No. 619,354. Patented Feb. 14, 1899.

J. M. SCHUTZ.

GRINDING MILL.

(Application filed Nov. 22, 1897.)

(No Model.)

FIG. 1.

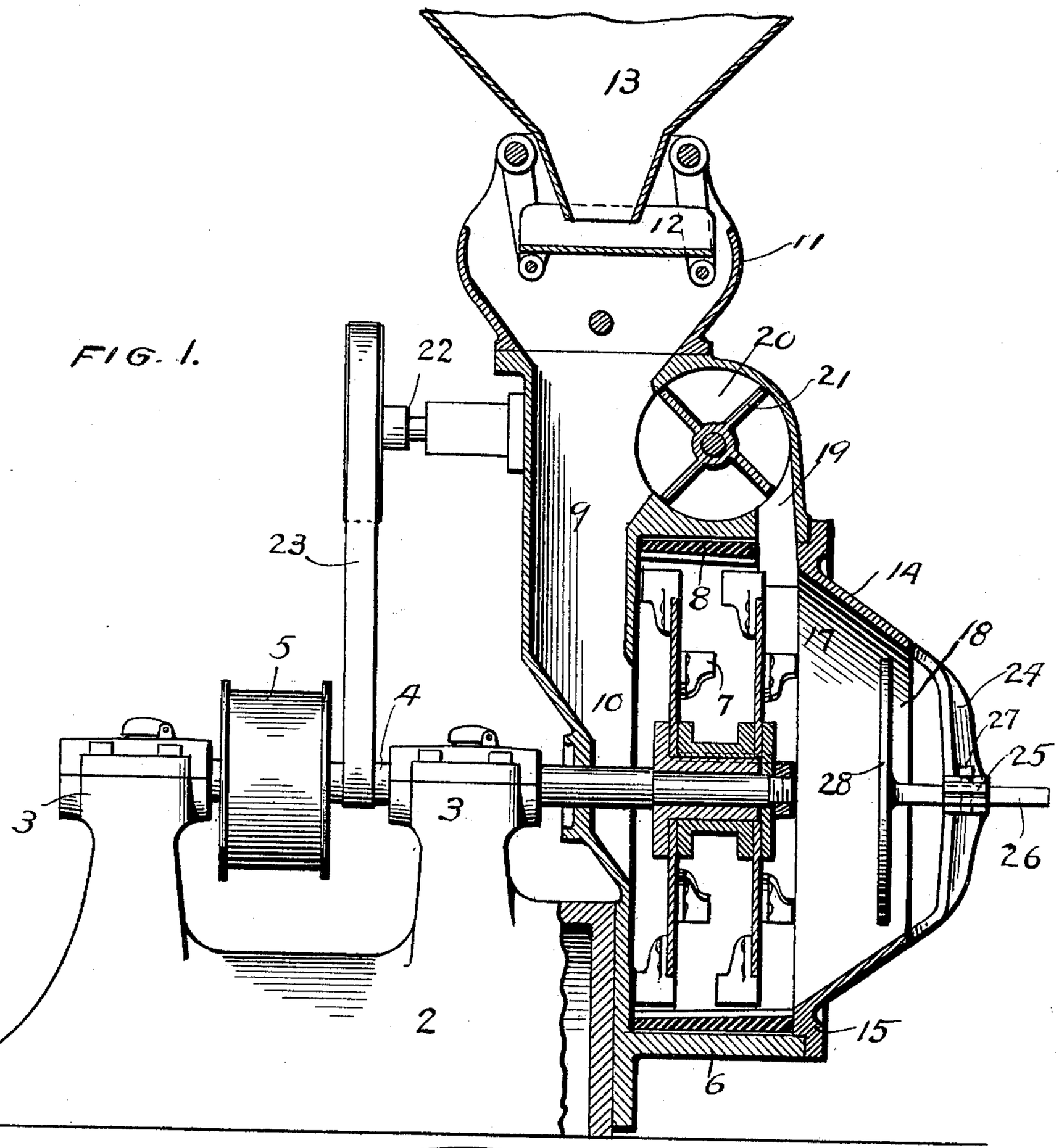
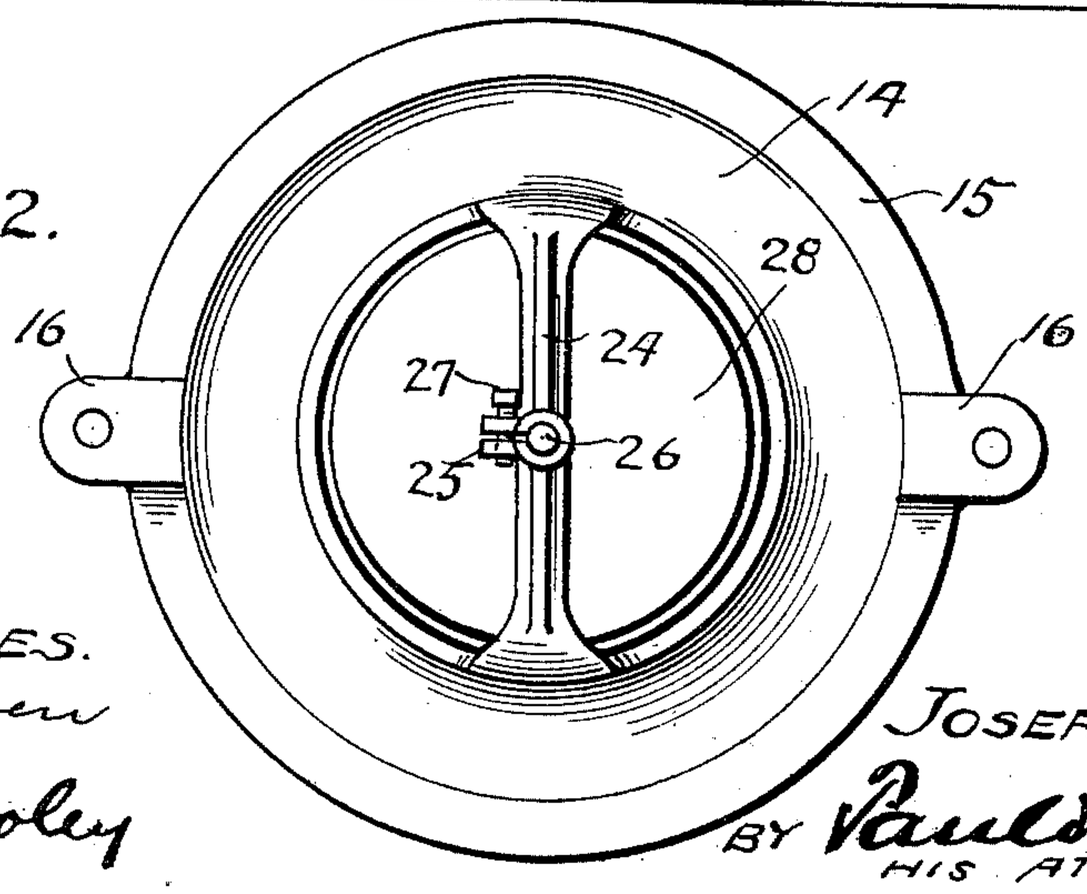


FIG. 2.



WITNESSES.
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JOSEPH M. SCHUTZ, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO THE SCHUTZ-O'NEILL COMPANY, OF SAME PLACE.

GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 619,354, dated February 14, 1899.

Application filed November 22, 1897. Serial No. 659,379. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH M. SCHUTZ, of the city of Minneapolis, county of Hennepin, State of Minnesota, have invented certain new and useful Improvements in Grinding-Mills, of which the following is a specification.

My invention relates to improvements in grinding-mills; and the particular object of my invention is to provide a grinding-mill and separator which will be entirely self-contained, from which there will be no tailings or refuse, and which will not clog or choke.

The particular object of the invention is to provide simple and effective means for regulating the fineness of the product of the machine.

The invention consists generally in a grinding-mill of the construction and combination of parts hereinafter described, and particularly pointed out in the claims.

The invention will be more readily understood by reference to the accompanying drawings, forming part of this specification, and in which—

Figure 1 is a vertical and longitudinal section of the machine embodying my invention. Fig. 2 is a front view of the separator portion thereof, showing the adjustable disk.

As shown in the drawings, 2 represents the base of the machine, which base is provided with blocks or bearings 3 3 for the shaft 4. Between the bearings this shaft is provided with a driving-pulley 5. On the end of the base I erect the body and upper portion of the machine. The body portion 6 has the form of a shallow cylinder, concentric with the shaft 4, and within which the beaters or breakers 7, carried on the end of the shaft 4, are adapted to rotate. The breakers operate close to the walls of the body of the cylinder 6 and effectually pulverize any material which is fed into said body. The inner wall of the cylinder is preferably composed of the movable plates, (not shown,) having suitable corrugations, and the inner wall proper, 8, of the cylinder or body is a truncated cone, flaring toward the base of the machine.

9 represents the feed and air-inlet trunk. This trunk communicates with the body 6 by an opening 10, provided around the shaft 4. The upper end 11 of the trunk is preferably enlarged to make room for the automatic feeder 12, which is arranged beneath the hopper 13. This automatic feeder 12 is not tightly inclosed in the trunk; but instead the upper end of the trunk is open for the full inlet of air or other fluid that is employed as a carrying agent for the pulverized material within and passing from the body 6. Upon the front or discharge end of the body 6 is the separator portion of the machine. This part comprises a shallow cone 14, of a pitch determined upon according to the coarsest grade of material which it is desired to produce with the machine. This cone is provided with a flange 15, that is secured to the end of the body in such a way that it may be rapidly moved therefrom and replaced by another cone of a different pitch. Any means may be used to secure the cone in place, but I prefer the lugs 16, (shown in Fig. 2,) which lugs are fastened by pins or bolts upon the ends of the body. There is no particular pressure upon the cone and the fastening need not therefore be particularly strong. The large end 17 of the cone or separator is preferably of the same diameter as the inner diameter of the body of the cylinder 6, and the outer end or outlet-opening 18 of the cone is of greater diameter than the inlet-opening 10, through which the air and the material to be ground are admitted to the cylinder.

19 represents a return-duct arranged between the body and the casing and through which the material is taken from the front end of the cylinder and returned to the trunk 9 to be reground. To prevent a heavy blast of air from escaping through the duct 19 and thus back into the trunk 9, I provide a simple rotating valve 21 in the larger or cylindrical portion 20 of the duct 19 and rotate said valve by means of suitable shaft connections 22, driven by a belt 23 from the main shaft 4. The speed of the valve need be only sufficient to carry away the material which is lifted into the duct 19 by the whirling air within the body.

If the conveyer or wheel should be taken out, so much air would be allowed to exhaust from the body or casing of the machine that

the whirling body of air would be interrupted and its action on the conical deflector would be imperfect. The only reason for using the return-duct at all is to take away the material that is returned by the deflector to prevent its accumulation in the end or corner of the body at its junction with the conical deflector, where friction between the beaters and said accumulated material would create great heat and render the machine unsafe.

On the forward end of the cone I preferably provide the bridge or yoke 24, which is provided with a hole or sleeve 25, concentric with the cone and shaft 4. In this is the shaft 26, which may be tightened and held in the sleeve 25 by means of a screw 27 or any suitable binder. On the inner end of the shaft or pin 26 and within the cone or separator is a disk 28, preferably of less size than the outlet-opening or end of the cone 18 and adapted to limit the flow of air from said cone.

The operation of my machine is as follows: The material to be pulverized is placed in the hopper 13 and is gradually and evenly fed into the trunk by means of a suitable feeder 12 or equivalent device. The feeder may of course be dispensed with. The material falls into the trunk 9 and thence into the cylinder or body of the machine. The shaft 4 is rotated at a high speed, and the beaters therefor rotate at a very high peripheral speed and close to the walls of the cylinder or body to pulverize the material. The beaters create a strong suction of air downward through the trunk and outward through the cone, the air being rapidly rotated and also urged forward. The material is finely ground by the beaters, and owing to the flaring arrangement of the inner wall of the cylinder the material is led or forced forward until it meets with the inner end of the cone or separator 14. The rapidly-rotating and forwardly-moving currents of air within the body carry the pulverized material spirally upon said cone, and the particles of materal will possess considerable centrifugal force, so that the heavier particles will be projected tangentially and striking the cone will be deflected backward into the body of the machine. This occurs at different points on the cone, according to the heaviness or lightness of the particles, and only such particles as have less force than the onward-moving force of the air will be discharged from the cone, and it is only necessary to regulate the onward or longitudinal movement of the air-currents to keep all but a certain grade of pulverized material from escaping through the open end of the cone. It is necessary to modify the foregoing statement in one respect only—to wit., that it is also necessary to prevent the interruption or breaking up of the spirally-rotating currents or body of air, as any such interruption would cause the precipitation of the material held in suspension, and thereby prevent the obtaining of an even output from the machine. Obviously the circular disk 28, which is employed within the cone, wherein the currents rotate in true spirals, does not in any way interfere with the path or paths of the material held therein, but simply restricts the final outlet-opening to the narrow annular space between the end of the cone and the circular disk. The obstruction of the outlet-opening by means of the disk results as follows: The rotation of the air-currents and therefore the degree of centrifugal force imparted to each particle is constant and the centrifugal force depends upon the weight of the particle. The heavier particles possessing greater centrifugal force than the lighter ones will be thrown from the supporting-air and will impinge upon the lower parts or inner part of the cone and will practically immediately pass back into the body of the machine, still lighter particles moving somewhat farther forward in the cone; but as the conical surface more closely approaches the axis of the rotating body of air the distance through which the particles must be thrown to strike the cone is decreased according to the distance of the body of the mill. Therefore although the weight of the particles is less they will come in contact with the surface of the cone and be deflected backward. This occurs except with all particles whose weight plus the constant centrifugal tendency imparted by the rotation is less than the onward-moving force of the body of air. The lighter particles will escape contact with the cone even at the extreme end thereof and will be carried out of the cone or separator and into a suitable settlings-chamber which is usually employed in connection with the machine. It follows, therefore, that with a given size of annular outlet-opening and a given speed of rotation in the mill particles of a regular size only will be discharged therefrom. Now the rotary movement remains the same owing to the fact that the speed of the mill proper is constant. Therefore to change the grade of material discharged from the mill the longitudinal velocity of the body of air therein is either checked or increased to respectively increase or decrease the fineness of the output or particles allowed to escape. This is effectually accomplished by the disk 28. As the disk is moved inward the annular opening between the same and the cone is increased in size to allow a freer undisturbed outlet of the air, which in consequence will then possess greater longitudinal velocity, and, so to speak, the pitch of the spiral will be increased, thereby diminishing the centrifugal action as compared with the longitudinal action, with the result that larger particles will be outweighed by the moving air and will escape through the annular opening around the disk. As the disk is drawn out and the discharge-opening decreased in size the air within the machine will be proportionately blocked, will have a greater rotative force and less longitudinal force, and the output will be finer.

It will be noted that the disk 28 is entirely

inclosed within the cone, so that it in no wise disturbs the rotative movement of the air, as the currents of air are held against expansion until they have actually passed beyond the disk. Any arrangement outside of the cone for checking or regulating the air would be ineffective, owing to the disturbance of the currents due to the expansion of the air after leaving the cone. A further and great advantage derived from the use of the disk 28 is that it prevents any backward rush of air into the cone to disturb the movement of the particles therein. This is one of the noticeable differences between the machine herein described and that set out in my pending application, filed May 4, 1897, Serial No. 634,991, (separator,) wherein other means are employed to limit the outward velocity of the air from the cone and the particles contained therein. Like as in the machine shown in the above-mentioned pending application the return-duct 19 carries the material which is deflected upon the cone back over the grinding mechanism and to the inlet-opening to again start it into the pulverizer proper, thereby preventing the clogging of the forward end of the machine. A noticeable difference between this machine and that shown in my pending application over and as compared with the pulverizers and separators heretofore invented lies in the absence of all interfering parts within the body of the separator—that is, any part or mechanism which would disturb or prevent the natural rotation of the particles within the separator or cone. I prefer the machine herein described to that defined in the pending application above mentioned on account of its greater simplicity and cheapness and particularly on account of the more effectual and simpler means for controlling the fineness of the output. A further advantage over any other machine arises from the ability of the present machine to start the cone from the periphery of the grinding-cylinder, the shoulder or end shown in my earlier machine being avoided. In practice it is found that such a shoulder causes a collection of material in the forward end of the grinding-chamber, against which material the beaters operate, and therefore generate an objectionable heat, particularly to be avoided in the working of wet or gummy materials. If but one grade of material is needed, the disk may be dispensed with, and different grades may be gotten by changing cones; but I prefer to use the disk upon all machines.

The machine herein described is adapted for reducing the grade of grindable or pulverizable materials, such as sugar, salt, various kinds of drugs, spices, ginger, and like materials, various seeds and cereals, and various minerals.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination of the pulverizer proper arranged to create a strong blast or current of fluid within it, with the conical separator into which said fluid and the partially-pulverized material are discharged, and the disk or plate arranged within the said conical separator and separated from the walls thereof by an annular opening, substantially as described.

2. The combination, of the pulverizer proper arranged to create a strong current of fluid within it, with the conical separator into which said fluid and the partially-pulverized material are discharged, and the disk or plate arranged within said conical separator and adjustable therein, substantially as described.

3. The combination, with the pulverizer-body, of the rotary pulverizer, the inlet trunk or opening, the conical separator into which the material and fluid from said body are discharged, while rotating at a high speed, and the adjustable disk provided in said conical separator, and means for adjusting and holding said disk, substantially as described.

4. The combination, with the pulverizer-body and the rotary pulverizers, with the inlet-trunk, the conical separator, the by-pass or duct leading from said body to said trunk and opening from the body at a point between the body and said conical separator, and the disk 28 within the outer part of said conical separator, substantially as described.

5. The combination, with a conical separator, of means for creating a positive current or blast of air longitudinally through said conical separator and for rotating said current or body of air, and a disk arranged within the smaller portion of said conical separator and separated therefrom by an annular opening, substantially as described.

In testimony whereof I have hereunto set my hand this 17th day of November, A. D. 1897.

JOSEPH M. SCHUTZ.

In presence of—
C. G. HAWLEY,
M. E. GOOLEY.