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PULVERIZING APPARATUS.

APPLICATION FILED OCT. 23, 1915.

1,260,406.

Patented Mar. 26, 1918.

2 SHEETS—SHEET 1.

Fig. 1.

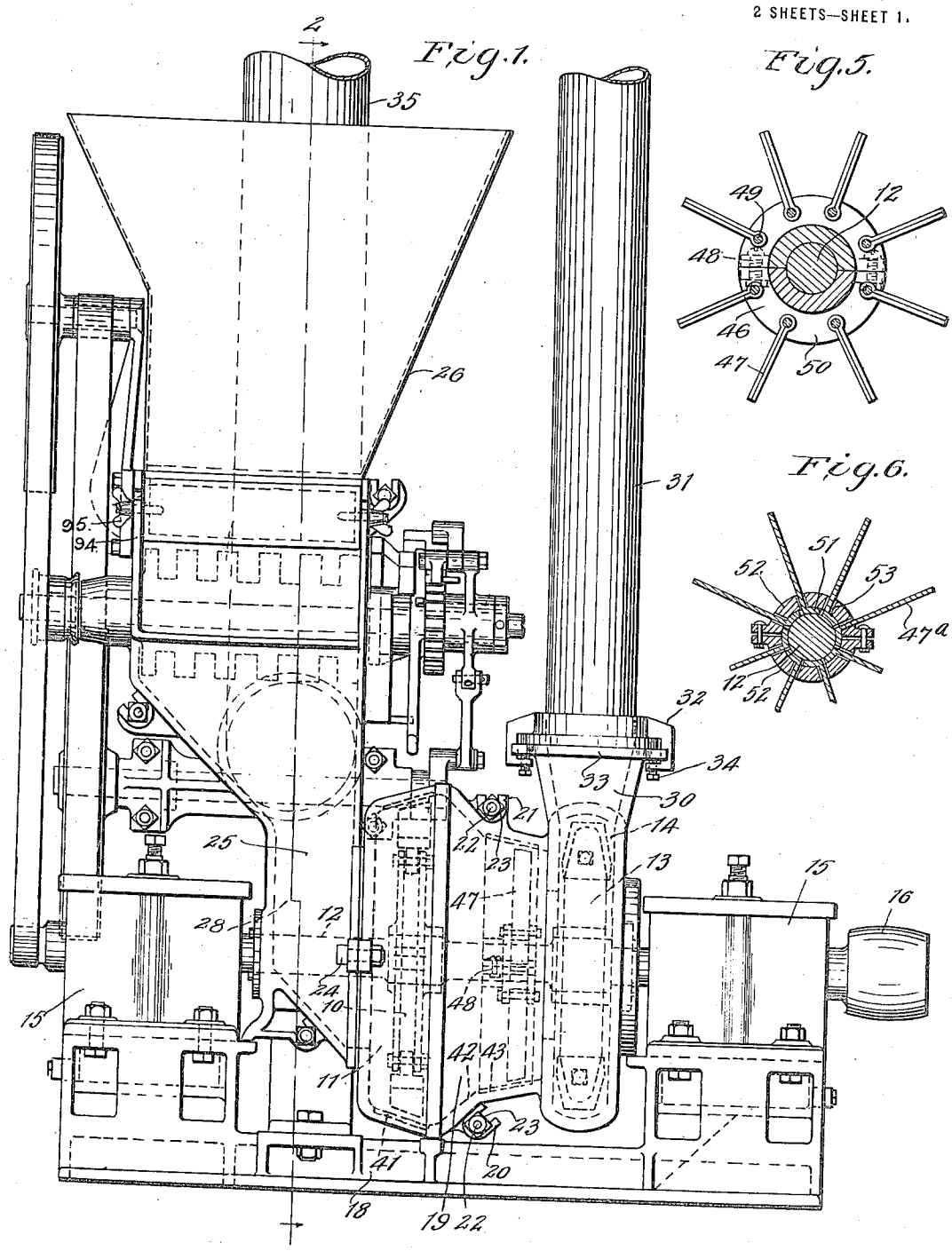


Fig. 5.

Fig. 6.

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2 SHEETS—SHEET 2.

Fig. 2.

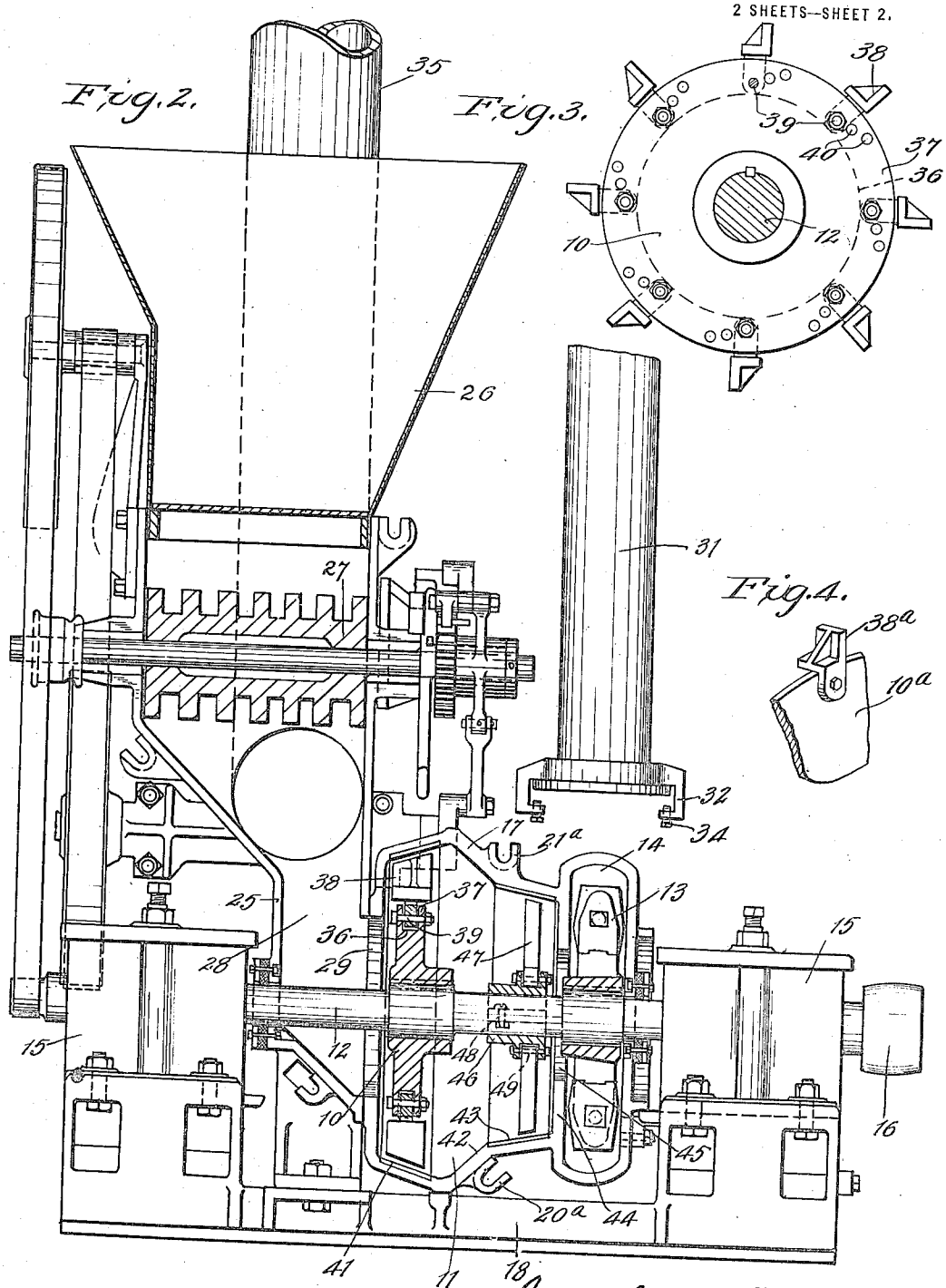


Fig. 3.

Fig. 4.

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PULVERIZING APPARATUS.

1,260,406. Specification of Letters Patent. Patented Mar. 26, 1918.

Application filed October 23, 1915. Serial No. 57,450.

To all whom it may concern:

Be it known that we, ROBERT A. LACHMANN, ALBERT W. RAYMOND, and WILLIAM B. SENSEMAN, citizens of the United States, residing at Chicago, Evanston, and Chicago, respectively, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Pulverizing Apparatus, of which the following is a specification.

Our invention relates to pulverizing apparatus of the type in which the material is reduced by means of an impact element revolving at a high rate of speed and is discharged from the pulverizing chamber while in suspension in the air.

The primary object of the invention is to provide an apparatus of this sort which can be used for the reduction of a large number of different materials and which can be readily adjusted so as to accurately vary the fineness of the product discharged.

A further object is to provide a machine of this type which may be made small in size and still be capable of a large output.

A further object is to provide a pulverizing machine which will be simple and relatively economical in its construction.

The invention consists in the novel and improved constructions, arrangements and devices to be hereinafter described for carrying out the above stated objects and such other incidental objects as will appear from the following description of the preferred embodiment of the invention shown in the drawings appended hereto.

In the drawings,

Figure 1 is a front elevation of the machine.

Fig. 2 is a similar view showing certain parts removed and others in section.

Fig. 3 is a side elevation of the impact element showing the shaft in section.

Fig. 4 is a detail view, in perspective, illustrating a modified form of impact element.

Fig. 5 is a sectional view illustrating one form of revoluble regulator for varying the degree of fineness to which the material is reduced by operation of the machine, and

Fig. 6 is a view illustrating a modified form of regulator.

Like characters of reference designate like parts in the several figures of the drawings.

Referring to the drawings, 10 designates the revoluble impact pulverizing element arranged in the pulverizing chamber 11 and keyed to a shaft 12. Keyed to the same shaft is a fan 13 arranged in a fan chamber 14. The shaft 12 is supported in suitable bearing boxes 15 and is provided with a pulley 16 for a driving belt (not shown).

Preferably the pulverizing chamber 11 and the fan chamber 14 are formed by two castings which meet in a plane passing through the axis of shaft 12, one of these castings 17 being fixed to the base 18 of the machine, and the other, the front casting 19, being removably secured to casting 17. To provide for the ready attachment and detachment of the front casting 19 this casting is provided with a pair of channeled lugs 20, 21, adapted to aline with a corresponding pair of lugs 20^a, 21^a on the fixed casting 17. 22 are bolts adapted to lie in the channels of these lugs, the nuts 23 of which may be readily turned up to bind the removable casting against the fixed casting. The removable or front casting is also secured by bolt 24 to the element 25 of the machine through which the material is fed to the pulverizing chamber. This element is provided with a receiving hopper 26 and a feeding mechanism 27 with which the present application is not concerned and which, therefore, need not be described in detail. A feed passageway 28 leads to the pulverizing chamber through a feed opening 29 in the ends of castings 17, 19. The front casting 19 has a tubular portion 30 leading from fan chamber 13 to the discharge pipe 31. The latter is formed with a yoke 32 which engages the flange 33 on the tubular projection 30, the parts being held together by set screws 34. Air is supplied to the feed passageway 28 by pipe 35.

The pulverizing element, in the form shown in Figs. 1, 2 and 3, consists of a disk, the edge of which is formed with a groove 36 providing a pair of flanges 37 between which the impact elements 38 are secured by means of bolts 39, the flanges being preferably formed with a plurality of perforations 40 for each impact element which are arranged at different distances from the periphery of the disk so that the impact members may be set out as they wear. In this

arrangement the impact members have a pivotal relation with the disk so that they may turn back a trifle if necessary in case it is necessary to pass over an obstruction. In Fig. 4 a modified construction is shown in which the impact members 38ª are bolted rigidly to the disk 10ª.

The pulverizing chamber is preferably provided at the feed opening end with a hard metal liner providing a conical surface 41 which flares away from the feed opening and beyond this with a conical surface 42 which has an opposite taper. Beyond the surface 42 is a hard metal liner providing a conical surface 43 converging in the same direction as the surface 42 but preferably less sharply. The pulverizing chamber is preferably separated from the fan chamber 13 by a web 44 having a central opening 45 through which the material is discharged. Located in the pulverizing chamber near the discharge opening 45, within surface 43, which forms a tapered discharge throat, is located a regulating device consisting of a hub 46 and radial arms 47. The hub 46 is made in two parts which are fastened together by screws 48, this construction permitting the adjustment of the regulator longitudinally of shaft 12. The radial arms 47 are shown as pivoted to the hub 46 by means of bolts 49 extending through spaced flanges 50 formed on the hub (Fig. 5); or the arms may have a rigid relation with the shaft 12 as shown in Fig. 6. In this case the arms 47ª have their inner ends bent over as indicated at 51 and clamped to shaft 12 by clamping members 52, 52, provided with slots 53 through which the arms project.

Operation: The material to be treated is placed in hopper 26 and is fed in regulated quantities by feeding device 27 into the feed passageway 28 and thence through opening 29 into the pulverizing chamber. It is there acted upon by the beaters 38 of the impact element 10 and reduced to the desired degree of fineness.

The revolution of the impact element creates a whirling movement in the air and suspended particles which thrusts the particles by impact and centrifugal force against the bounding surface 41 of the pulverizing chamber. The fan exerts a constant pull on the material longitudinally of the chamber and the combination of these two forces produces a spiral movement of the particles which travel forwardly through the pulverizing chamber in a film or stratum close to the inner surfaces of the chamber and its discharge throat.

As the longitudinal component of the force exerted against the material is greater in proportion to the radial component, in the case of smaller particles than in the case of larger particles, the smaller particles are drawn little by little from the peripheral stratum by the air current generated by the fan and are discharged from the mill through the fan chamber.

The regulator, by revolving at a high speed within the conical surface 43, which diminishes in diameter in the direction toward the discharge opening, produces a counterforce against the peripheral film of outflowing material which retards the outward movement of such material; that is, the air and suspended particles acted upon by the regulator impinge upon an inclined surface so that the radial force is given a longitudinal component opposed to the longitudinal force exerted by the fan. The outflow of the material is also retarded, in the embodiment of the invention shown, by the wall 44 between the discharge throat and the fan chamber, the purpose of which is also to deliver the material to the fan chamber at the center thereof. The retardation of the peripheral film in the discharge throat results necessarily in a retardation of the material all the way along the wall of the chamber. Hence the particles are kept for a longer time in the region of the beaters than would be the case if the regulator were absent.

The degree of fineness to which the pulverization is carried may be varied by the adjustment of the regulator on shaft 12. When the regulator is moved toward the pulverizing element the distance between the ends of arms 47 and the conical surface 43 is increased so that a larger amount of air can escape through this portion of the discharge opening. Moreover, the farther the ends of the arms are from the bounding surface of the throat the less will be the centrifugal force which the force longitudinally produced by the fan will have to overcome before a particle of a given size and weight can be discharged. By giving the regulator a position as near to the discharge opening as possible, in which case the extremities of the arms will work close to the wall of the discharge throat, the material will be reduced to an extreme degree of fineness. The regulator is not an obstacle to any appreciable extent to the outflow of the finer particles of material through the center of the discharge throat. The inner ends of the arms 47 necessarily revolve at a low velocity so that the counterforce which is exerted in this region against the air and suspended particles is comparatively slight.

What may be considered as the pulverizing chamber proper, that is, the portion of the chamber adjacent the feed opening, is preferably bounded by two conical surfaces, as shown, the first one, surface 41, flaring toward the discharge end of the mill, and the second one, surface 42 converging in this direction. The flaring of surface 41 increases the rapidity of movement of the

material which is desirable in order to keep the material feeding into the mill. The convergence of surface 42 has exactly the opposite effect and operates to slow down the movement of the material and hold the same within the region in which it is acted upon by the pulverizing element. Therefore, where fineness and uniformity are not essential, the desideratum being maximum capacity, the regulator may be adjusted far enough in the direction toward the impact element so that its effect will be reduced to a minimum; or the regulator may be removed entirely, in which case the flaring cone operates to produce a very rapid movement of the material through the mill which is, however, checked to a certain extent when the material reaches the tapering cone. As the contour of the pulverizing chamber obviously cannot be changed, and as it is an easy matter to remove the regulator, the apparatus, when so constructed, has greater utility than the ordinary pulverizing mills. The taper of surface 43 defining the discharge throat is preferably quite gradual, as shown, for another reason; viz., so that the degree of fineness of the output may be accurately varied by the longitudinal adjustment of the regulator. If the inclination of this surface is too sharp, slight adjustments of the regulator will result in too great variations in the radial dimension of the annular space beyond the ends of the regulator blades, making accurate regulation of fineness difficult.

Because of the regulation dependent on the longitudinal adjustment of the regulator, a mill constructed in accordance with our invention is capable of operating on a great variety of different materials and the degree of fineness of the product can be varied through a very wide range. The apparatus will pulverize the material to an impalpable powder, the output in such case being relatively small, or, on the other hand, the same apparatus, by simple adjustment may be used for turning out a large output where fineness and uniformity are not so important. In this connection it will be noted that as the regulator is moved inwardly for a coarse product, the circumferential dimension, as well as the radial dimension of the free annular space beyond the regulator blades is increased so that the volume of output is considerably increased; as is desirable, and is quite possible in view of the relative coarseness of the material delivered from the machine.

The inner surfaces of the pulverizing chamber and its discharge throat have been described and will be claimed as conical but this does not mean that they need be so in a strict geometrical sense of the word, although that is the preferred manner of constructing the apparatus.

It will be understood that the pulverized product is discharged to any suitable device for collecting it through pipe 31 and that the air from such device (not shown) may be returned to the mill through pipe 35.

While we have described our apparatus in a preferred embodiment, the invention is not to be considered as limited to these precise constructions, arrangements and devices except so far as the language of the claims is expressly so limited.

We claim:

1. In pulverizing apparatus, the combination with a pulverizing chamber having a discharge throat partially closed by an end wall formed with an orifice of smaller diameter than the discharge throat, of means for producing a draft of air through said chamber and throat, and means, which permits outflow through the center portion of the throat and said orifice, for creating a counter-force in the air and suspended particles adjacent the bounding surface of the throat which retards the outward movement of said particles.

2. In pulverizing apparatus, the combination with a pulverizing chamber having a discharge throat, of means in said chamber for pulverizing material, means for producing a draft through said chamber and throat, and regulating means movable to produce a counterforce effective against the portion of the material adjacent the bounding surface of the throat which retards the outward movement of that portion of the material, said regulating means being adjustable to vary the intensity of such counterforce whereby the degree of fineness of the output may be governed.

3. In pulverizing apparatus, the combination with a pulverizing chamber having a discharge throat, of means for producing a draft through said chamber and throat, a regulator in said throat arranged transversely thereof comprising a plurality of radial, revoluble members arranged in the same plane with open spaces between them to permit the outflow of air and suspended particles through the center portion of the throat.

4. In pulverizing apparatus, the combination with a pulverizing chamber having a discharge throat, of means for producing a draft through said chamber and throat, a regulator in said throat arranged transversely thereof comprising radial, revoluble members with open spaces between them to permit the outflow of air and suspended particles through the center portion of the throat, said regulator being adjustable to vary the cross sectional area of the annular space between the ends of the revoluble members and the bounding surface of the throat.

5. In pulverizing apparatus, the combina-

tion with a pulverizing chamber having a discharge throat, of revoluble beaters in said chamber, means in addition to said beaters for producing a draft of air lengthwise of the chamber and throat, and a regulator arranged in the throat transversely thereof comprising a plurality of radial, revoluble members arranged in the same plane with open spaces between them to permit the outflow of air and suspended particles through the center portion of the throat.

6. In pulverizing apparatus, the combination with a pulverizing chamber having a discharge throat, of revoluble beaters in said chamber, means in addition to said beaters for producing a draft of air lengthwise of the chamber and throat, and a regulator arranged in the throat transversely thereof comprising radial, revoluble members with open spaces between them to permit the outflow of air and suspended particles through the center portion of the throat, said regulator being adjustable to vary the cross sectional area of the annular space between the ends of said revoluble members and the bounding surface of the throat.

7. In pulverizing apparatus, the combination with a pulverizing chamber having a conical discharge throat, of a regulator in said throat tapering in the direction away from the chamber, and means for producing a draft through said chamber and throat arranged transversely thereof comprising radial, revoluble members with open spaces between them to permit the outflow of air and suspended particles through the center portion of the throat, said regulator being adjustable in the direction of its axis of revolution.

8. In pulverizing apparatus, the combination with a pulverizing chamber having a conical discharge throat, of revoluble beaters in said pulverizing chamber, means for producing a draft of air longitudinally through said chamber and throat, a regulator in said throat arranged transversely thereof comprising radial, revoluble members with open spaces between them to permit the outflow of air and suspended particles through the center portion of the throat, said regulator being adjustable in the direction of its axis of revolution.

9. In pulverizing apparatus, the combination with a pulverizing chamber formed with a feed opening at one end and a discharge throat at the other end, said chamber being bounded at the feed end with a flaring, conical surface and beyond this with a tapering, conical surface, of revoluble impact members in the part of the chamber bounded by the flaring conical surface, and means for producing a draft of air longitudinally through said chamber.

10. In pulverizing apparatus, the combination with a pulverizing chamber formed with a feed opening at one end and a discharge throat at the other end, said chamber being bounded at the feed end with a flaring, conical surface and beyond this with a tapering, conical surface, of revoluble impact members in the part of the chamber bounded by the flaring conical surface, means for producing a draft of air longitudinally through said chamber, and a regulator in said discharge throat arranged transversely thereof which permits the discharge of material through the center portion of the throat and is adjustable so as to vary the cross sectional area of the space between it and the bounding surface of the throat.

11. In pulverizing apparatus, the combination with a pulverizing chamber formed with a feed opening at one end and a conical discharge throat at the other end, said chamber being bounded at the feed end with a flaring conical surface and beyond this with a tapering conical surface, of revoluble impact members in the part of the chamber bounded by the flaring conical surface, means for producing a draft of air longitudinally through said chamber, and a regulator in said discharge throat comprising radial, revoluble arms arranged transversely of the throat, said regulator being adjustable in the direction of its axis of revolution.

12. In pulverizing apparatus, the combination with a pulverizing chamber having a discharge throat tapering in the direction away from the chamber, and means for producing a draft through said chamber and throat, of a longitudinally adjustable regulator in said throat arranged transversely thereof comprising a hub and a plurality of radially arranged arms in the same plane, secured to said hub.

13. In pulverizing apparatus, the combination of a pulverizing chamber having an opening in one end through which the material enters the chamber, and formed at the other end with a discharge throat tapered toward its outlet, the portion of the chamber adjacent said first-named opening increasing in diameter in the direction toward the discharge throat; a revoluble beater in said portion of the chamber provided with radially arranged beating elements, the ends of which are oblique to conform to the adjacent part of the wall of said chamber; and a revoluble regulator to vary the degree of pulverization, arranged in said throat and adjustable axially thereof and open at the middle to permit the discharge of material therethrough.

14. In pulverizing apparatus, the combination of a pulverizing chamber having an opening in one end through which the material enters the chamber, and formed at the other end with a discharge throat tapered

toward its outlet, the portion of the chamber adjacent said first-named opening increasing in diameter in the direction toward the discharge throat; a revoluble beater in said portion of the chamber provided with radially arranged beating elements, the ends of which are oblique to conform to the adjacent part of the wall of said chamber; and a revoluble regulator to vary the degree of pulverization, arranged in said throat and adjustable axially thereof, comprising a hub and radial arms pivoted thereto.

15. In pulverizing apparatus, the combination with a pulverizing chamber having a discharge throat converging toward its outlet end, of means in said chamber for pulverizing material, means for producing a draft through said chamber and throat, and a revoluble regulator in said throat to impart centrifugal movement to the material in the throat which is adjustable longitudinally of the throat whereby the degree of fineness of the output of the apparatus may be governed.

16. In pulverizing apparatus, the combination with a pulverizing chamber having a discharge throat converging toward its outlet end and a bounding surface inwardly of and adjacent said throat which converges in the same direction but at a sharper angle, means in said chamber for pulverizing material and imparting centrifugal movement to the same, means for producing a draft through said chamber and throat, and a revoluble regulater in said throat to impart centrifugal movement to the material in the throat which is adjustable longitudinally of the throat whereby the degree of finesess of the output of the apparatus may be governed.

17. In pulverizing apparatus, the combination of a fan chamber, a centrifugal fan therein, a pulverizing chamber having a discharge throat converging in the direction toward the fan chamber and having an opening into said fan chamber of smaller diameter than the fan chamber, a revoluble impact pulverizer in said pulverizing chamber, and a revoluble regulator in said throat to impart centrifugal movement to the material in the throat which is adjustable longitudinally of the throat whereby the degree of fineness of the output of the apparatus may be governed.

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