(No Model.)

2 Sheets—Sheet 1.

J. MILLS.

PURIFIER AND SEPARATOR.

No. 476,231. Patented May 31, 1892.

Fig 2.

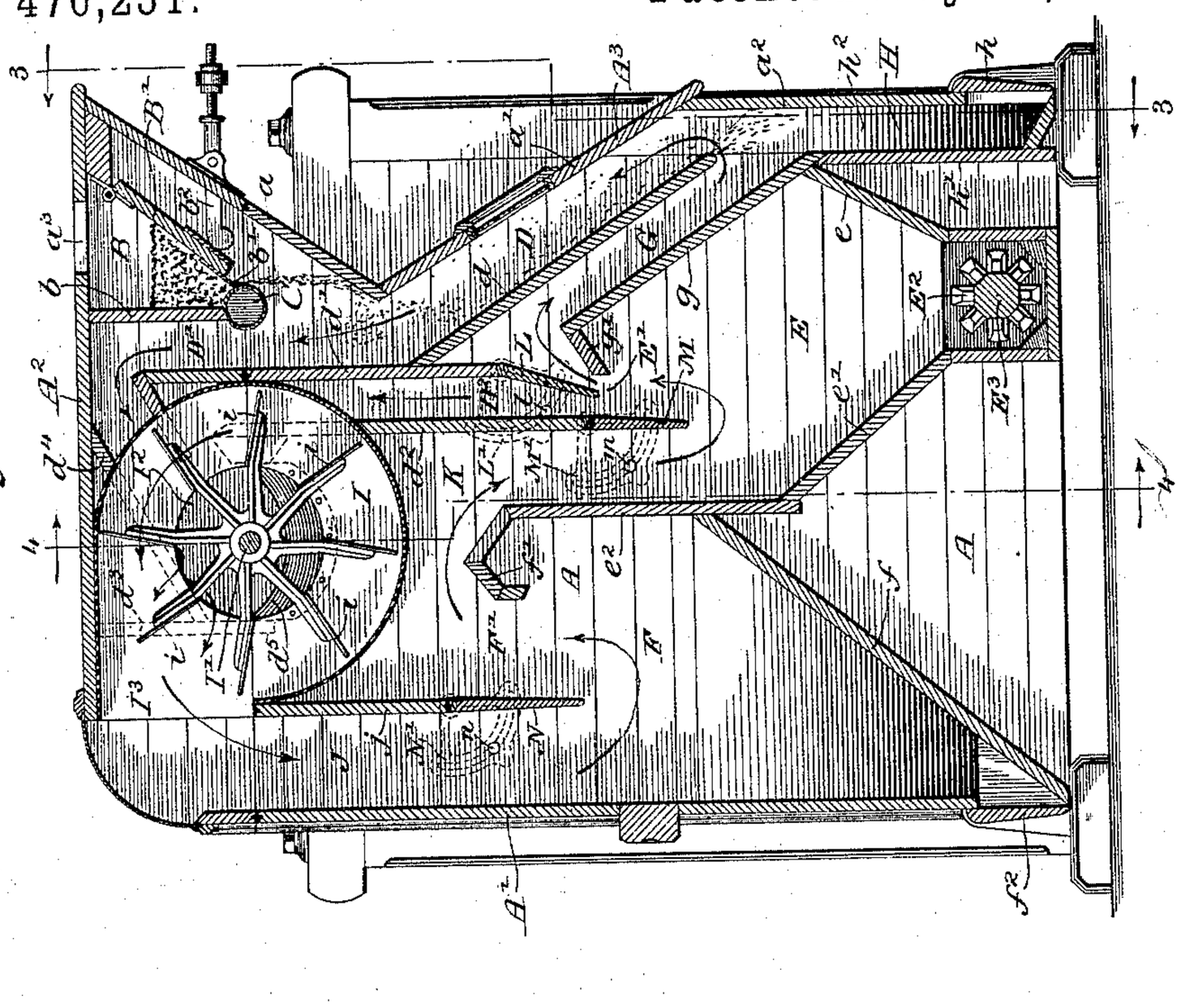
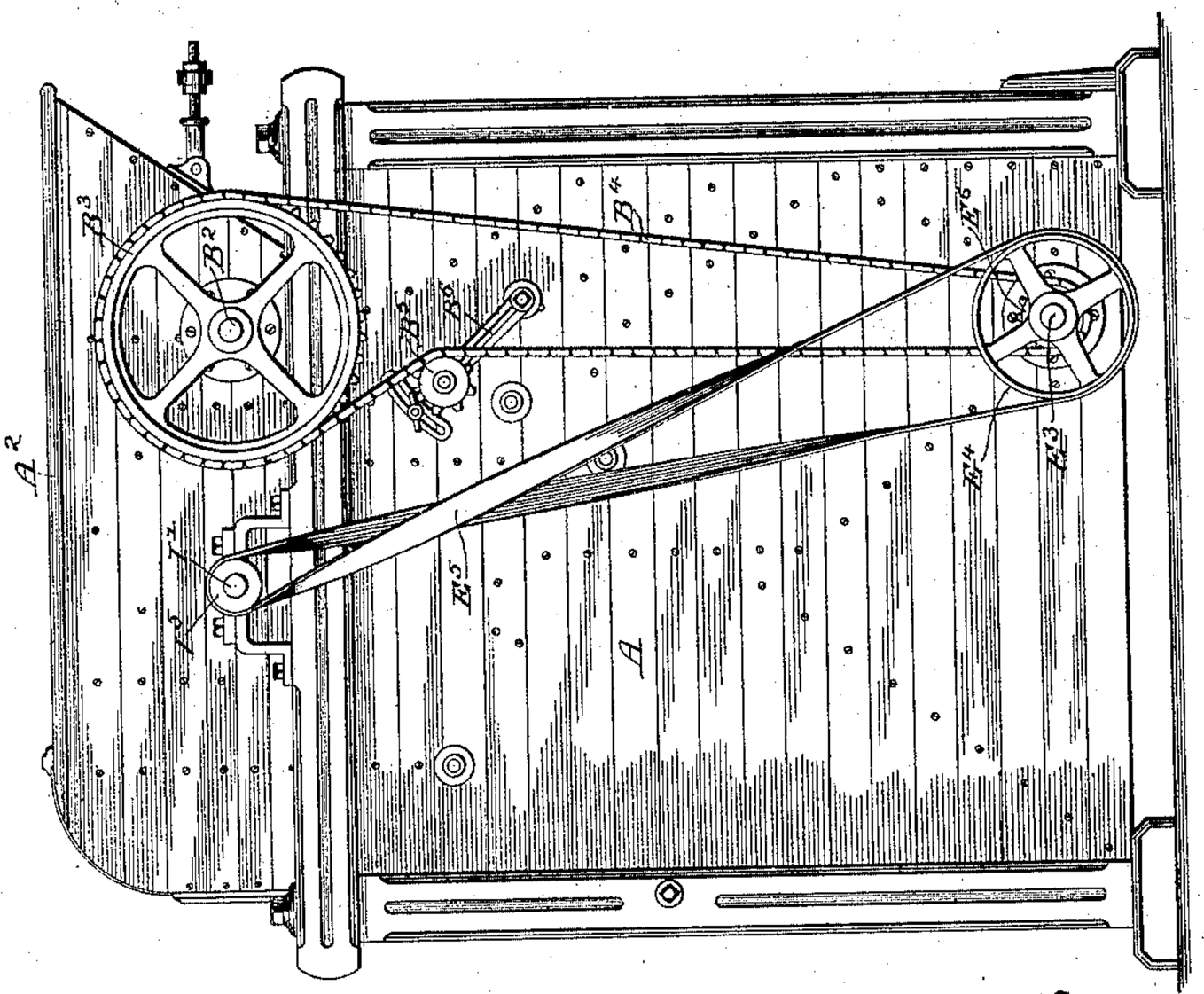


Fig 1.



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(No Model.) 2 Sheets—Sheet 2.

J. MILLS.

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Fig 4.

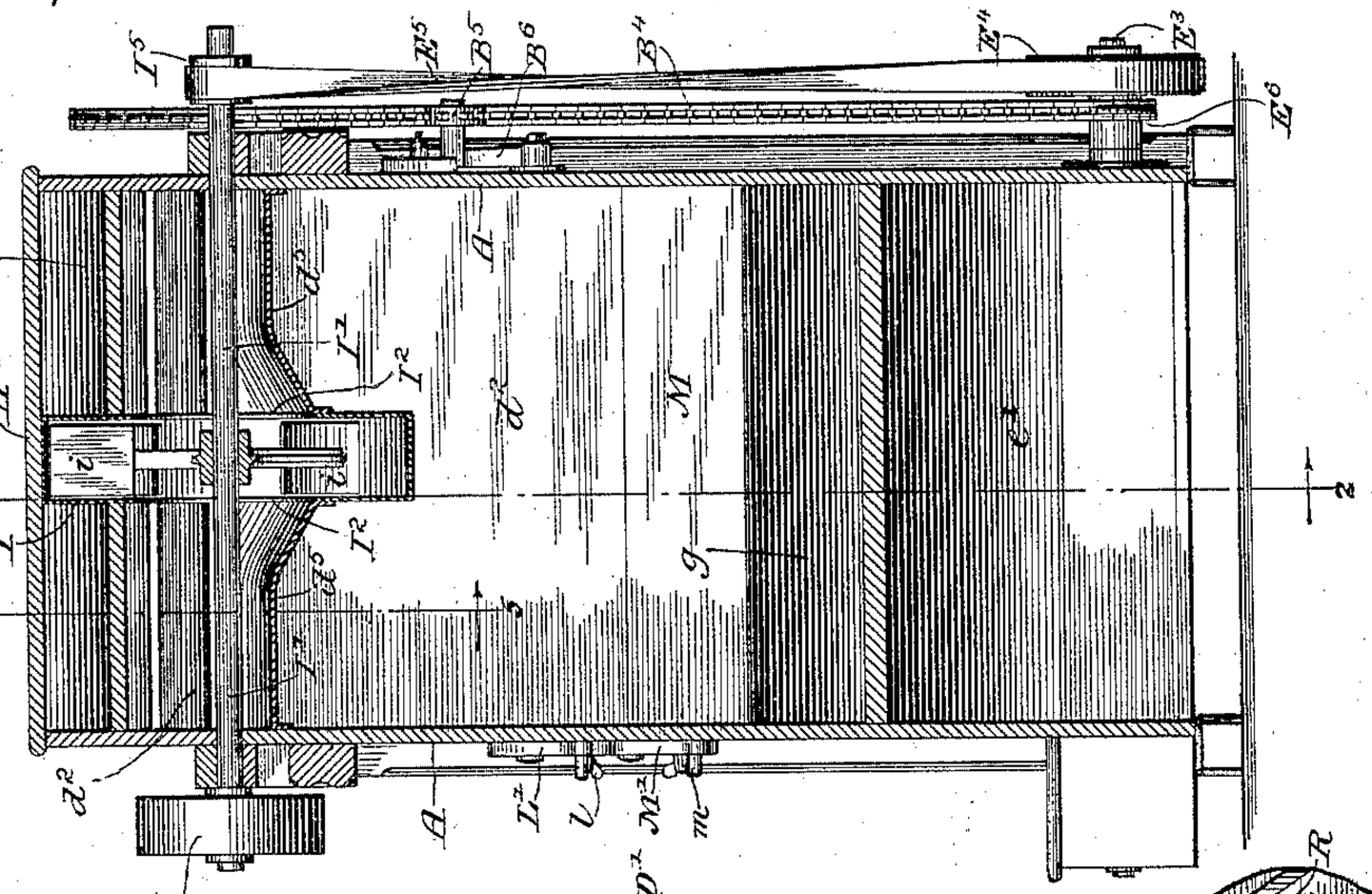


Fig 5.

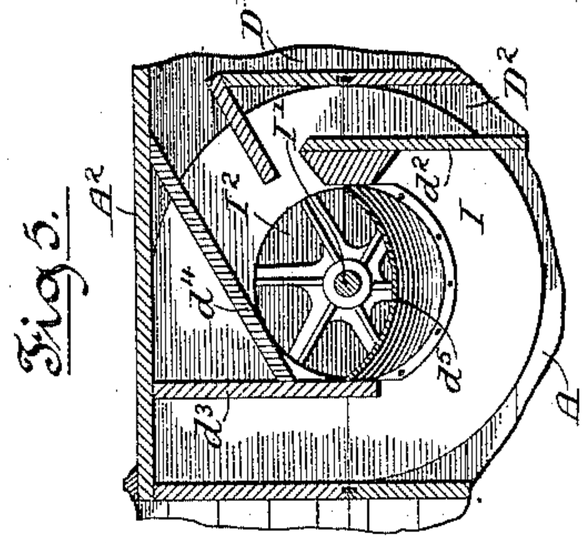


Fig 6.

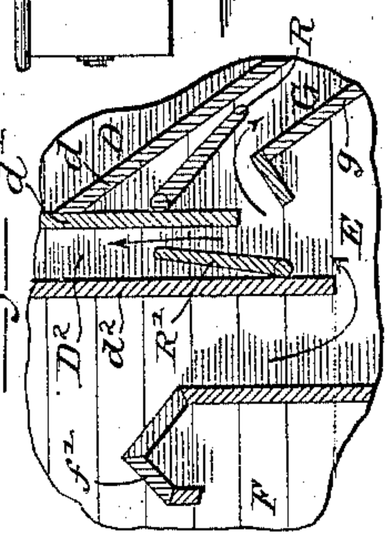
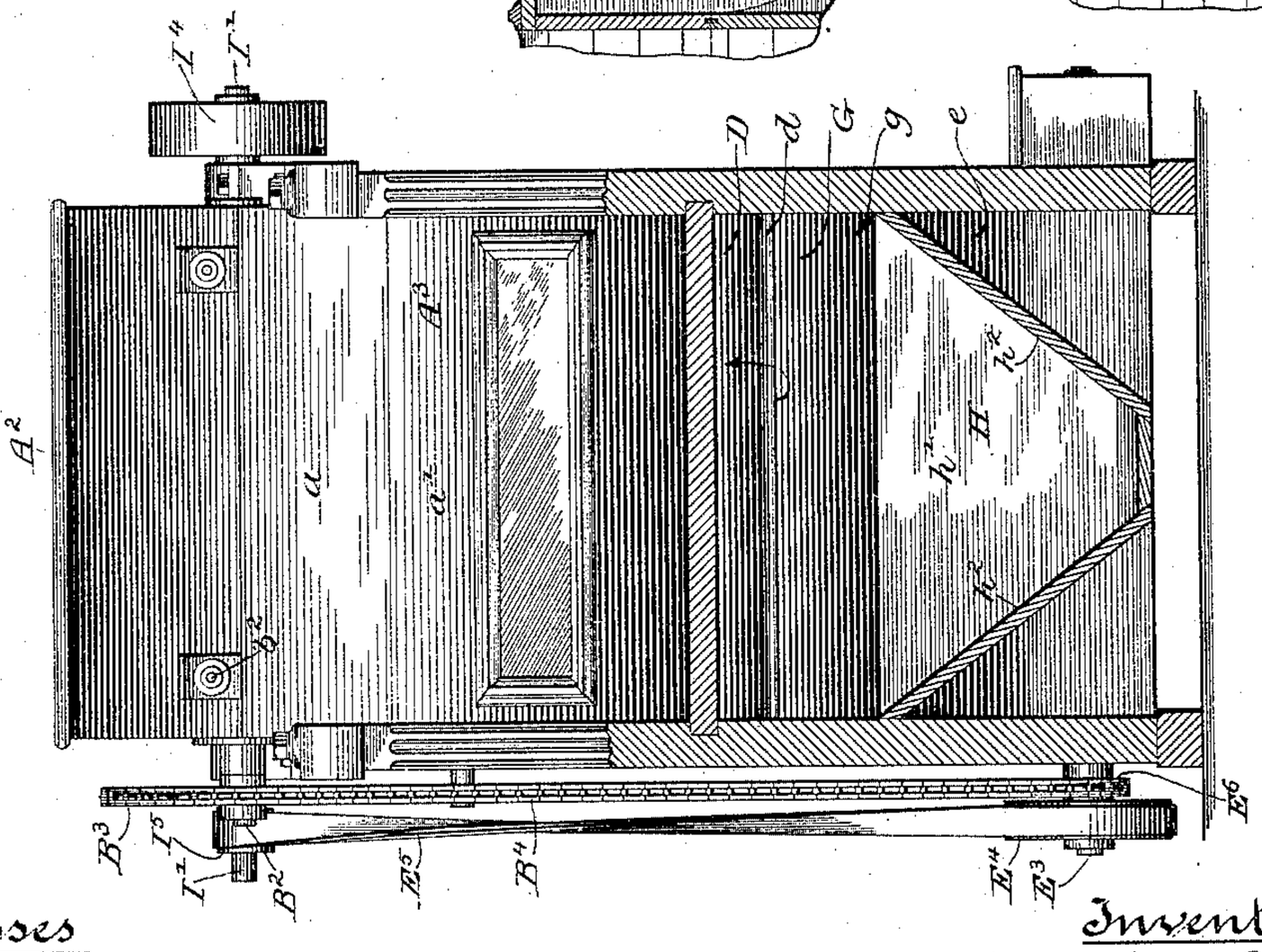


Fig 3.



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UNITED STATES PATENT OFFICE.

JONATHAN MILLS, OF COLUMBUS, OHIO.

PURIFIER AND SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 476,231, dated May 31, 1892.

Application filed July 17, 1890. Serial No. 359,028. (No model.)

To all whom it may concern:

Be it known that I, JONATHAN MILLS, of Columbus, in the county of Franklin and State of Ohio, have invented certain new and useful Improvements in Purifiers and Separators; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to machines for separating granular substances with reference to their weight or density of that class in which an air blast or current is employed as a means of separating the lighter from the heavier particles of the material being operated upon.

The invention is herein shown as embodied in a machine for the separation or purification of middlings in the manufacture of flour; but the novel features of construction herein set forth and claimed may be employed in machines for separating other substances.

The invention consists in the matters hereinafter described, and pointed out in the appended claims.

In the accompanying drawings, illustrating my invention, Figure 1 is a view in side elevation of a machine embodying the invention. Fig. 2 is a central vertical section thereof, taken upon line 2 2 of Fig. 4. Fig. 3 is a view, partially in front elevation and partly in section, taken upon line 3 3 of Fig. 2. Fig. 4 is a cross-sectional view taken upon line 4 4 of Fig. 2. Fig. 5 is a detail section taken upon line 5 5 of Fig. 4. Fig. 6 is a detail sectional view illustrating a modification hereinafter referred to.

As illustrated in the said drawings, the several parts of the machine are embraced within a casing or housing having opposite side walls A A, a rear wall A′, a top wall A^2, and a front wall A^3. In the upper part of the housing adjacent to the front wall thereof is located a receiving-hopper B, the same being formed by means of a transverse partition *b*, extending between the side walls A A and connected at its upper edge with the top wall A^2, and a hinged wall B′, located inside of the front wall A^3 and hinged at its upper end to the top wall of the housing in the manner illustrated. At the bottom of the said hopper is located a revolving feed-roller C, which operates, in connection with the lower edge of the wall B′, to produce a regular feed of material from the hopper, said hinged wall being provided at its lower edge with a flexible lip *b′*, which rests adjacent to the said roller, so as to form therewith a narrow slot or opening for the passage of the material within the hopper in a manner heretofore common and well known. For adjusting the position of the edge of the said lip with reference to the roller to give a more rapid or slower feed, as desired, supporting-bars b^2 b^2 are inserted through the front wall of the housing and bear against the under surface of the said wall B′, said bars b^2 being pivoted on the front wall of the housing, said bars being threaded at their outer ends to receive adjustable counter-weights, by means of which the pressure they exert upon the wall B′ may be regulated as desired, said wall being provided with a stop to limit its motion and the weight being sufficient to hold the same in place, as shown, except when large obstructions attempt to pass, when the parts may yield.

The upper part *a* of the front wall A^3 of the housing is downwardly and inwardly inclined in a direction approximately parallel with the flap B′ of the hopper, and at its lower end said part *a* is attached to the upper edge of an outwardly and downwardly inclined part *a′* of said front wall, which part *a′* is connected with a vertical part a^2 of the front wall, which forms the lower portion thereof.

D is an inclined passage located in the housing adjacent to the front wall thereof, and one side of which is formed by the inclined part *a′* of said front wall.

E is a chamber or receptacle located in the lower part of the housing at the front part thereof, and F another receptacle or chamber located in the lower part of the housing at the rear part thereof.

Between the inclined passage D and the chamber E is located another inclined passage G, and adjacent to the front wall of the housing, below said passages D and G, is located a receptacle or hopper H, provided with a valved outlet *h*.

I is a fan-casing located in the upper part of the housing and containing a series of re-

volving fan-blades *i i*, mounted upon a shaft I′, which extends through opposite side walls of the housing and is sustained in suitable bearings thereon. The fan-casing is made narrower than the housing and contains in its side walls inlet-openings I^2 I^2, which are connected with the passage D and chamber E by passages hereinafter described. The exit-opening I^3 of said fan is connected with a vertical passage J, which is located adjacent to the rear wall A′ of the casing and extends downwardly from the top of the casing and opens into the upper part of the chamber F.

D′ is a passage extending upwardly from the upper end of the passage D and communicating at its top with the inlet-openings I^2 I^2 of the fan, and D^2 is another passage leading upwardly from the top of the chamber E, and also communicating with the said inlet-openings I^2 I^2 of the fan.

K is a passage connecting the chambers E and F and extending from the upper part of one chamber to the upper part of the other chamber.

The several chambers and passages above described are, as herein shown, formed by means of partitions in the housing, arranged as follows: An inclined partition *d* is arranged approximately parallel with the inclined part *a′* of the front wall A^3 of the housing, and divides the passage D from the passage G, the said partition terminating near the lower end of the inclined part *a′*, so as to allow the passage of air from the passage G to the passage D around the lower end of said partition. A partition *g* is arranged approximately parallel with the partition *d*, and forms the inner wall of the passage G and the outer wall of the chamber E. At its lower end said partition *g* is connected with the inclined bottom wall *e* of the chamber E and also with a vertical partition *h′*, arranged parallel with the vertical part a^2 of the front wall A^3, and forming, with the latter, the receptacle or hopper H, hereinbefore described. Inclined side walls h^2 h^2 are located between the walls a^2 and *h′*, and give a hopper shape to the bottom of the receptacle H, as clearly shown in Fig. 3.

The chamber E is provided with an inclined rear wall *e′*, and the upper part of said chamber E is separated from the chamber F by means of a vertical partition e^2, connected at its lower end with the said inclined or hopper-bottom *f* of the receptacle F. The inclined partition *d*, hereinbefore described, is connected at its upper edge with a vertical partition *d′*, which extends from a point below the upper edge of said partition *d* to a point near the top wall of the housing, and the upper part of which forms, with the rear wall of the hopper B, the passage D′. Inside of or at the rear of the partition *d′* is located a second vertical partition d^2, forming, with said partition *d′*, the passage D^2. Said partition d^2 extends downwardly to a point opposite the upper end of the partition *g*, forming therewith the exit-opening E′ of the chamber E. An inclined board *g′* is preferably attached to the upper edge of the partition *g* and extends toward the lower edge of the partition d^2, so as to make the opening E′ of a desired width, in the manner illustrated. The partition *d′*, which, as before described, extends below the top of the partition *d*, terminates some distance above the upper margin of the partition *g*, so that air passing out of the exit-opening E′ of the chamber E will be divided and part will go downwardly through the passage G and a part upwardly through the passage D^2, in the manner indicated by the arrows, Fig. 2, and inasmuch as both said passages D^2 and G communicate with the inlet-openings of the fan-casing, it is obvious that the air-current drawn from the said chamber E by the fan will be divided and part will pass through the passage D^2 directly to the fan, while a part will pass through the passages G, D, and D′ to the said fan. Any suitable arrangement of partitions may be employed to connect the upper ends of the air-passages D′ and D^2 with the inlet-openings I^2 I^2 of the fan-casing. In the particular construction illustrated in the drawings such partitions are made as follows: Partitions d^3 d^4 extend from the opposite sides of the fan-casing outwardly to the side walls A A of the housing at the rear and top of the said inlet-openings of the fan, and other partitions d^5 d^5, preferably made of sheet metal, as shown, Figs. 4 and 5, are connected with the lower edge of the rear partition d^3 and the upper edge of the partition d^2, the inner ends of said partitions d^5 being secured to the fan-casing below the said inlet-openings, while their outer ends are attached to the side walls A of the housing. The said partitions d^5 d^5 thus arranged serve to separate the several passages which are connected with the inlet-opening of the fan from the passage K, which connects the chambers E and F, as clearly seen in Fig. 2.

The passage J, leading from the fan-outlet I^3 to the chamber F, is formed by means of a vertical partition *j*, which extends across the machine between the side walls of the housing and is provided with a central opening at its top, where it is connected with the fan-casing. The said chamber F is provided with an outlet-opening F′, formed between the lower margin of the partition e^2; but in order to make the said opening F′ narrower than the space between said partitions a partition *f′* extends rearwardly from the top edge of the partition e^2, in the manner illustrated, said partition *f′* forming in effect a lower wall to the passage K, the upper wall of which is formed, in the construction illustrated, by means of the bottom of the fan-casing and the partitions d^5 d^5, hereinbefore described.

The several chambers and passages hereinbefore described constitute a continuous air-duct leading from the exit to the inlet opening of the fan and kept closed from communication with the outer air by the external walls

of the housing, which have no openings in them excepting those provided for the inflow and exit of the material being operated upon. The hopper B will always be partially filled with material, which is inserted therein through the opening a^3 in the top wall of the housing, so that no air can enter through said hopper. The receptacle H is always partially filled with material, which will be drawn therefrom either continuously or at suitable intervals through the gate *h*. The chamber E is provided in its bottom with a revolving spiral conveyer E^2, by which the material accumulating therein is discharged at one side of the housing without allowing ingress of air in a familiar manner. The chamber F is provided at its bottom with a discharge-opening having a gate f^2, through which material accumulating therein may be discharged without allowing influx of air.

Means are provided for regulating or controlling the passage of an air-current through the several passages or chambers as follows: At the exit-openings E′ of the chamber E is located a flap-valve L, the free margin of which may be swung nearer to one side or the other of said opening, as desired, so as to deflect the air passing from said chamber in greater or less quantity into either the passage G or the passage D^2—as, for instance, when the free edge of said flap-valve L is swung toward the partition *g*, the greater part of the air will flow through the passages D^2, while, on the contrary, when the free edge of the flap-valve is swung nearer the partition d^2, a greater part of the air will flow through the passages G, D, and D′. The inflow of air from the passage K to the chamber E is controlled by means of a flap-valve M, which makes a tight joint with the lower edge of the partition D^2, and the free edge of which may be brought nearer to or farther from the partition e^2, so as to make the inlet-opening to the chamber E larger or smaller, as desired.

N is a flap-valve for controlling the inflow of air from the passage J to the chamber F. Said valve N makes a tight joint with the lower margin of the partition *j*, and the free edge of said valve may be swung toward or from the rear wall A′ of the housing, so as to make the inlet-opening to the said chamber larger or smaller, as desired.

The several valves L, M, and N are adapted to be easily controlled from the exterior of the casing by having their pivots, which are mounted in the sides of the casing, attached to slotted segments L′ M′ N′, which segments are held in desired positions by means of thumb-screws *l m n*, passing through the slots and into the wall of the housing in a familiar manner.

Motion is given to the several operative parts of the machine as follows: On the shaft I′ of the exhaust-fan is located a belt-pulley I^4, over which is placed a belt, by which motion is transmitted to the machine. On the opposite end of said shaft is placed a belt-pulley I^5, and upon the shaft E^3 of the conveyer E^2 is placed a belt-pulley E^4, which is driven from the pulley I^5 by a crossed belt E^5.

Said shaft E^3 also carries a sprocket-wheel E^6, and upon the shaft B^2 of the feed-roll is located a sprocket-wheel B^3, driven from the sprocket-wheel E^6 by means of a chain-belt B^4. An idler B^5, mounted on a swinging arm B^6, serves to keep taut the chain-belt B^4.

The operation of the apparatus described, which is more especially intended for the purification of middlings, is as follows: The unpurified middlings are spouted or otherwise delivered to the hopper B, and by the rotation of the feed-roll are fed in a thin stream from said hopper into the upper part of the passage D, the middlings first falling upon the lower part of the inclined wall *a*, and then dropping from said wall to the partition *d*, over which they slide or roll until they fall from the lower edge of the same into the receptacle H. As the material falls from the lower edge of the wall *a* to the partition *d* and from said partition across the lower end of the passage G, and as said material rolls or slides downwardly over said partition, the air-current flowing upwardly through the passage D acts upon the material to separate from the coarse material or middlings proper the flour and fine or light impurities, which are carried away and upwardly by and with the air-current. The passage of the material over the inclined partitition *d* facilitates the separation of the fine and light impurities therefrom by the air-current for the reason that the finer or lighter particles are brought to the surface of the mass of material as the latter moves downwardly over the partition and are taken up by and carried upwardly with the air-current.

In order to secure desired results in different kinds or qualities of material, it is necessary to vary the force of the air-current passing upwardly through the passage D, and this is accomplished without varying the speed of the exhaust-fan by shifting the valve L, so as to permit a greater or less quantity of the air passing from the chamber E to flow through the passage D, while the remainder of the air passes directly to the inlet-opening of the fan through the passage D^2. By the employment of the valve L in the manner described the air-current flowing out of the chamber E and into the inlet-openings of the fan remains constant, while the working current flowing through the passage D is varied. This is a feature of great advantage in machines of this kind for the reason that it enables the fan to be driven at a speed to give a suitable and constant air-current for the operation of other parts of the machine while it enables the flow of air through the passage D, by which the separation of the fine and light impurities from the middlings proper is effected to be varied in force or speed, as may be necessary for the best results. Purified middlings falling into the receptacle H are re-

moved therefrom through the gate *h* as often as necessary. The dust, flour, bran, and other fine and light impurities separated from the middlings by the air-current in the manner described are drawn into the fan-casing and ejected therefrom with the air-current and pass from the same downwardly through the passage J. The dust-laden air-current passes through the upper part of said chamber and through the passage K into the chamber E; but in its passage through the chamber F the larger and heavier of the impurities suspended in the air—such, for instance, as the flakes of bran—will be thrown or fall out of the air-current and will be arrested in said chamber. The arresting of the heavier part of the material with which the air is laden will be caused partially by the decreased speed at which the current passes through the chamber F and partially by the fact that as the current passes abruptly around the lower edge of the partition *j* or the valve thereon the heavier particles will be thrown by centrifugal force outside of and beyond the action of the current, and will thereby be allowed to fall by gravity to the bottom of the receptacle. By shifting the valve N the inlet-opening to the chamber F will be widened or narrowed, so that the current will have greater or less velocity in entering the chamber and can thus be made to part with finer or coarser material, as desired. By moving said valve, therefore, the separation accomplished in the chamber F may be regulated, so that heavier or lighter material will be deposited in said chamber, as desired—as, for instance, if in purifying middlings it is found that a small quantity of flour is being deposited in the chamber F with the flakes of bran and other similar particles which are heavier than the flour the inlet-opening of the said chamber F will be made larger by shifting the valve, so that the current will move more slowly, when fewer of the lighter particles will be thrown out of the current by centrifugal action. On the contrary, if it is found that some of the bran or larger impurities pass out of the chamber E with the flour the inlet-opening will be made smaller by shifting the valve, and the greater speed thereby given to the current as it passes around the valve will cause all of the heavier particles to be thrown or cast out of the current, and they will remain in the said chamber. The current of air, ladened with flour and fine dust, will pass from the chamber F through the passage K into the top of the chamber E. The inlet-passage leading into the said chamber E is made smaller than that leading into the chamber F, so that the air-current will enter said chamber E with great velocity, and the partition d^2 or the valve at the lower end thereof is extended downwardly a considerable distance below the top of said chamber, so that the air-current will make a very abrupt and rapid turn in passing around the lower edge of the said partition or valve, thereby insuring that all or a greater part of the finer impurities will be thrown out of the current and will be deposited in the said chamber. The said inlet-opening of the chamber E may be increased or diminished in size by shifting the valve M for the same purpose and with the same result as hereinbefore described in connection with the chamber F. Said chamber E takes the place of the dust-separators or settling-rooms heretofore employed in connection with middlings-purifiers for removing the flour and fine dust from the air. As far as that part of my invention which relates to the said auxiliary passage or by-pass is concerned and means for controlling the passage of air through the main passage D and the said auxiliary passage, any form of valve or valves or other controlling device or devices may be employed, the use of a single flap-valve constructed and operating in the manner shown not being essential to this part of the invention—as, for instance, the construction illustrated in the detail view, Fig. 6, may be employed, wherein the opening leading from the chamber E to the passage G is controlled by a flap-valve R, while the auxiliary passage D^2 is controlled by a separate similar valve R′. The single flap-valve L illustrated has the advantage, however, of enabling a current of the same strength to be maintained through the chamber E; or, in other words, of maintaining the same aggregate area of the air-passage, whatever may be the position of the said flap-valve, and a construction of this kind is therefore herein claimed as a special and separate improvement.

The machine herein shown differs from all prior machines employed for purifying middlings or for similar purposes by having in connection with a series of closed passages or chambers in which there is a continuous circulation or flow of air, a by-pass or auxiliary passage in addition to the passage in which the aspiration is accomplished, such by-pass being controlled by a valve or valves, so that a lighter or stronger air-blast may be obtained in the aspirating-passage without changing the quantity of air passing through the exhaust fan or blower, and a construction involving these features is therefore herein broadly claimed as my invention without restriction to the other features of construction herein illustrated.

It will of course be understood that the particular construction described in the housing, partitions, and valves is not essential to my invention and that the several passages and valves necessary for the operation of the apparatus in the manner set forth may be constructed or arranged otherwise than in the particular manner illustrated.

I claim as my invention—

1. A separator comprising an exhaust-fan, a passage to receive the material to be separated when first introduced and through which said material falls by gravity, said passage

communicating directly with the inlet-opening of the fan, a second or auxiliary passage also communicating directly with the said inlet-opening of the fan, but separate from and not communicating with the first passage, a settling-chamber communicating with the exit-opening of the fan and with both of said passages, and means for controlling the flow of air through both of said passages, whereby the force of the aspirating-current may be varied at the point where the material introduced is first acted upon without changing the speed of the fan or affecting the current during its subsequent course, substantially as described.

2. A separator comprising an exhaust-fan, a passage to receive the material to be separated when first introduced and through which said material falls by gravity, said passage communicating directly with the inlet-opening of the fan, a second or auxiliary passage also communicating directly with the said inlet-opening of the fan, but separate from and not communicating with said first passage, a settling-chamber communicating with the exit-opening of the fan, a second settling-chamber communicating with the first settling-chamber and also with the said passages, and means for controlling the flow of air through said passages, whereby the force of the air-current may be varied at the point where the material is first acted on without changing the speed of the fan or affecting the current during its subsequent course through said settling-chambers, substantially as described.

3. A separator comprising an exhaust-fan, a passage through which the material to be separated falls by gravity, said passage communicating at its upper end with the inlet-opening of the exhaust-fan, a settling-chamber communicating with the exit-opening of the exhaust-fan and with said passage, a vertical wall or partition extending downwardly into said chamber between the inlet and outlet openings thereof, and a flat valve at the lower edge of said partition, substantially as described.

4. A separator comprising an exhaust-fan, a passage through which the material to be separated falls by gravity, said passage communicating at its upper end with the inlet-opening of the exhaust-fan, a second air-passage also communicating with the inlet-opening of the exhaust-fan, means controlling the flow of air through said passages, a settling-chamber connected with the outlet-opening of the exhaust-fan and with the said passages, and a vertical wall or partition extending downwardly into said settling-chamber between the inlet and outlet openings thereof, substantially as described.

5. A separator comprising an exhaust-fan, a passage through which the material to be separated falls by gravity, said passage communicating at its upper end with the inlet-opening of the exhaust-fan, a settling-chamber communicating with the outlet-opening of said exhaust-fan and with the lower end of said passage, and a gate or valve controlling the inlet-opening to the settling-chamber, substantially as described.

6. A separator comprising an exhaust-fan, a passage through which the material to be separated falls by gravity, a second or auxiliary passage also communicating with the inlet-opening of the exhaust-fan, a settling-chamber communicating with the exit-opening of the fan and with both of said passages, means controlling the flow of air through said passages, and a single flap-valve applied to control the admission of air to said passages, substantially as described.

7. A separator comprising an exhaust-fan, a passage through which the material to be separated falls by gravity, a feeding device delivering material to the upper end of said passage, a hopper or receptacle located at the lower end of the passage, a settling-chamber communicating with the outlet-opening of the exhaust-fan and with said passage, a second passage leading from the outlet-opening of the settling-chamber to the inlet-opening of the fan, and means controlling the flow of air through said passages, substantially as described.

8. A separator comprising an exhaust-fan, a passage through which the material to be separated falls by gravity, said passage being connected at its top with the inlet-opening of the exhaust-fan and having an inclined side wall, upon which the material is delivered, a hopper or receptacle located at the lower end of the passage, a second or auxiliary passage also communicating with the casing of the exhaust-fan, a settling-chamber communicating with the exit-opening of the exhaust-fan and with both of said passages, and means controlling the flow of air through said passages, substantially as described.

9. A separator comprising an exhaust-fan, a passage through which the material to be separated falls by gravity, said passage being connected at its top with the inlet-opening of the exhaust-fan and having an inclined side wall, upon which the material is delivered, a feed device supplying material to the upper part of said wall, a hopper or receptacle located at the lower end of said passage, a second or auxiliary passage also communicating with the casing of the exhaust-fan, a settling-chamber communicating with the exit-opening of the exhaust-fan and with both of said passages, and means controlling the flow of air through said passages.

10. A separator comprising an exhaust-fan, a passage through which the material to be separated falls by gravity, said passage being connected at its upper end with the casing of the exhaust-fan and having an inclined side wall, upon which the material is delivered, an inclined wall *a*, the lower end of which is lo-

cated over the upper part of said inclined side wall, a feed device discharging upon said wall *a*, a hopper or receptacle located at the lower end of the said passage, a second or auxiliary passage also communicating with the casing of the exhaust-fan, a settling-chamber communicating with the exit-opening of the exhaust-fan and both of said passages, and a valve or valves controlling the flow of air through both of said passages, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

JONATHAN MILLS.

Witnesses:

C. P. L. BUTLER, Jr.,

R. D. ROBINSON.