefied areas of the machine.

I believe and broadly claim that in this separator substantially all of the very light material is reclaimed, and I believe the most efficient construction in this regard to be one involving rarefied-air chambers which communicate with the whirl area in a direction generally axial relative to the whirl, as I have found that the fine dust enters such axially-opening rarefied-air chambers more readily than it does peripheral air-chambers. Furthermore, I have found that in so far as separation is concerned the action appears to be somewhat better by a disposition of the fan which produces in the pipe 37 a whirl in a peripheral direction opposite to the peripheral direction of the whirl caused by the tangential entry of the air through the inlet 21. It will be apparent that when the peripheral direction of air-flow is thus reversed the air-bodies must at the point of reversal momentarily come to a standstill, so that the difference in pressure existing in the machine has a maximum opportunity for effecting the expulsion of the material particles from the air. I have found that this theory is borne out in practice by a somewhat-increased efficiency where such an arrangement is employed, but offsetting to some degree the increase in efficiency is an increase in back pressure, and as the escape of material under the conditions herein shown and first described is so slight as to be utterly negligible in practice I deem the arrangement shown to be well suited for general purposes.

The apertures 52 and 54 regulable by their suitable closures are provided in the machine for effecting in a measure a regulation of the separation produced. It will be apparent that the opening of said apertures provides a secondary source of air-supply, establishing a subordinate air-current drawn upward through the apertures 23 to mingle with the main current in the central chamber. This arrangement I have found to be efficacious in preventing the heavier dust particles which centrifugally are thrown to the periphery of the central enlargement, from carrying with them into the hopper 24 lighter dust particles which may tend to adhere to the heavier particles, freeing the lighter particles for disposition in their respective chambers, but such refinement might be omitted, if desired.

The action of the trap at the front end of the conveyer has been heretofore described, and I will now describe the fabric-tube arrangement illustrated as a means for trapping the dust from the hopper 24 and the spout 45. It will be understood that as soon as the machine is set in operation the rarefaction of the air in the hopper 24 and the conveyer-chamber communicating with the hopper 35 causes the tubes 40 and 46 to collapse, so that their sides meet and form closures for the open ends of the parts to which they are attached, as best illustrated in Fig. 5. When now dust accumulates in the tube, as shown in Fig. 7, the area of contact of the sides is forced downward by the accumulating weight of material thereabove to the position shown in Fig. 8. When sufficient material has accumulated to break by its weight the seal effected therebelow by the closing of the fabric, the accumulated material falls from the bag, the sides collapsing above the accumulated material, as shown in Fig. 9. Thus the dust is trapped out of the communicating parts without admitting air thereto.

While I have herein described in some de-

tail an embodiment of my machine which I have found to be practical and the detail whereof I may claim, I do not desire to be understood as limiting my invention to the specific construction shown and described, as it will be apparent that numerous changes in the construction and arrangement of parts might be effected without departure from the spirit and scope of my invention.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a machine of the character described, means for exhausting air, a separator-casing wherethrough air is drawn by said exhausting means, and means for causing the air in transit through the casing to rotate, said casing providing a rarefied-air area without the path of travel of the air, open to the path of travel of the air axially of the whirl, to receive dust escaping from the air-current.

2. In a machine of the character described, means for exhausting air, a casing wherethrough air is drawn by said exhausting means, and means for causing the air in transit through the casing to rotate, the casing providing an area radially without the area of rotation of the air, having communication therewith to receive material particles centrifugally expelled from the air-current, and a rarefied-air chamber without the path of travel of the air, open to the said path of travel axially of the whirl to receive material escaping from the air-current by reason of the difference in pressures between the rarefied area and the area of air-flow.

3. In a machine of the character described, a casing provided with a tangential inlet, an axial outlet-pipe extending into the casing, and an air-propelling device connected with the outlet-pipe to draw air through the casing in whirl from the inlet to the outlet pipe, there being provided in the casing, peripherally without the path of air-whirl, an area for the reception of material centrifugally expelled from the air-current, and there being also provided, surrounding the outlet-pipe, a rarefied-air area opening to the whirl area axially of the latter.

4. In a machine of the character described, a casing; an inlet thereto; an apertured, curved wall within the casing arranged to direct material, introduced through the inlet, in a curved path and separating from the axis of the casing a peripheral collection-chamber for the reception of centrifugally-separated material, said casing including a collection-chamber, opening axially to the area within the aforesaid curved wall, an axial air-outlet from the casing, material-outlets from the collection-chambers, and an air-propelling means arranged to draw air through the casing from the inlet through the air-outlet, and adapted to rarefy air in the casing without the path of the flowing air, whereby air in flow through the casing is whirled in the area within the apertured, curved wall and the air in the area of the casing axially opening to said whirl area is rarefied.

5. In a machine of the character described, a casing, a tangential inlet thereto, an axial air-outlet, and an air-propelling device connected with the outlet to draw air in whirl through the casing from the inlet to the outlet, and adapted to rarefy air in the casing without the path of air-flow, there being provided in the casing an area radially without the air-whirl area, for the reception of centrifugally-expelled material, and there being further provided in the casing a rarefied-air area axially beyond the air-outlet, and opening axially to the air-whirl area, to receive material escaping axially from said whirl; material-outlets from the material-receiving areas, and trapping devices for permitting the removal of dust from said outlets substantially without admitting air.

6. In a machine of the character described, means for exhausting air, a casing wherethrough air is drawn by said exhausting means having a peripheral inlet and a substantially axial exhaust-outlet, a chamber radially without the path of travel of the rotating air, and a chamber opening to the path of the rotating air in a generally axial direction, the opening of the last said chamber being of less diameter than the area into which the air enters from the inlet.

7. In a machine of the character described, having a rarefied-air chamber, means for trapping material out of the rarefied-air chamber substantially without permitting the introduction of air thereto, comprising a collapsible tube flexible throughout its entire perimeter open at one end and at its other end opening to and suspended from the material-outlet to be closed.

8. In a machine of the character described, an exhaust-fan, a casing comprising an enlarged portion having a tangential inlet, a chamber without said enlarged portion opening thereto, to receive material, a chamber of less diameter than the enlargement, an air-pipe connected with the eye of the fan, and arranged to draw air substantially axially from the casing in a path excluding the smaller chamber, whereby the air in said smaller chamber is rarefied.

9. In a machine of the character described, a casing involving a central chamber having a tangential inlet, and areas axially alining with said central chamber communicating therewith through apertures in the sides of the chamber of less diameter than said chamber, an exhaust-pipe leading from a substantially axial position within the casing to the exterior thereof, and means for exhausting air through said pipe.

10. In a machine of the character de-

scribed, a casing involving a central chamber having a tangential inlet, and areas axially alining with said central chamber communicating therewith through apertures in the sides of the chamber of less diameter than said chamber, an axially-adjustable exhaust-pipe leading from a substantially axial position within the casing to the exterior thereof, and means for exhausting air through said pipe.

11. In a machine of the character described, a casing, wherethrough air flows, inclosing a central area, and an area axially communicating therewith without the path of air-flow, a tangential inlet to the central area, a substantially axial air-exhaust opening, and means other than the inlet for admitting regulable quantities of air to the central area; in combination with an air-exhaust device arranged to draw air from the casing through the axial outlet.

12. In a machine of the character described, the combination with a casing having an inlet arranged to cause ingoing air to whirl in the casing, and an air-outlet substantially axial of the whirl, of an exhausting means arranged to draw air in whirl through the casing, said casing containing an area inclosed at all points save that toward which it opens to the whirl wherein the air is rarefied by the action of the exhausting means, arranged to be crossed by the escaping air.

13. In a machine of the character described, a casing providing a central chamber, wherein air and material may whirl, and providing also areas or chambers without the whirl area, opening to said whirl area axially of the whirl at opposite ends, normally closed dust-outlets from the last said areas or chambers, an air-inlet to the central chamber, an air-outlet therefrom, and an air-exhausting device communicating with the air-outlet adapted to draw air through the casing from its inlet to its air-outlet, and to rarefy the air in the end chambers axially without the whirl.

In testimony whereof I hereunto set my hand in the presence of two witnesses.

ORVILLE M. MORSE.

In presence of—
WILLIAM B. KNICKERBOCKER,
JOHN L. BENTLEY.