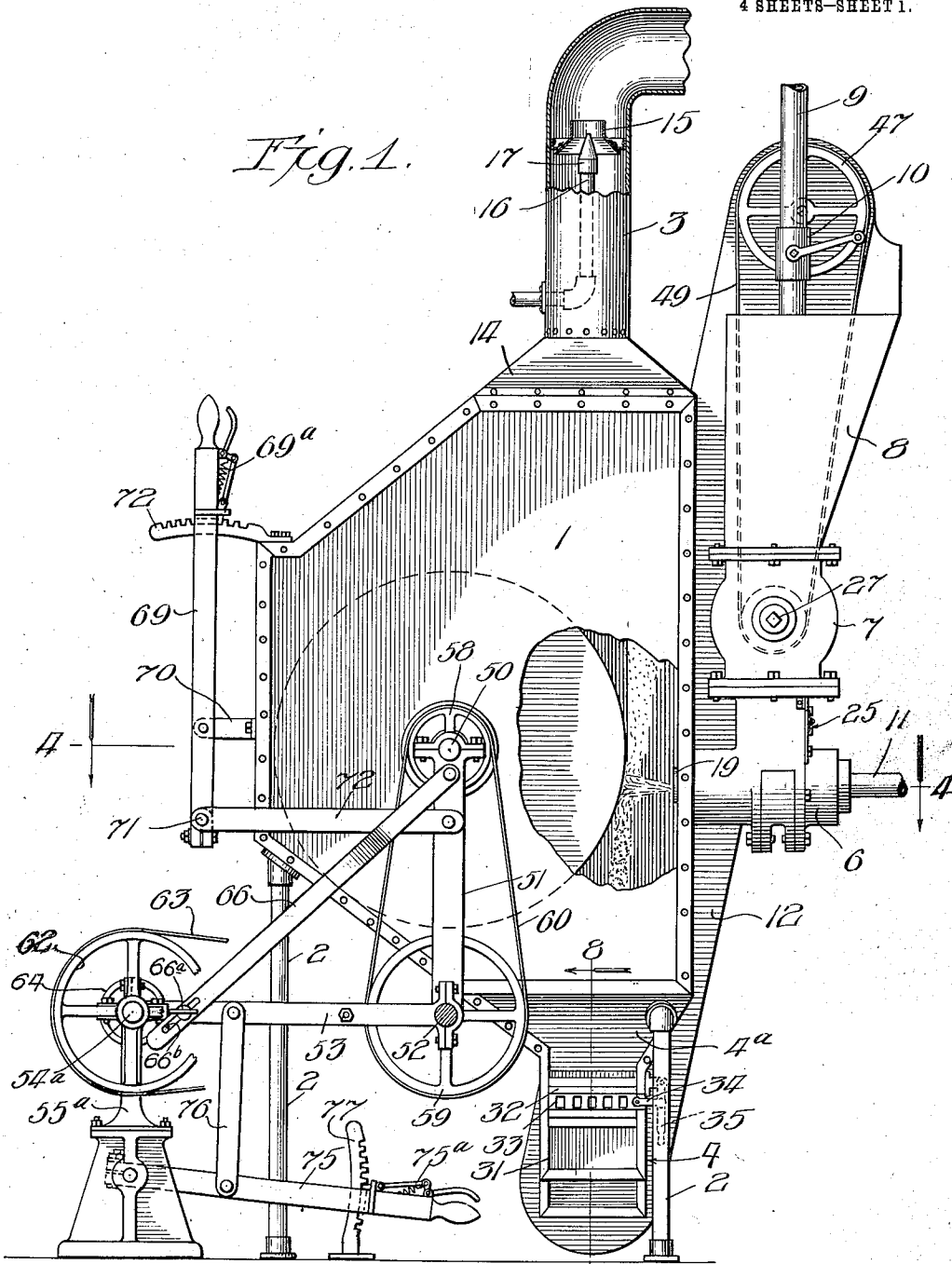


C. A. HUPP.
PULVERIZING APPARATUS.
APPLICATION FILED JAN. 16, 1913.

1,121,631.

Patented Dec. 22, 1914.

4 SHEETS—SHEET 1.



Witnesses:
Harry S. Gaither
Charles H. Pooe

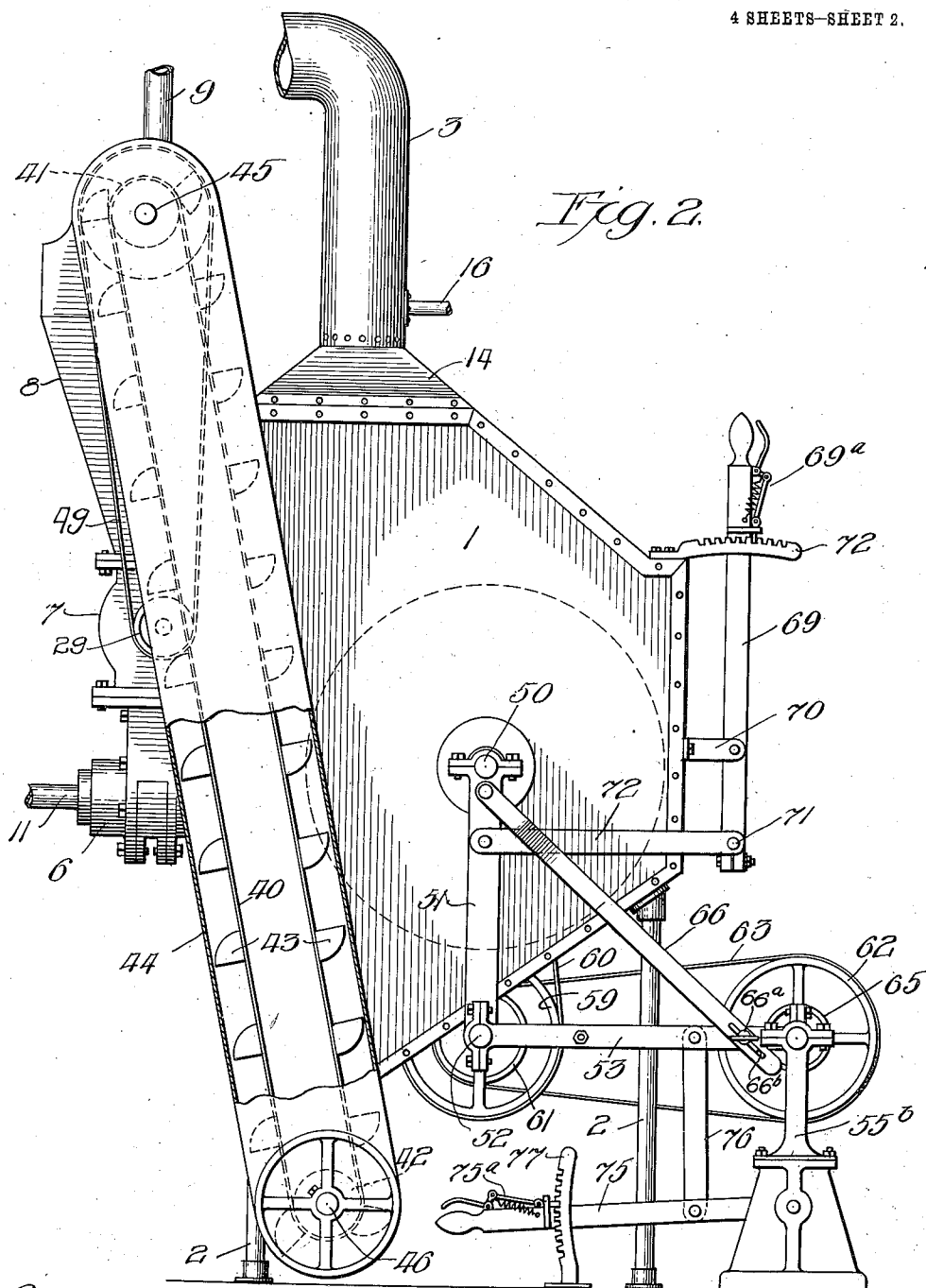
Inventor:
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by *Boole & Ormer*
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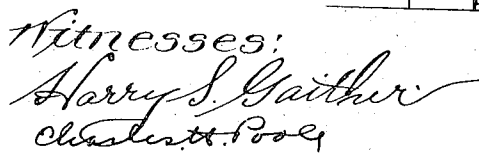


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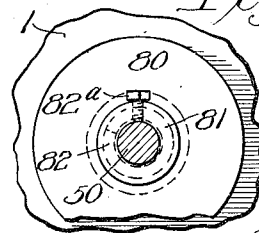
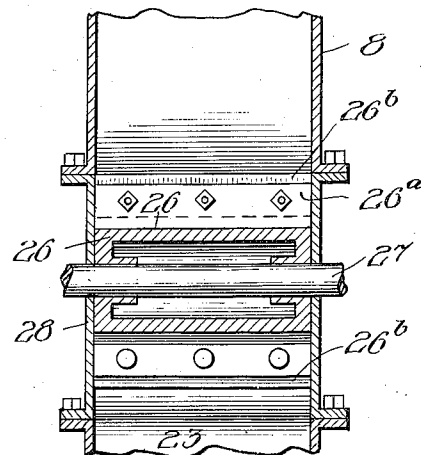
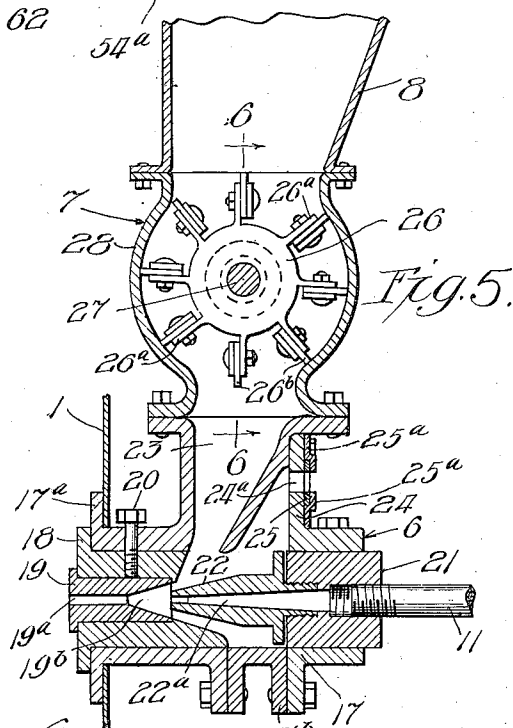
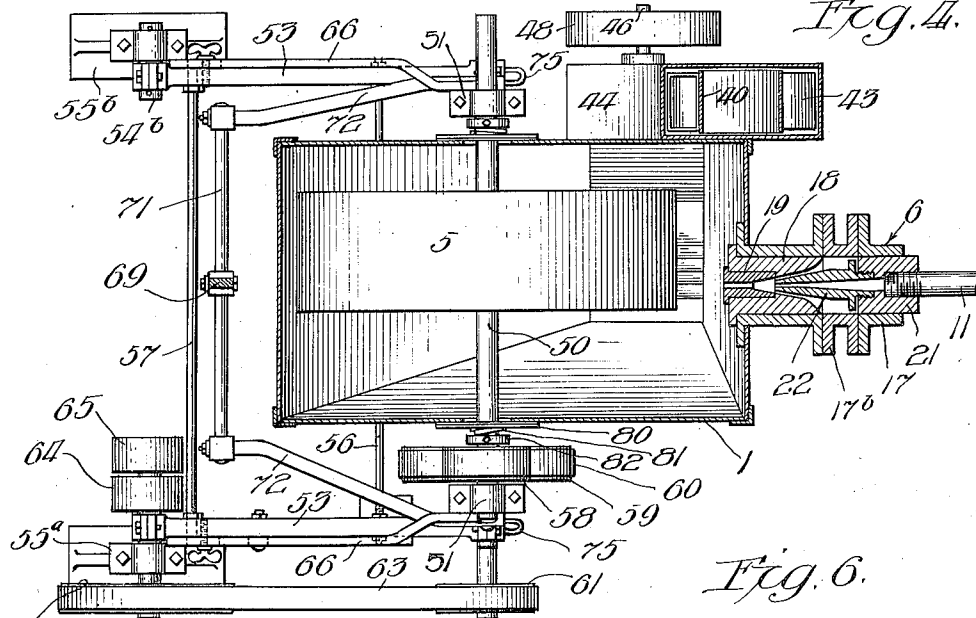
4 SHEETS—SHEET 3.



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Att'ys

1,121,631.

4 SHEETS--SHEET 4.



Witnesses; 17th
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Inventor:
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Attys

UNITED STATES PATENT OFFICE.

CHARLES A. HUPP, OF OTTAWA, ILLINOIS, ASSIGNOR TO KEEN KLEENER MANUFACTURING COMPANY, OF OTTAWA, ILLINOIS, A CORPORATION OF ILLINOIS.

PULVERIZING APPARATUS.

1,121,631.

Specification of Letters Patent.

Patented Dec. 22, 1914.

Application filed January 16, 1913. Serial No. 742,327.

To all whom it may concern:

Be it known that I, CHARLES A. HUPP, a citizen of the United States, and a resident of Ottawa, in the county of La Salle and State of Illinois, have invented certain new and useful Improvements in Pulverizing Apparatus; 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 improvements in pulverizing apparatus, and more particularly to improvements in that class of pulverizing apparatus adapted for reducing sand and like granular materials, of varying degrees of coarseness, to a finely powdered or pulverized form.

The object of this invention is to produce a construction for an apparatus of the class described, whereby the granular material may be impelled with high velocity against a hard surface, the impact of the particles against the said surface tending to break them up into smaller particles.

A further object of this invention is to provide means whereby the powdered or pulverized material may be carried by suction from the apparatus, and means whereby the particles not sufficiently reduced in size may be automatically returned to a receptacle from which they are again delivered to the apparatus, and are thereby repeatedly acted upon until they are reduced to the desired degree of pulverization.

A further object of the invention is to provide a movable surface against which the particles of granular material impinge, and also to provide means whereby this surface may be adjusted relative to the path of the moving particles with advantages and results hereinafter pointed out.

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

Referring to the drawings—Figure 1 is a view in front elevation of the apparatus; Fig. 2 is a view in rear elevation of the apparatus; Fig. 3 is a view in end elevation of the apparatus; Fig. 4 is a cross-sectional view taken on line 4—4 of Fig. 1; Fig. 5 is an enlarged detail view in vertical section of the nozzle and feeding device; Fig. 6 is a longitudinal section taken on line 6—6 of

Fig. 5; Fig. 7 is an enlarged detail view in side elevation of plate, spring and collar mounted upon the drum shaft, immediately exterior to the casing; Fig. 8 is a detailed cross-sectional view taken on line 8—8 of Fig. 1; Fig. 9 is a sectional view taken on line 9—9 of Fig. 8.

Referring to the drawings, my improved pulverizing apparatus consists in general of a vertically elongated casing 1, supported in an upright position upon legs 2, said casing being provided with vertical front, rear and end walls and inclined top and bottom walls, a suction discharge pipe 3 adjacent to the said top wall, and a receiving hopper 4 located at the bottom of the casing. Mounted within the casing is a rotative drum or wheel 5 having a circumferential cylindric face of a hard material, as for instance, of steel. Means are provided for rotating said drum and for shifting the drum vertically and horizontally. At one side of the apparatus I provide an impelling device for the granular material, comprising a nozzle-casing 6, and a jet nozzle 22 extending into said casing; said nozzle casing 6 being provided with a discharge nozzle 19 having its bore 19^a in alinement with the jet nozzle and directed toward the peripheral surface of the drum 5. Said discharge nozzle 19 extends through the vertical wall of the main casing 1, to which the nozzle casing 6 is attached. The nozzle casing 6 is so constructed as to form a chamber which surrounds the delivery end of the jet nozzle 22. Said nozzle casing 6 is adapted to receive the granular material, through a feed regulating or controlling device 7, from the receptacle or hopper 8. The jet from the jet nozzle 22, in passing through the bore 19^a of the delivery nozzle 19, acts to induce a strong current of air outwardly through the said delivery nozzle, and the casing 6 is provided with a damper 25 (Fig. 1), through which air is drawn into said casing. By the action of the air current so induced through the casing, the granular material delivered thereto is taken up by such air current and discharged through the delivery nozzle with the jet of air, or air and steam, which issues therefrom.

A supply pipe 9, provided with a valve 10, admits from a suitable source of supply, the granular material into the hopper and thence to the casing 6. The granular mate-

rial is forced or impelled through the delivery nozzle 19, of the casing 6, at a high velocity by the action of the jet of compressed air or steam from the jet nozzle 22.

5 At the rear of the casing I further provide a conveyer, of the traveling bucket type, which communicates at its lower extremity with the receiving hopper 4 and at its upper end with the feed hopper 8, by means of an inclined chute 13 (Fig. 3).

10 Proceeding now with a more detailed description of my apparatus, the casing 1 is preferably constructed of sheet metal, having its end and side walls vertical, said end walls being somewhat less in width than the side walls. The discharge pipe 3 communicates with the top of the casing by means of an upwardly tapered hood 14 which is secured to the upper edges of the side walls of the casing, and of the end wall, to which the nozzle casing 6 is attached, the same being hereinafter designated as the front end wall. By preference, the top wall of the casing is inclined downwardly from the lower margin of the hood 14 in its part above the drum 5. The bottom wall of the casing is inclined beneath said drum and slopes downwardly toward the receiving hopper.

30 Within the vertical portion of the discharge pipe 3 is supported a short pipe 15, made conical and upwardly tapering at its lower part. A vertical pipe 16, provided with a nozzle 19 is located in the discharge pipe 3 with its nozzle beneath and adjacent to the short pipe 15. The pipe 16 is supplied with air or steam under pressure, and the jet from its nozzle 17 affords an induced draft or suction outwardly through the said discharge pipe.

40 The nozzle casing 6 is, by preference, made as follows: The body 17 of said nozzle casing is generally cylindric in shape and is provided at its inner end with a flange 17^a, which abuts against the inner surface of the front end wall of the casing 1, and with a semi-circular wall section 17^b, removably secured between flanges formed upon the under side of the body exterior to the casing. Within the body and adjacent to the inner end thereof is a bushing 18 provided with a central bore, in which is inserted a tube constituting the nozzle 19, in which is formed the discharge passage or orifice 19^a. The said bushing and nozzle 19 are retained in place by a set screw 20 extending through the wall of the body and the bushing 18, and bearing upon the nozzle 19, said set screw having screw-threaded engagement with the bushing 18. The nozzle 19 is provided at the receiving end of the orifice 19^a with a tapered or flaring portion 19^b. At the rear of the body is a block 21 provided with a horizontal bore, in which is secured the supply pipe 11 and the jet nozzle 22

thereof; said nozzle and pipe having screw-threaded engagement with said block 21. The jet nozzle 22 is in alinement with the discharge passage 19^a in the nozzle 19, and the bore 22^a of said jet nozzle converges slightly toward its mouth. The discharge end or mouth of said jet nozzle is located a short distance from the entrance of the nozzle 19. The said discharge passage 19^a of the nozzle 19 is as shown, made slightly larger in diameter than the mouth of the nozzle 22.

Connected with the top of the body 17 of the casing 6 is an upright feed tube 23, provided therein with an inclined guide plate 23^a sloping downwardly toward the receiving end of the discharge passage 19^a of the nozzle 19. Immediately behind the guide plate 23^a is a plate 24 provided with a plurality of horizontally arranged air inlet openings 24^a. The size of these openings is regulated by a simple form of damper (Figs. 3 and 5) comprising, as shown, a sliding plate 25 provided with a plurality of openings adapted to register with the openings 24^a in the plate 24, said sliding plate being mounted in two parallel, horizontal guideways 25^a. A pivoted lever 25^b and a link 25^c, connecting the plate 25 with said lever, constitute a manually operable means for shifting said plate to regulate the size of the openings, and likewise the quantity of air admitted to the interior of the nozzle casing 6.

Above the feed channel is mounted the feed controlling device, comprising a cylindrical rotative feed member or drum 26, secured to a horizontal shaft 27, and provided with a plurality of radial wings 26^a, evenly spaced about the periphery of the drum and to which are secured strips 26^b of flexible material such as leather or rubber. The said drum is inclosed within a cylindric housing 28, through the end walls of which extends the shaft 27; the latter being provided with a driving pulley 29. The said housing is connected at its bottom with the feed tube 23 and at its top with the feed hopper 8.

Referring now to the construction of the receiving hopper 4 at the bottom of the casing 1, said hopper 4 comprises inwardly inclined bottom and upright side walls; the rear wall thereof being vertical and made integral with the rear wall of the main casing 1. The bottom wall 4^a thereof slopes downwardly and rearwardly approximately at an angle of 45°. The lower portion of the hopper 4 preferably has vertical and parallel side walls. The inclined bottom wall, and upright side walls of said hopper form a narrow chute (Figs. 8 and 9), which is directed toward an aperture 30 in the rear wall of the hopper at its bottom. Connected with the inclined wall 4^a

of the hopper, exterior to the same, is an inclosure 31, the same having front vertical and bottom horizontal walls. Within the front vertical wall of the said inclosure is provided a damper 32 consisting of a plurality of horizontally arranged apertures in the wall, and an endwise slidable plate 33 provided with corresponding apertures. For operating said plate 33, a link 34 is connected to said plate and to a pivoted lever 35. In the said inclined bottom wall 4^a of the hopper 4, and in communication with the interior of the external inclosure 31, are a plurality of horizontal slots or openings, the same being formed by means of a plurality of parallel strips 36, spaced apart from each other, and arranged with their inner margins on a line which is inclined to correspond generally with the inclination of said wall 4^a. Said strips are transversely inclined downwardly and inwardly, so that granular material sliding downwardly over the inclined wall 4^a will pass over said strips and the slots or openings between the same.

As hereinbefore stated, the receiving hopper 4 communicates with the conveyer 12, which is located immediately adjacent to one of the side walls of the casing 1. The said conveyer (Fig. 2) consists of a flexible belt 40 mounted upon upper and lower pulleys 41 and 42, the lower pulley 42 being located below the casing, adjacent to the opening 30 at the bottom of the hopper 4, and the upper pulley 41 at a short distance above the level of the feed hopper 8. Secured to the belt 40 is a plurality of buckets 43 evenly spaced apart upon the outer surface thereof. The said conveyer belt and pulleys are inclosed in a housing 44 of sheet metal. Said pulleys 41 and 42 are mounted upon shafts 45 and 46, respectively, which have bearings in the sides of said housing. Upon the said shafts 45 and 46 are mounted driving pulleys 47 and 48. The lower driving pulley 48 is adapted to be connected by a belt (not shown) with any suitable driving means. The upper pulley 47 is connected by a belt 49 with the driving pulley 29 of the feeding device 7. Extending from the upper portion of the conveyer housing 44 is the inclined chute 13 communicating with the hopper 8. The aperture 30 at the bottom of the receiving hopper is so located relative to the path of the buckets that material passing through the opening will be delivered into the said buckets and carried upwardly thereby. From the said buckets the material is discharged into the chute 13 and conveyed by the latter to the hopper 8.

Referring now to the wheel or drum 5 (Figs. 1 and 4) the same is mounted upon a horizontal shaft 50 and has its peripheral surface in the vertical plane of the discharge passage 19^a for the granular mate-

rial, or, in other words, in such position relatively to the discharge nozzle 19, that the material to be pulverized on leaving the said discharge nozzle 19 strikes against the annular peripheral surface of the drum. The said drum is further located relative to the nozzle so that the point of contact of the material with the drum will be at or near the point of tangency of a vertical line to the periphery of the said drum.

In order that the degree of pulverization of the material may be varied, I have provided a construction by which the drum is mounted in such a manner that the same may be raised or lowered, and also moved toward or away from the discharge nozzle 19. The effect of moving the drum toward or from the discharge nozzle, is to vary the force of the impact of the particles of granular material against the drum, assuming that the velocity of the particles at the point of discharge be constant. The effect of shifting the drum in a direction at right angles to the path of the particles, or the central axis of the discharge nozzle, will be understood when it is considered that the effect of moving the drum in this manner, will be to shift the point of contact of the particles with the surface of the drum, and to thereby change the angle at which the moving particles strike the cylindric surface of the drum. Assuming that the drum is rotating in the direction of the arrow (Fig. 1), that is, counter-clockwise, the particles of the material will strike the drum with greater force when the point of contact is below the level of the axis of the drum than when such point of contact is in horizontal alinement with said axis, and the particles strike the cylindric surface of the drum at right angles to the same.

By adjusting the drum vertically, the same may be placed in such position relatively to the discharge nozzle to afford a maximum pulverizing effect according to the velocity imparted to the particles under different conditions of operation of the impelling means by which the particles are thrown against the drum.

Referring now to the means for supporting the drum, two similar vertical beams 51, 51 are provided, having bearings at their upper ends within which is journaled the drum shaft 50. Connecting the lower ends of the said beams is a shaft 52 parallel to the drum shaft and located immediately below the casing and exterior thereto. The said shaft 52 is journaled at the extremities of the said vertical beams 51 and also within bearings provided at the ends of parallel horizontal beams 53 which extend laterally and are pivotally mounted at their other ends upon short stub shafts 54^a, 54^b. Said stub shafts are mounted in bearing standards 55^a, 55^b secured to the floor at points

located at each side of and at a distance forward from the casing 1. The said horizontal beams are rigidly connected by rods 56 and 57, extending between the said beams adjacent to their ends. The drum 5 is rotated by a belt and pulley device, as follows: A small pulley 58 is mounted upon the drum shaft 50 exterior to the front wall of the casing (Figs. 1 and 4). A larger pulley 59 is mounted upon the shaft 52 and lies in the vertical plane of the said pulley 58 and transmits power thereto by means of a belt 60. Upon said shaft 52 and exterior to the forward horizontal beams 53 is secured another pulley 61 which is connected to a third pulley 62 mounted upon the adjacent stub shaft 54^a by a belt 63. A small driving pulley 64 is also mounted upon the stub shaft 54^a with the pulley 62, together with a similar idler pulley 65, loosely mounted upon the shaft adjacent to the rigidly mounted pulley 64. A belt (not shown) connects these driving pulleys 64 and 65 with any suitable prime mover, there being preferably provided the usual type of belt shifting means adapted to transfer the belt from the rigid driving pulley 64 to the idler pulley 65 when it is desired to stop the rotation of the drum.

It is obvious that the combination of pivotally connected beams do not form a rigid structure, but as thus described permit both the vertical and horizontal movement of the drum shaft in that the vertical beams are free to oscillate about their lower extremities, and the horizontal beams to oscillate about their outer extremities. In order to rigidly connect said vertical and horizontal beams, I provide links 66, 66, which are pivoted to the vertical beams 51, 51, adjacent to their upper extremities and are adjustably attached to the horizontal beams 53, adjacent to the outer extremities of the latter by means of bolts and wing nuts 66^a which extend through longitudinal slots 66^b formed in the lower ends of said links 66. By loosening the bolts 66^a, the drum may be shifted to any desired position vertically and horizontally, and fixed in that position by tightening the said bolts.

I further provide manually operable means for shifting the drum both horizontally and vertically, as follows: Referring to the horizontal shifting means, the same comprises a hand lever 69 pivotally mounted in a vertical position upon a bracket 70 secured to the end wall of the casing 1, midway between the front and rear walls. Through the lower extremity of the lever 69 extends a horizontal rod 71 (Fig. 4) to the ends of which are pivotally secured two horizontal links 72 which are likewise pivotally secured to the vertical beams 51, 51 adjacent to their upper extremities. Adjacent to the handle of the lever 69 is

mounted a spring dog 69^a which is adapted to engage the notches of a notched quadrant 73, secured to the casing. For effecting the raising and lowering of the drum, an adjusting device is provided, comprising a lever 75, pivotally mounted at one end upon the forward bearing standard 55^a, a vertical link 76 connecting the midportion of the lever with the adjacent horizontal beam 53, and a vertically arranged quadrant, which is supported upon the floor and is provided with a plurality of notches adapted to be engaged by a spring dog 75^a mounted upon the lever adjacent to its handle. By loosening the bolts 66^a of the links 66, the drum may be moved as desired, by manipulating the levers 69 and 75, after which operation the bolts will be again tightened, thus securing the shaft rigidly in its adjusted position.

The openings in the casing through which the drum shaft extends are made considerably larger in diameter than the shaft, for the purpose of allowing the necessary lateral and horizontal movement of the said shaft. In order that these openings may be kept constantly closed, I provide two circular plates 80 (Fig. 7) of diameters greater than the said apertures, which are mounted upon the shaft and are adapted to bear against the casing adjacent to the openings. I further provide coiled springs 81, 81 and collars 82, 82, exterior to the plates 80, said springs being interposed between the plates and collars and being adapted to exert endwise pressure upon the said plates to hold them tightly against the casing. Set screws 82^a are provided in the collars, by means of which they may be held in place upon the shaft.

As a further improvement, the apparatus shown is constructed in such a manner that the drum may be shifted or adjusted laterally, or its shaft endwise relative to the casing, and the discharge nozzle. The purpose of so shifting the drum is to prevent the undue wear upon the surface of the drum by the constant impact of the material against one part of the cylindric surface of the same, it being obvious that the continuous action of the particles at one point in the annular surface of the drum would result in the formation of an annular groove therein. I provide for such lateral shifting or adjustment by making the drum shaft of such length that it will extend at its ends beyond its bearings, and by adjustably securing the collars 82, 82 and the pulleys to the said shaft, whereby the shaft may be shifted endwise while the pulleys remain in their proper positions for operation.

The operation of the apparatus described is as follows: The material to be pulverized is fed into the hopper 8, through the supply pipe 9, and thence to the feed controlling

apparatus, by means of which latter a constant or uniform quantity of the material to be pulverized is carried downwardly between the blades of the rotative feed member 26 and delivered to the nozzle casing 6. In its descent through the said nozzle casing, the material is deflected by the guide plate 23 toward the delivery end of the jet nozzle 22, and the receiving end 19^b of the discharge nozzle 19. Steam or compressed air being admitted through the jet nozzle 22 from the pipe 11, is directed at a high velocity into and through the delivery nozzle 20, and carrying with it the particles of granular material, impels the latter with great force against the revolving surface of the drum. The particles of granular material are broken up or pulverized by their impact against the surface of the drum. The action of the jet of steam or compressed air from the jet nozzle through the discharge nozzle tends to create a vacuum in the nozzle chamber, and the purpose of the damper 25, located behind the guide plate, is to permit the inflow of air to said chamber, as the air is discharged therefrom by the action of the jet from the jet nozzle. The particles of the material upon striking the surface of the drum are broken up into smaller particles, as hereinbefore described, but obviously these particles will vary in size owing to the non-uniformity of size of the original particles, as well as variations in the hardness thereof. Those particles that are small enough to constitute the desired grade of the product are carried upward with the current of air due to the suction created in the discharge pipe, and are discharged therethrough to a storage receptacle or elsewhere. The larger particles, however, which are too heavy to be carried away by the upwardly moving air current in the casing, drop downwardly into the receiving hopper 4, where they pass downwardly along the inclined wall of said hopper and over the slots or openings formed between the strips 36 in the said inclined wall of the hopper. Strong currents of air pass inwardly through these openings, the same being induced by the suction within the casing; the force of the air currents being controlled by means of the damper 32. By the action of such air currents the small particles of powdered or pulverized material which are carried down with the larger particles, and as well as those which for other reasons are not carried upwardly from the drum directly to the discharge pipe are separated from the larger particles and drawn upwardly with the air current in the casing to the said discharge pipe. The larger particles, however, continue downwardly to the bottom of the hopper where they pass through the aperture 30 and are received by the buckets of the conveyer, carried up-

wardly and discharged into the inclined chute 13. From thence they are delivered again fed to the nozzle casing and dis- into the feed hopper, from which they are charged therefrom against the drum, to be further or completely pulverized.

The apparatus illustrated may be variously modified without departing from the spirit of my invention, and I do not wish to be limited to the features or details of construction, as hereinbefore described and shown in the drawings, except so far as set forth in the appended claims as constituting parts of my invention.

I claim as my invention:

1. An apparatus for pulverizing granular material, comprising a casing provided with an outlet opening located in the upper portion thereof, and with an air inlet opening located in the lower portion thereof, a rotative wheel in said casing and located intermediate said outlet and air inlet openings, means acting on the particles of granular material, to impel the same against the rim of said wheel to effect the fracture of said particles, and means associated with said outlet opening acting to induce an outward current of air through said casing to remove the pulverized material and to effect the separation of pulverized material from the coarser material after the fracture of said particles.

2. An apparatus for pulverizing granular material, comprising a casing, a rotative wheel in said casing, said casing being provided with an outlet opening above said wheel, means acting on the particles of granular material, to impel the same against the rim of the wheel to effect the fracture of said particles, means associated with said outlet opening acting to induce a current of air through said casing to remove the pulverized material, and a receiving hopper below said wheel, said hopper being provided in one wall thereof with an air inlet opening adapted to admit air into said casing for the separation of pulverized material from the coarser materials after the fracture of said particles.

3. An apparatus for pulverizing granular material, comprising a casing, a rotative wheel located in said casing, said casing being provided with an outlet opening located above said wheel, an injector acting to impel the particles of granular material against the rim of the wheel to effect the fracture of said particles, an ejector associated with said outlet opening and acting to induce an outward current of air through said casing to remove the pulverized material; said casing being provided below said wheel with an inclined wall, said inclined wall being provided with an air inlet opening adapted to admit air into said casing for the separation of pulverized material

from the coarser materials after the fracture of said particles, and means for regulating the quantity of air admitted through said air inlet opening.

5 4. An apparatus for pulverizing granular materials, comprising a casing, a rotative wheel in said casing, said casing being provided with an air discharge outlet located above the axis of rotation of said
10 wheel, a receptacle for the granular materials provided with a discharge passage, means acting on the particles of granular materials discharged from said receptacle, to impel the same against said wheel, and
15 means associated with the discharge outlet producing an outward current of air therethrough; the lower portion of said casing below the axis of rotation of said wheel constituting a hopper adapted to receive
20 the coarser particles which fall to the bottom of said casing, one wall of the hopper being provided with an air inlet opening whereby an air current will pass through the coarser particles which fall into the
25 hopper.

5. An apparatus for pulverizing granular materials, comprising a rotative wheel, a casing surrounding the same, provided with an air discharge outlet, a receptacle for the
30 granular materials provided with a dis-

charge passage, means acting on the particles of the granular materials discharged from said receptacle, to impel the same against said wheel, means associated with the discharge outlet producing an outward
35 current of air therethrough, and a receiving hopper at the bottom of the casing, provided with an inclined bottom wall, said inclined bottom wall being provided with
40 horizontal slots or openings, means producing an air current inwardly through said slots or openings, and the coarser particles passing over the said slots or openings.

6. An apparatus for pulverizing granular materials, comprising a rotative wheel,
45 means acting on the particles of the granular materials to impel the same against the rim of said wheel, a shaft on which said wheel is mounted, bearings for said shaft, and supporting means for said bearings per-
50 mitting adjustment of said wheel transversely of the axis of rotation of said wheel.

In testimony, that I, claim the foregoing as my invention I affix my signature in the presence of two witnesses, this 13th day of
55 January, A. D. 1913.

CHARLES A. HUPP.

Witnesses:

EUGENE C. WANN,
CHARLES H. POOLE.