(No Model.)

3 Sheets—Sheet 1.

C. A. FREDERICKS.

GRANULATING MILL.

No. 368,710. Patented Aug. 23, 1887.

Fig. 1.

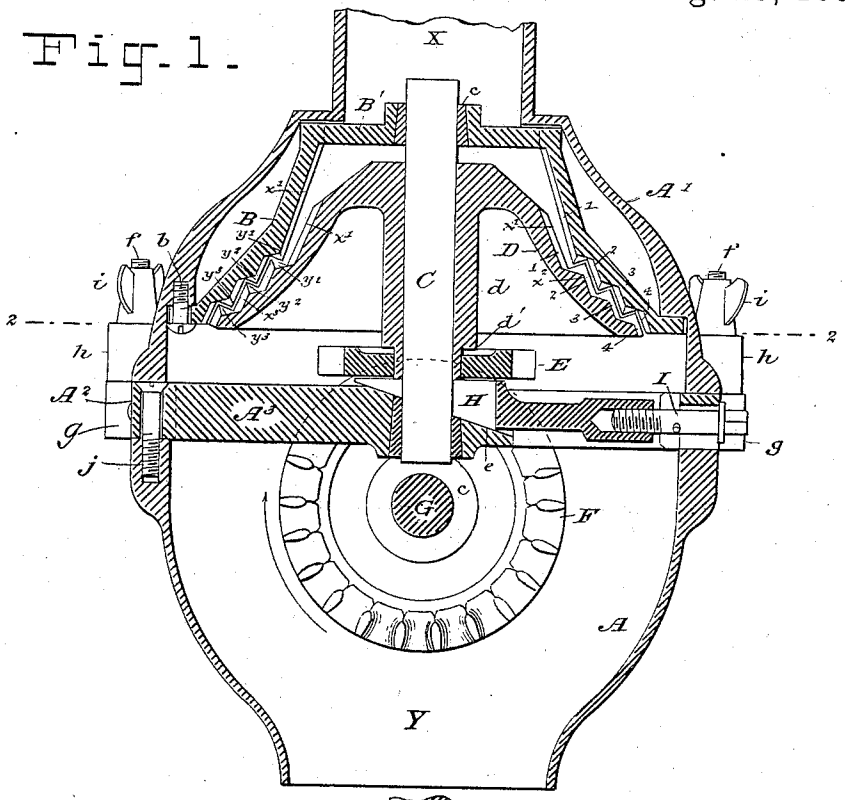
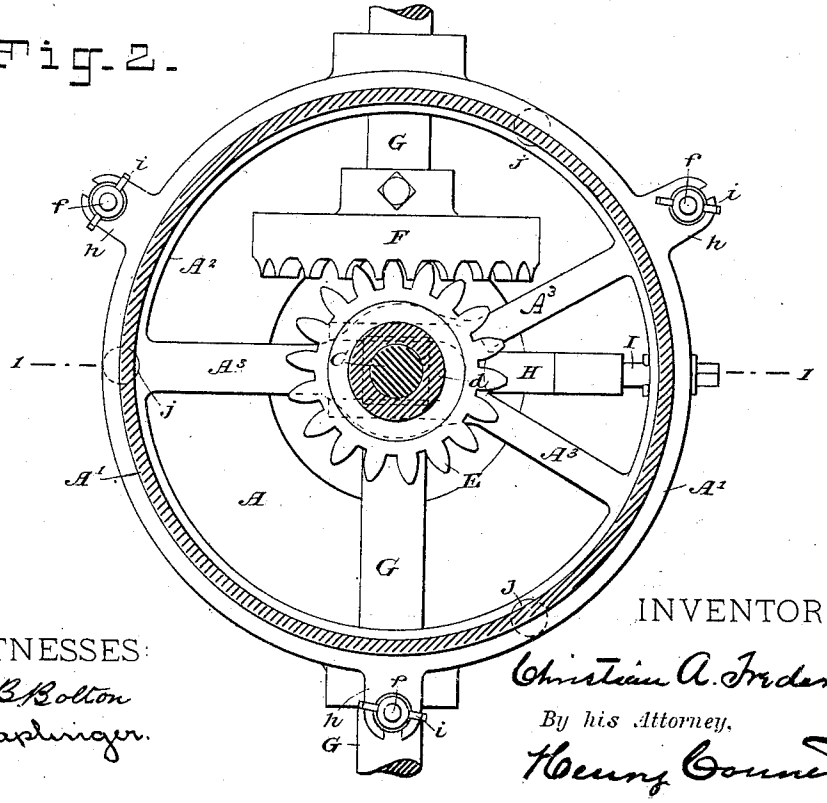


Fig. 2.



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(No Model.)

3 Sheets—Sheet 2.

C. A. FREDERICKS.

GRANULATING MILL.

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Fig. 3a.

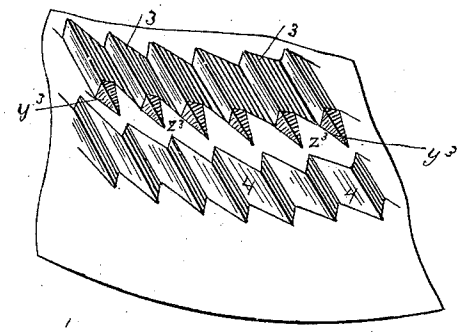


Fig. 3.

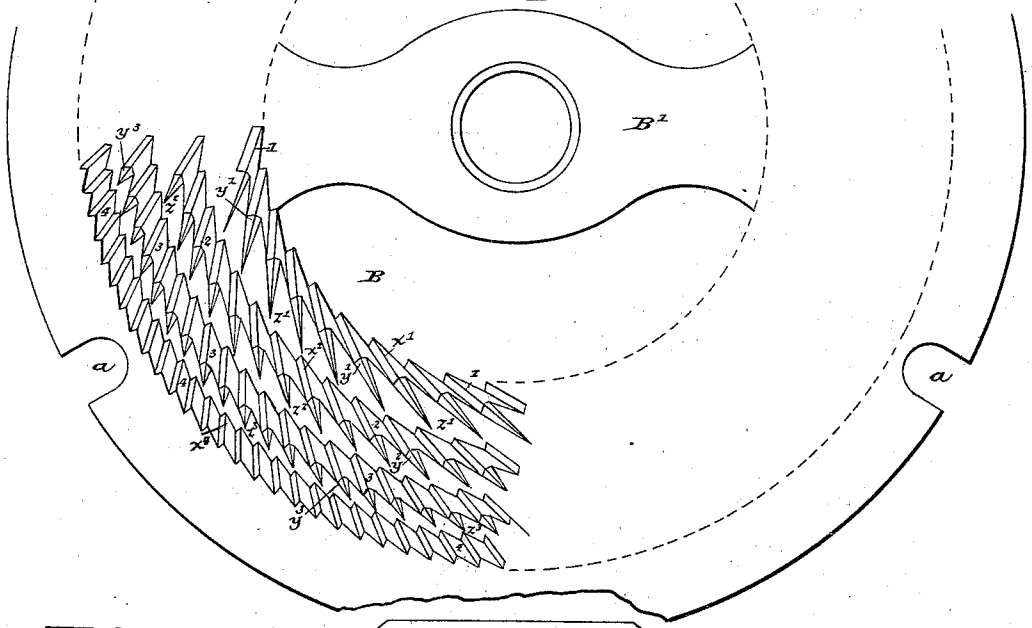
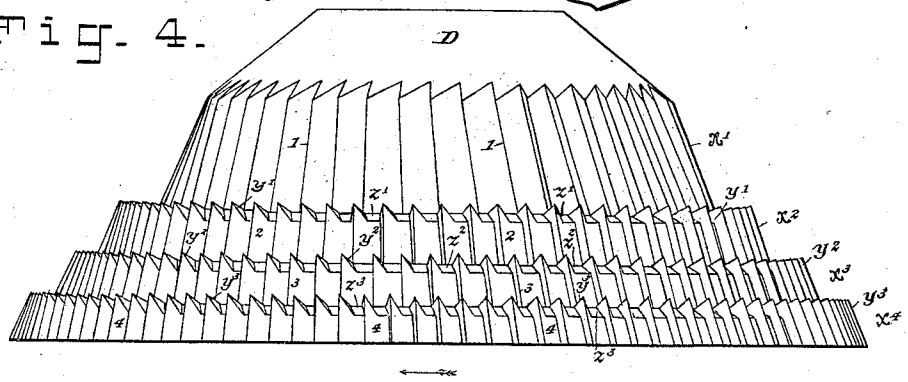


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

C. A. FREDERICKS.

GRANULATING MILL.

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Fig. 5.

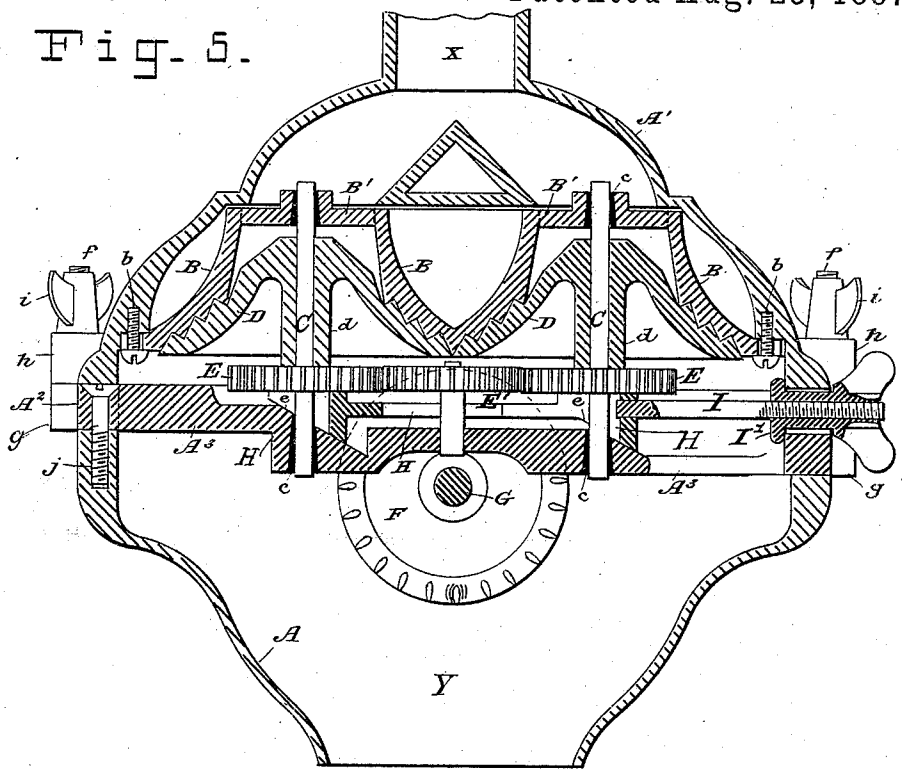


Fig. 5a.

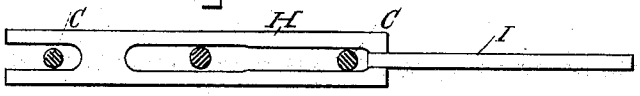
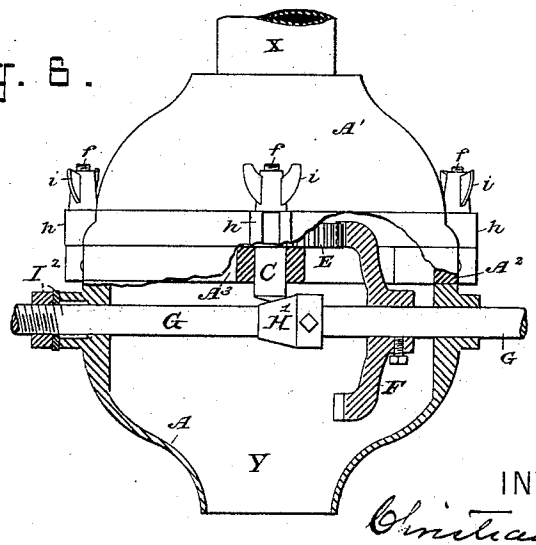


Fig. 6.



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UNITED STATES PATENT OFFICE.

CHRISTIAN A. FREDERICKS, OF BROOKLYN, NEW YORK.

GRANULATING-MILL.

SPECIFICATION forming part of Letters Patent No. 368,710, dated August 23, 1887.

Application filed November 23, 1886. Serial No. 219,655. (No model.)

To all whom it may concern:

Be it known that I, CHRISTIAN A. FREDERICKS, a citizen of the United States, and a residen of Brooklyn, Kings county, New York, have invented certain Improvements in Granulating-Mills, of which the following is a specification.

My invention relates to mills for grinding or granulating substances in general, but mainly for grinding coffee; and the leading object of my invention, so far as the function of the mill is concerned, is to produce a mill that will uniformly and evenly granulate the coffee to the desired degree of fineness with the least amount possible of dust or very fine particles.

So far as relates to the construction of the mill, the object of my invention is to produce a mill that will require the minimum of skill or care in putting together or assembling its parts, and one in which the maximum yield may be obtained with the most convenient arrangement of the driving-shaft and crank.

In so far as concerns its operation on the material to be ground, my mill acts very much in the same manner as a series of mills each set to grind to a different degree of fineness, there being a respite for the material between each grinding operation—that is to say, I employ two grinders, an outer one and an inner one, as usual in such mills. These are of conical form, the outer grinder or shell being fixed and the inner grinder or runner rotatively mounted. The male grinder or runner is constructed in the form of a series of conic frusta superimposed or mounted one on the other, and each (except the lower one) having an annular platform at its base. The outer grinder or shell conforms to the runner. The annular platform at the base of each conic frustum or "cone" forms a place of refuge for the material, where it arrives from the grinding-surfaces next above. The particular construction will be hereinafter fully described.

So far as concerns the construction of the mill in general, I arrange the axes of the grinders to stand vertically and the axis of the driving-shaft to stand horizontally and drive the runner through the medium of a peculiarly-constructed gearing, whereby the said runner is free to be adjusted to effect coarse or fine granulation. The shell is loosely mounted—that is with sufficient looseness—in order that it may fit itself or adapt itself to its mate independently of the main shaft and the other fittings, whereby the necessity of accurate fitting and the consequent expense are entirely avoided. The construction whereby I attain these ends, as well as other novel features of the construction, will be fully described hereinafter.

In the drawings, which serve to illustrate my invention, Figure 1 is a vertical axial section through the mill in the plane indicated by line 1 1 in Fig. 2. Fig. 2 is a horizontal section of the mill taken in the plane indicated by line 2 2 in Fig. 1. Fig. 3 is a plan view of the non-rotative shell inverted and on a larger scale than Figs. 1 and 2. This view shows only a part of the grinding-surface, the remainder being omitted as involving unnecessary repetition. Fig. 3^a is a fractional view, on a still larger scale, of a part of the grinding-surface. Fig. 4 is a side elevation of the runner. This view is drawn to the same scale as Fig. 3. Fig. 5 is a vertical axial section of a double mill constructed according to my invention. Fig. 5^a is a plan of the adjusting-bar H detached. Fig. 6 illustrates a modification of the means for adjusting the runner to effect a finer or coarser granulation.

I will first describe the construction of my mill as shown in Figs. 1 and 2, premising that my improvements are herein represented as embodied in a mill for store or hotel use.

The globular casing of the mill is composed of three sections—namely, the lower section, A, the upper section, A′, and the middle section, A^2. This middle or intermediate section is in the nature of a ring, provided with a Y-shaped bridge, A^3, extending across it.

B is the exterior grinder or shell, which is arranged in and secured to the upper section, A′. In the flanged rim of this shell are formed two or more notches, *a a*, (seen in Fig. 3,) and the shell is secured to the section A′ by screws *b b*, which engage said recesses and screw into protuberances or thickened parts on the wall of the said section A′. The bodies of the screws *b* engage the recesses *a* loosely, and their heads take over the flanges at the margins of the recesses. This allows considerable margin for lateral adjustment of the shell B within the section A′. At its upper end the shell B is provided with a bridge or tie-bar,

B′, in which is formed a bearing for a fixed (non-rotative) shaft, C, the other end of which has a bearing below in the bridge A^3. *c* represents Babbitt metal or other fusible metal cast about the ends of shaft C at its bearings, the latter being made somewhat larger than the shaft.

D is the rotary grinder or runner, which revolves on the shaft C. This runner has a square bearing, *d′*, on the lower end of its boss *d*, on which is fixed a toothed wheel, E, and this toothed wheel meshes with a peculiarly-constructed crown-wheel, F, Fig. 2, mounted on a driving-shaft, G, which has bearings in the sides of the lower section, A, of the globular casing of the mill. Rotation of shaft G, the axis of which is horizontal, imparts rotation to the runner D, the axis of which is vertical.

To adjust the runner D up or down, in order to vary the fineness of the granulation, I form an incline, *e*, on the bridge A^3, and provide a forked adjusting bar or wedge, H, which is beveled on its lower face, where it takes under the squared bearing *d′* of the grinder D. This wedge is moved in and out by means of a screw, I, collared in the ring of the section A^2 and arranged to screw into a screw-threaded socket in the end of the wedge H. This construction is best seen in Fig. 1.

In order that the gear-wheels E and F may mesh or engage properly, and yet allow the runner D, carrying wheel E, to be moved up and down in regulating the fineness of granulation, I make the teeth of said wheel E pointed, with convex faces, as seen in Fig. 2, and give to the teeth on the crown-wheel F the peculiar form shown. (Specially illustrated in Fig. 1, where some of said teeth are shaded in order to the better show their convex form.)

X is the feed-inlet of the mill, and Y is the outlet for the granulated substance.

In putting the mill together the parts are assembled as follows: The shell B is secured in the upper section, A′, by the screws *b*, but not tightly. The shaft C is secured in the section A^2 by babbitting it where it enters its bearing in bridge A^3. The male grinder D, carrying the wheel E, is slipped on the upper end of shaft C, and the upper section, A′, with the female grinder, is placed on the ring-section A^2. The ring-section and section A′ are secured together by means of screws *f*, hinged in cleft-lugs *g* on the ring-section, which screws engage corresponding cleft-lugs, *h*, on section A′, and by clamping wing-nuts *i* on said screws. The shaft C now projects up through its loose bearing in the bridge of the shell B and is babbitted therein, as shown. This last is only designed to properly center and steady the shaft, and not to secure it irremovably in its said bearing. Screws *j j*, which pass through somewhat enlarged holes in the ring-section A^2, serve to secure said section adjustably to the lower section, A. One of these screws is seen in Fig. 1. Two or more each of screws *b*, *f*, and *j* may be employed. I have herein employed three of each.

By rotation of the runner the shell is made to adjust itself thereto, being free to do so by the enlargement of the recesses *a*, through which screws *b* pass.

I do not wish it understood that the shell B is left absolutely loose, but only loose enough to yield laterally to the runner. When it is desired to get at the runner for any reason, it is only necessary to loosen nuts *i*, turn back screws *f* on their hinges, and lift off the upper section of the casing, which carries with it the shell B. This latter is only loosely mounted on shaft C, and it readily slips off. Now, in replacing these parts they will not go back precisely as they were, but the loose mounting of shell B will again permit it to adjust itself to the runner. The bridge B′ is not absolutely essential; but it serves to steady the upper end of shaft C. The ring-section A^2 is permanently secured to the lower section, A, of the casing.

The object in making the bearings for shaft C large and afterward babbitting them is twofold. In the first place, as the shaft is non-rotative, it is less expensive to form the holes in casting the parts and afterward to cast soft metal around the shaft therein than to bore the holes for the shaft; and in the second place, this plan enables me to properly center the shaft and adjust the shell and runner with very little trouble. Where boring is relied on in fitting up the mill, it must be done with very great accuracy, or the shell and runner will not properly fit each other, and of course will not operate well. Such accurate fitting is very expensive and makes the mill too costly.

So far I have only described the general structure of the mill. I will now describe the peculiar construction of the faces of the shell and runner, premising that as the grinding-face on the shell B is the same in form and construction as that on the runner D, except that one face is concave and the other convex, a minute description of the face of runner D will suffice for both.

Referring especially to Figs. 1, 3, and 4, $x' x^2 x^3 x^4$ represent the several cones forming the runner D. These are superimposed or arranged one over the other, and the differerences in their respective diameters leave or form annular platforms or shoulders at the bases of all the cones except that at the bottom. On their faces these cones are provided with the usual teeth or cutters obliquely arranged for shear cutting and graduated in fineness from top to bottom of the grinder—that is, those teeth on cone x' are coarsest and those on cone x^4 are the finest. These teeth are indicated, respectively, on the several cones by the numerals 1, 2, 3, and 4. The annular platforms at the bases of the cones are sloped outwardly somewhat, by preference, and on them are formed spade-like teeth with sharp angles or points. These spade-like teeth are indicated, respectively, by the letters y', y^2,

and y^3. The upper edges of these teeth stand nearly horizontal, preferably sloping inwardly or oppositely to the slope of the platform, and they disappear or vanish, or nearly so, at the inner edge of the platform. Their front or advancing faces are substantially vertical planes, and their rear faces are sloped. Between the teeth y' y^2, &c., are spaces, which I term "pockets of refuge." These are indicated, respectively, by the letters z' z^2 z^3.

The shell B is, as before stated, provided with teeth, &c., in the same manner as the runner, except that the relative positions and obliquity of the teeth are reversed. The advancing points of the teeth y' y^2, &c., on the runner sweep around close in the angles formed at the bases of the cones of the shell, and the points of the corresponding teeth on the shell do the same with respect to the corresponding angles of the runner. The opposite obliquity of these two sets of teeth, however, prevents their interlocking even when they are in contact.

The height of the cone, as x^2, for example, should not be less than double the height of a tooth, y', plus the greatest extent of movement of the runner in adjusting it, which will usually not exceed one-sixteenth of an inch—that is to say, when the runner is lowered to its fullest extent for coarse grinding, the edge of the platform at the base of cone x' of runner D should not descend to the level of the edge of the platform or shoulder next below on shell B. This, however, is not an essential requirement, as the mill will do good work even if it is not complied with.

The operation is as follows: The substance—as coffee, for example—is first coarsely granulated by the teeth on the upper cones, and the granules pass thence down into the pockets z' at the base of cone x'. The teeth y' and the corresponding teeth on shell B, by reason of their oppositely-oblique arrangement, move forward the granules outward and from the pockets to the teeth of the second pair of cones, where they are further reduced. From the pockets z^2 the granules are again fed to the teeth of the third pair of cones, where they are still further reduced, and so on until they are finally expelled from the shell and runner and pass out at the outlet Y. Thus I effect a step-by-step granulation of the substance instead of a continuous grinding thereof. In the ordinary mill the berries are being constantly crushed, chafed, abraded, and the particles worked upon, both by the teeth of the mill and by each other, from the time they enter the mill until their discharge, and hence a considerable amount of dust or fine particles is produced, and the granules are very irregular in size.

The spade-like teeth y' y^2 y^3 (which are lettered alike on both grinders) act both as feeders or forwarders of the granules and as regulators of the size of the same. Their points sweep close to the bases of the teeth on the face of the cone above, and act to reduce the larger granules that descend from above.

My mode of mounting the shell and runner and my general construction enable me to conveniently construct and operate a double mill, or one with two sets of shells and runners, from a single main shaft. This is illustrated in Fig. 5. I need only indicate, with respect to this construction, the points wherein it differs from the single mill already described. The runners are driven from a wheel, E′, arranged between the two wheels E, and in mesh with both. Wheel E′ is in mesh with the driving-wheel F. The bar H (shown detached in plan in Fig. 5ª) has two wedges or inclines, one for each runner. The means for operating this adjusting-bar may be the same as that before described; but I have shown a modified form, the screw I being here represented as connected rigidly to the slide and passing through a nut, I′, collared in the ring-section A^2.

The shells may be cast in one piece, if desired. I may thus mount more than two runners to be driven from one main shaft. This method of driving the runner through the intermediation of toothed gears enables me to avoid the costly and accurate methods heretofore employed in boring and fitting up the bearings for the main shaft, as in my construction it is not important whether this shaft is mounted exactly horizontally or not. The looseness of mesh of the gear-wheels will compensate any inaccuracy in this respect.

I may say that while I do not wish to limit myself to any particular height for the several cones of the shell and runner, and while I may make them of different heights, nevertheless I believe the best results may be obtained by giving the cones as little height as possible consistent with the conditions I have already stated. I find that the less the height of the cone is, consistent with the necessary reduction of the granules, the less dust and fine particles will be produced.

In Fig. 6 I have shown, partly in section, a mill provided with a modification of my wedge device for raising the runner. In this construction the shaft C is rotatively mounted in the bridge A^3, and the runner is fixed on said shaft. The lower end of shaft C, which depends below the bridge, is slightly coned, and secured on the main driving-shaft G is a cone, H′, which takes under the coned end of said shaft. By moving the shaft G endwise to the left, as the parts are arranged in Fig. 6, the runner D and its shaft will be raised. A movement in the opposite direction permits said runner to descend. Any means may be employed to move the main shaft endwise—as, for example, a washer and nut, I^2, as shown in Fig. 6, the nut engaging a male screw on the shaft.

I have herein, for convenience, spoken of the wedge H and its screw as a device for raising and lowering the runner D; but, in fact,

the runner descends of itself when permitted to do so by the withdrawal of said wedge. Respecting the peculiar form of the teeth of wheels E and F, I may say that the flanks of the teeth of wheel E, taken in a radial direction, are convex, and taken in an axial direction are planes. The flanks of the teeth of wheel F, taken in a radial direction, are concave, and taken in an axial direction are convex. This conformation gives to the teeth on wheel F perfect freedom in their engagement with those on wheel E, and yet preserves their strength. Another feature of this gearing is that there is no apparent crowding or wedging of the wheels apart when a strain is brought on them.

Respecting the self-adjusting peculiarity of the shell and runner, I will further explain that the shell and runner in such mills, to operate properly, must be concentric at their lower or discharging ends. Their exact concentricity at their upper or receiving ends is less important. By mounting the shell loosely it will adapt itself readily to its mate.

The shaft or axis C may be non-rotative, and the runner rotative thereon, or the shaft may rotate in its babbitted bearings and the runner be fixed thereon; or both may rotate, if desired.

Having thus described my invention, I claim—

1. In a mill, as a housing for the grinders, a metal casing of globular form, comprising a semi-globular lower section, A, having an outlet, Y, at its bottom for the ground material, and bearings for the driving-shaft, the semi-globular upper section, A′, having an inlet, X, for the unground material, protuberances on its inner face to form seats for the flange on the shell B, and cleft-lugs *h*, the ring-section A^2, screwed in a permanent manner to the section A, and having a bridge, A^3, and cleft-lugs *g*, and the screws *f*, hinged in the lugs *g*, and provided with nuts *i*, said bridge A^3 being provided with a bearing to receive the runner-shaft, all as set forth.

2. The combination of the runner D, the ring-section A^2, provided with a Y-shaped bridge, A^3, having an inclined face formed with a bearing for the shaft C, said shaft C mounted in said bridge, the forked wedge H, straddling said shaft and interposed between the boss of the runner and the incline on said bridge, and the screw I, for operating said wedge.

3. A grinder for a mill, having the form of superimposed conic frusta with annular platforms at their bases, and having pockets of refuge for the granules, substantially as described.

4. A grinder for a mill, having the form of superimposed conic frusta with annular platforms at their bases provided with upwardly-projecting teeth, and spaces between said teeth forming pockets of refuge for the granules, as set forth.

5. A grinder for a mill, having the form of superimposed conic frusta with annular platforms at their bases sloping outward, and having obliquely-arranged spade-like teeth formed at intervals on said platforms, the upper edges of said teeth sloping inwardly to the base of the cone, substantially as set forth.

6. A grinder for a mill, having the form of superimposed conic frusta provided with obliquely-arranged teeth on their inclined faces, and having annular platforms at the bases of said conic frusta, said platforms having on them obliquely-arranged teeth, the spaces between which teeth form pockets of refuge, substantially as set forth.

7. A grinder for a mill, having the form of superimposed conic frusta provided with obliquely-arranged teeth on their inclined faces, and having annular platforms at the bases of said conic frusta, said platforms having on them obliquely-arranged teeth, the teeth on each platform forming continuations of the teeth on the faces of the conic frustum, of which such platform forms the top, substantially as set forth.

8. A mill wherein the shell and runner each have the form of superimposed conic frusta provided with obliquely-arranged teeth on their inclined faces, and having annular platforms at the bases of said conic frusta, said platforms having on them obliquely-arranged teeth, substantially as set forth.

9. The combination, in a mill, of two conical runners, the middle section, A^2, of the casing provided with a Y-shaped bridge provided with two inclined faces and two bearings, the shafts of said runners, said shafts mounted in said bridge, and a wedge having slots through which said shafts pass, said wedge being located between the bosses of the runners and the inclined faces of said bridge, and means, substantially as described, for adjusting said wedge, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CHRISTIAN A. FREDERICKS.

Witnesses:
HENRY CONNETT,
J. D. CAPLINGER.