W. F. TRENARY.

PULVERIZING MACHINE.

APPLICATION FILED SEPT. 27, 1906.

984,048.

Patented Feb. 14, 1911.

3 SHEETS—SHEET 1.

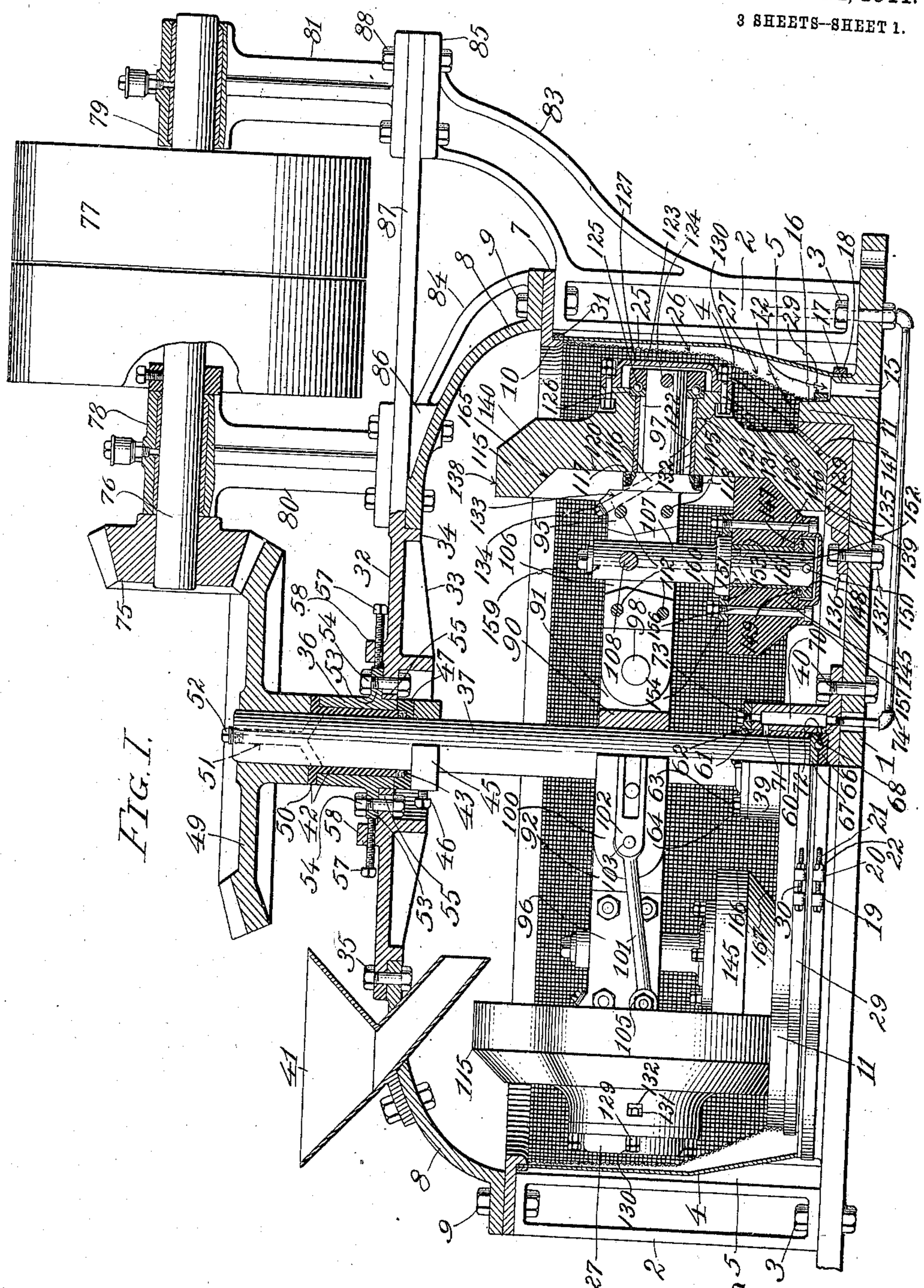

FIG. 1.

Witnesses

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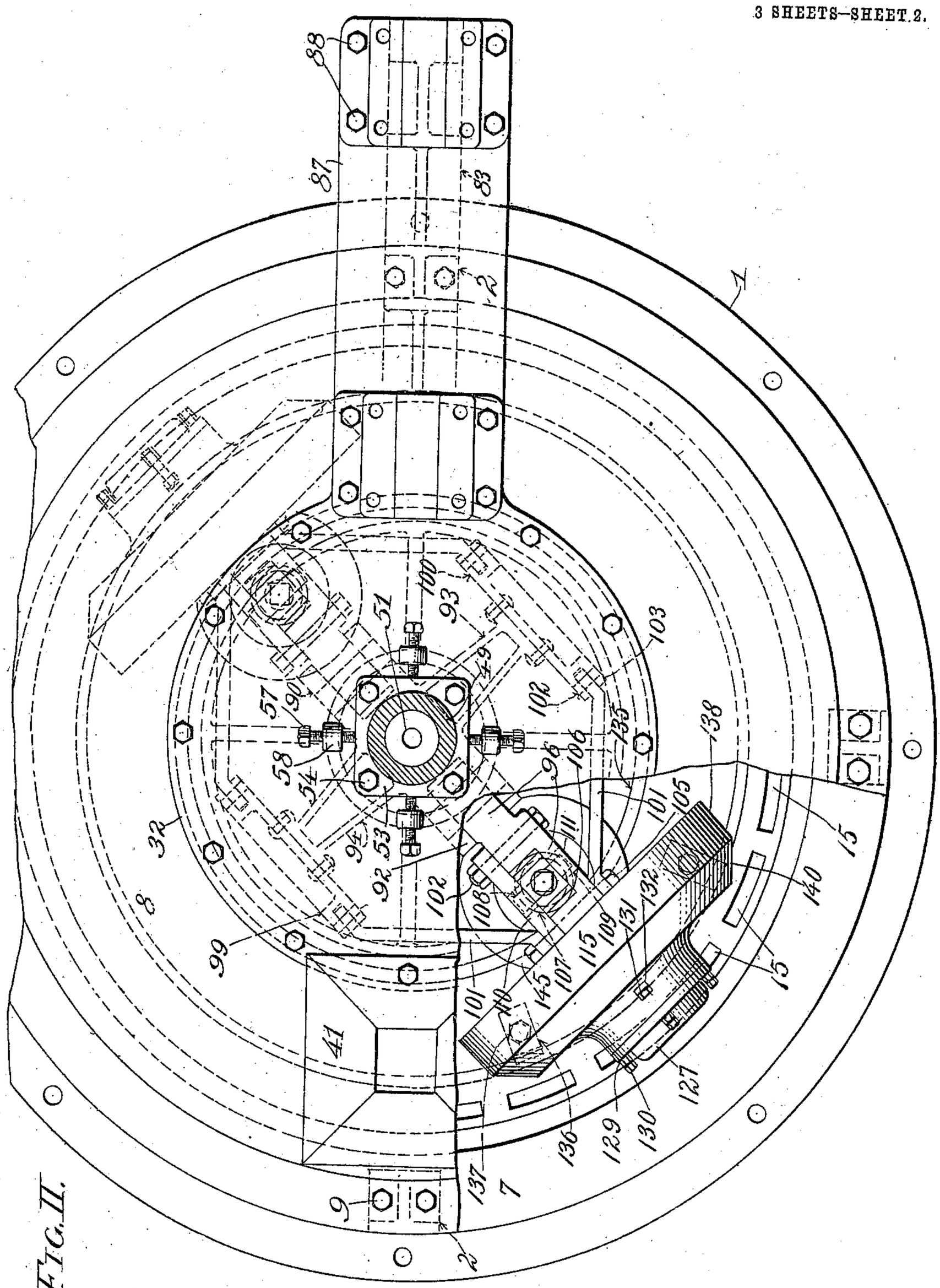

FIG. II.

Witnesses

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3 SHEETS—SHEET 3.

FIG. IV.

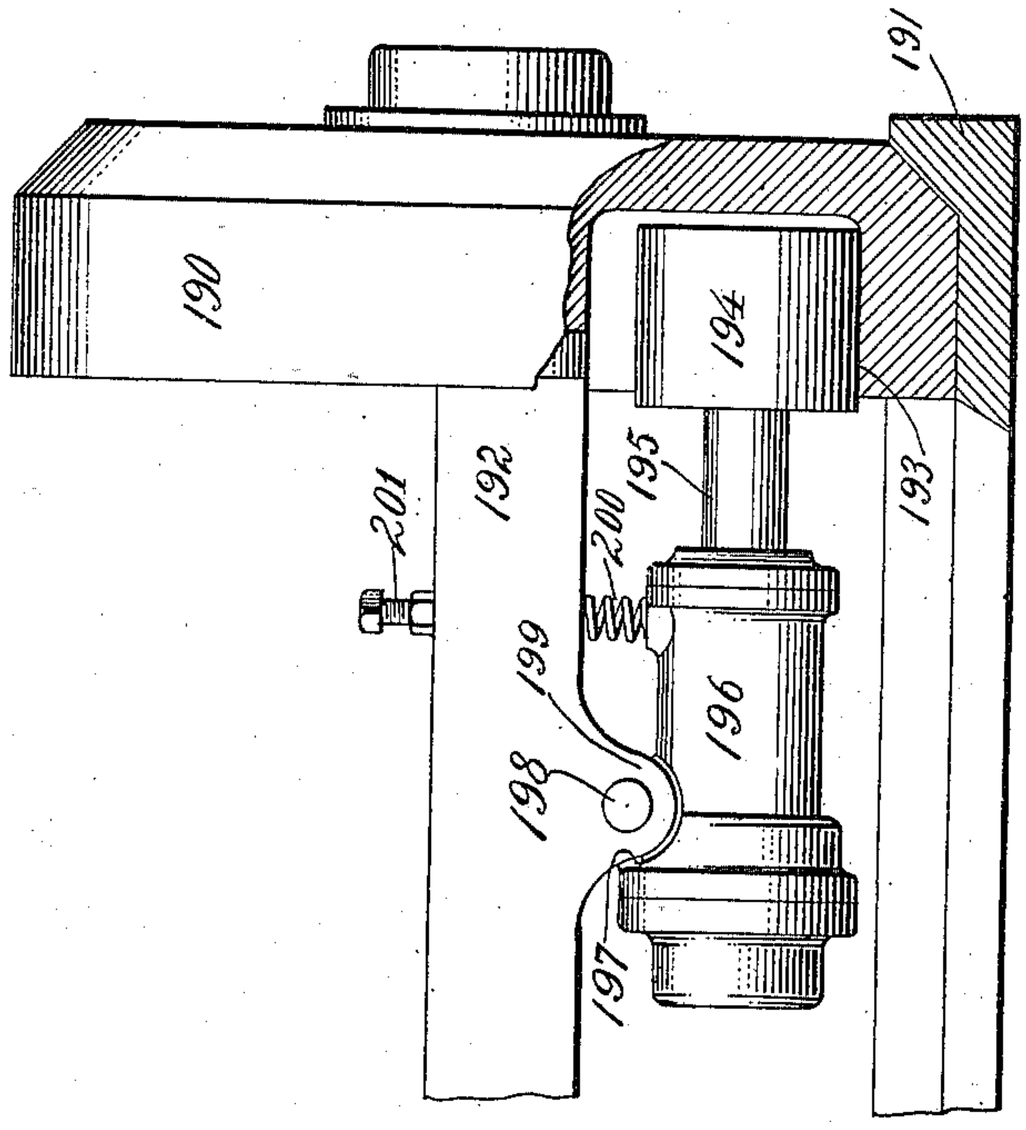
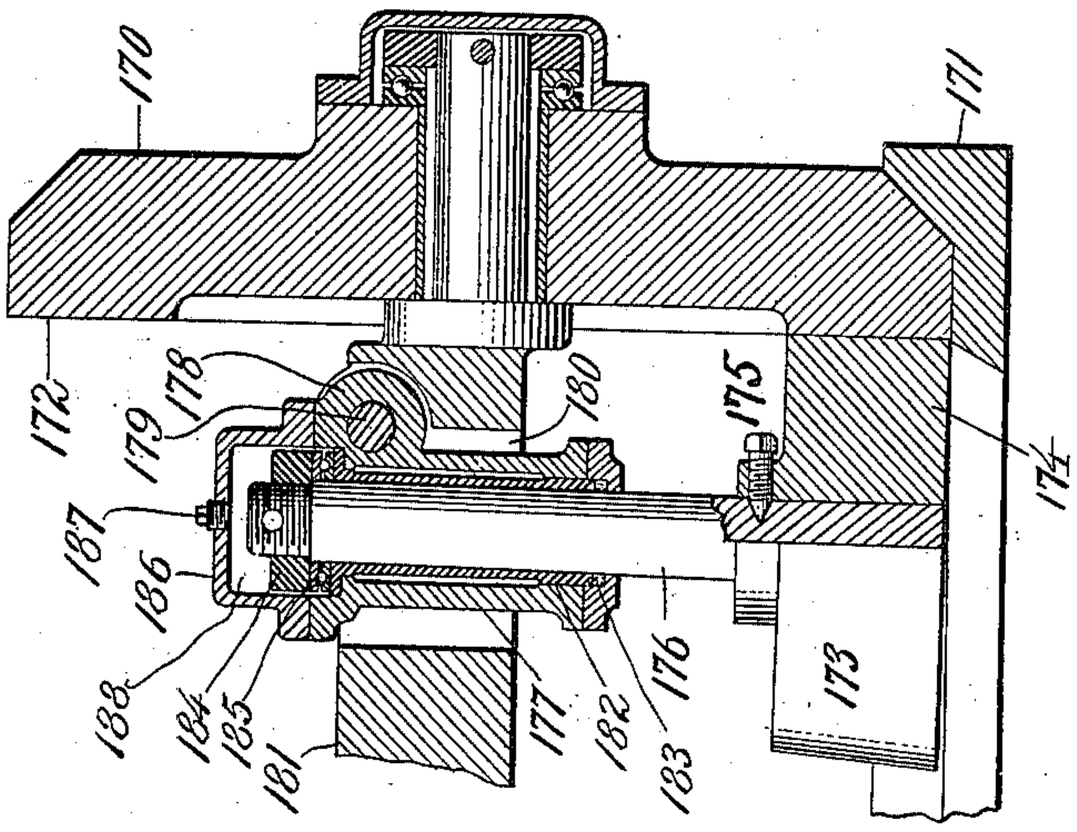


FIG. III.



Witnesses

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UNITED STATES PATENT OFFICE.

WILLIAM FRANCIS TRENARY, OF MARIETTA, GEORGIA.

PULVERIZING-MACHINE.

984,048. Specification of Letters Patent. Patented Feb. 14, 1911.

Application filed September 27, 1906. Serial No. 336,454.

To all whom it may concern:

Be it known that I, WILLIAM FRANCIS TRENARY, of Marietta, in the county of Cobb, State of Georgia, have invented certain new and useful Improvements in Pulverizing-Machines, of which the following is a specification.

The object of my invention is to produce an improved machine for the reduction of any and all substances, without other restriction than the possession of susceptibility to such reduction, to a state of perfect pulverulence.

My invention is designed and adapted to accomplish the production of a strong, rigid, and stable machine which in the completeness of its preferred form of embodiment involves a principle of operation possessing both distinctive novelty and distinctive utility in the art to which it belongs. I refer to the means employed in my machine and to the mode of operation thereof hereinafter specified, by which a crushing, grinding, rubbing, and abrasive action, substantially correspondent to or identical with the well known triturative or pestle and mortar action, is attained.

What constitutes my invention will be hereinafter specified in detail and succinctly set forth in the appended claims.

In the accompanying drawings, which constitute a part of this specification, Figure I is a central, vertical section of a preferred form of embodiment of my invention, some of the parts being shown in elevation. Fig. II is a top plan view of the subject matter of Fig. I, a portion of the crown or dome being broken away, with so much of the mechanism as is obscured by the crown being shown in dotted lines. Fig. III is a central, vertical section, partially in elevation, of a modified form of bull roll and auxiliary roll, with portions of members cooperative therewith, including the bull ring. Fig. IV is a view similar to Fig. III illustrative of a further modification of the bull roll and auxiliary roll.

Referring to the numerals on the drawings, 1 indicates the metal bed-plate of my machine of any suitable and preferred shape and dimensions, and of a weight sufficient to lend the requisite rigidity and stability of installation to the machine. It is provided with a series of columns 2, of suitable and preferred number, preferably disposed around the bed-plate preferably in concentric order with reference to the bed-plate and near its edge to which they are respectively secured, as by bolts and nuts 3. These columns surround a case 4, preferably of sheet steel and preferably reinforced at intervals next to the bed-plate by buttresses 5, or other means of reinforcement. The columns are surmounted by a ring 7, concentric with the order of disposition of the columns, and a crown or dome 8 superposed upon it, the columns, ring, and crown being securely and closely joined together by a series of bolts and nuts 9, for the accommodation of which provision is made, as illustrated, in the construction of the columns and crown respectively. The ring 7 is preferably provided with an internal depending flange 10 and the bed-plate likewise with an upwardly extending annular projection 11, concentric with the flange 10. The projection 11 is rabbeted around its upper external periphery to define an annular bench 12, from the face of which descend, at suitable intervals, preferably elongated outlet apertures 15 penetrating through the bed-plate (compare Figs. I and II).

The bench 12 defines, upon the projection 11, two circular walls 16 and 17. The latter is adapted for the accommodation of the case 4, which is secured to the said wall as by a circumferential band 18, the non-contiguous ends of which are provided with apertured lugs 19 and 20, which, being penetrated by a bolt 21, are adapted to be drawn toward each other by a nut 22, for fastening the band in place and thereby securing the case 4 to the bed-plate by a tight joint. The wall 16 is adapted for the accommodation of a screen 25 of required mesh, which being intended for the separation of the properly pulverized material within the mill, preparatory to its liberation for discharge through the outlets 15, is, for reason hereinafter specified, constricted in its diameter from top to bottom. For this reason, it may be shaped with two inclined sides of different inclination, as indicated in Fig. I of the drawings at 26 and 27 respectively. The screen 25 being preferably secured to the flange 10 and wall 16 near its upper and lower edges, respectively, it is for the accommodation of its restriction referred to that the wall 16 is made of narrower diameter than the flange 10. The screen 25, being preferably of reticulated metal of suitable mesh, is se-

cured about the wall 16 as by a band 29, corresponding to the band 18, and like it, provided with a draw bolt 30. In like manner, the upper portion of the screen, as well as the case 4, is secured, as by a band 31 corresponding in form and function to the band 18 previously described, to the external periphery of the flange 10.

The crown or dome 8 is provided with a crown-cap 32 preferably strengthened at intervals by webs 33 and provided with a projecting flange 34, which fits snugly within an aperture fitted and provided for its accommodation in the top of the crown 8, to which it is secured by a crown of nuts and bolts 35. The crown-cap 32 is concentrically provided with a journal box 36 within which is revolubly supported a vertical shaft 37, the lower end of which is carried in a box 39 co-axial with the box 36, and secured, preferably, to the bed-plate 1, and above the bed-plate, within the case 4, as by nutted bolts 40.

The machine so far as above described, comprehends a practically dust-tight receptacle or housing. Dust being the intended product of the machine, it is made dust-tight to prevent waste of the product, and is penetrated only by a hopper 41, of any suitable and preferred construction, secured to the crown 8, and by the outlets 15 for the finished product, previously referred to.

The box 36 is preferably provided with a gland 42 bearing against a stuffing-ring or other packing 43 in the bottom of the box. A set collar 45 working against the bottom of the box and secured to the shaft 37 as by an abutment screw 46 serves to hold the annular detachable bottom 47 of the box in place against the stuffing-ring 43.

49 indicates a gear wheel secured to the upper end of the shaft 37 and preferably rotating against the flange 50 of the gland 42. A bifurcated oil reservoir 51, closed as by a screw-plug 52, is preferably provided in the head of the shaft for supplying lubricant to the bearing surface of the shaft within the gland 42.

The box 36 is preferably provided with means of horizontal adjustment upon the crown-cap 32 and it is to that end provided with a square flange 53 securable by bolts and nuts 54 to the said cap. The apertures 55 provided in the cap for the reception of the bolts 54 are in the form of slots, whereby when the nuts on the bolts 54 are loosened the box 36 may be adjusted into true concentricity with the box 39. The means of adjustment provided, preferably consist of a series of say four abutment screws 57, working, respectively, in lugs 58 upon the crown-cap 32, each provided with an internally threaded aperture for the reception of its appropriate screw 57.

The box 39 receives the end of the shaft 37 within a bushing 60, which is surmounted by a gasket 61 held in place by an annular cap 62 secured as by stud-bolts 63 and nuts 64. The end of the shaft 37 is supported upon suitable ball bearings, represented by plates 66 and 67, and an annular series of balls working between them in grooves, said series being represented by the ball 68 in Fig. 1. As a suitable and convenient means of lubricating the bearings of the shaft 37 within the box 39, I provide an oil reservoir 70 communicating with said bearings as by branches 71 and 72. The reservoir 70 is closed as by a screw-plug 73 at its upper end, and supplied on the outside with lubricant as through a pipe 74.

The gear 49, previously specified, is shown as a bevel gear and driven by a like pinion 75 fixed to a shaft 76, upon which travels a split pulley 77. The shaft 76 is carried in bearings 78 and 79 upon uprights 80 and 81. These uprights constitute the upper portion of a pedestal that is mounted directly upon the bed-plate 1. For convenience, the pedestal, although forming a support for the shaft upon the bed-plate, is incorporated with one of the columns 2 and with the crown 8 and crown-cap 32. To that end, one of the columns 2, as shown in Fig. I, is provided with an arm 83, and the crown 8 with a rib 84, provided, respectively, with plates 85 and 86, whose upper surfaces are flush with each other. The arm 83 and the rib 84 constitute, in effect, two branches proceeding from the column 2. They are spanned and joined by an extension 87 of the crown-cap 32, which rigidly unites them, and upon the top of the extension 87, the uprights 80 and 81 are rigidly fixed, as by a suitable number of nutted bolts 88.

The function of the shaft 37 is to communicate driving power to the pulverizing mechanism within the case 4, and to that end it is provided with a cross-head whose hub 90 is firmly keyed or otherwise secured to the shaft 37 (compare Figs. I and II). The cross-head is preferably provided with two bifurcated arms 91 and 92, and two brace-arms 93 and 94, all preferably made integral with each other. The bifurcated arms 91 and 92 carry, respectively, bull-roll-supporting-members 95 and 96, terminating, respectively, in bull-roll axles, of which one is shown in elevation in Fig. I of the drawings and there indicated by the reference numeral 97. Each bull-roll-support is movably secured between the bifurcations of one of the arms, 91—92, as upon a horizontally disposed pin 98, so that it is susceptible of oscillatory motion in a vertical plane.

The brace-arms 93 and 94 are provided, respectively, with cross-arms 99 and 100, riveted or otherwise secured to the brace-arms, respectively, and which are employed

to lend rigidity to the axles of the bull-rolls and to render them unyielding save as to their motion in a vertical plane, as previously specified. To that end, each of the cross-arms is provided at each end with a lead rod, indicated in each instance by the reference numeral 101. Each lead rod works at one end between bifurcations 102 in the end of its cross-arm upon a pivot-pin 103, of which there are four, two being disposed opposite to the ends of each of the arms 91—92, one at one end and one at the other, and the three pins of each series, respectively, being in co-axial alinement, whereby provision for the movement of each of the bull-roll-supports in a vertical plane, as specified, is made, the ends of each pair of leads 100 being secured to the said supports, respectively, as by a nutted bolt 105. Each of the bull-roll-supports is provided with a central vertically disposed aperture 106, within which oscillates an auxiliary-roll-support 107. For convenience of construction and assemblage, each of the supports 107 is provided with a diametrical pin 108 projecting beyond the opposite sides of the member 107 in trunnions 109, which are set into socket apertures provided for them in the cheek-plates 110 and 111 of the aperture 106. For convenience, the cheek-plate 111 is made removable, as will appear by comparison of Figs. I and II, and is secured by say four bolts 112, three of which are indicated by the reference numeral 112, the fourth being the bolt 105 previously specified.

Each of the two axles 97 accommodates a bull-roll 115, which is revolubly secured in place by mechanism comprehended in a dust-proof bearing. With that end in view, each axle 97 at its inner end is defined by a shoulder 116 within which is accommodated an annular gasket 117, yieldingly urged as by a spring 118, seated behind it in a recess provided for the said spring and gasket, against the inner face 120 of the bull-roll. The bore of the bull-roll is provided with a bushing 121, between the inner surface of which and the outer surface of the axle anti-friction rollers 122 work. Near the outer end of the axle 97, an annulus 123 is secured as by a linch-pin 124. The inner face of the annulus 123 is grooved to accommodate a circular series of anti-friction balls 125, which work also in the grooved face of an annulus 126 seated in a recess provided for it in the outer end of the bull-roll. The end of the axle 97, with its ball bearings just described, is covered and protected by a cap 127, secured as by bolts 128, nuts 129, and lock-nuts 130. The heads 131 of the bolts 128 are accommodated within recesses 132 provided for them, respectively, in the bull-roll. The bearings of each bull-roll upon its axle 97 may be furnished with a supply of lubricant from a reservoir 133 located in each bull-roll-support, as shown in Fig. I, closed as by a screw-plug 134. The bull-rolls are made of material specially selected to lend to them hardness and durability, and in the travel imparted to them by the rotation of the shaft 37 work with both crushing and abrasive force against a bull-ring 135. This bull-ring being made of material similar to that of which the bull-rolls are made, and being in practice usually of considerable diameter and ponderosity, is preferably made in sections, rigidly and unyieldingly fixed in position upon the bed-plate 1. It may be conveniently accommodated upon the bed-plate 1 against the inner face of the annular projection 11 and secured in place by a series of retaining-members 136 (see Fig. I) secured to the bed-plate 1 as by bolts 137.

The terms bull-roll and bull-ring are employed correlatively in this specification and the claims to designate members having a definite relationship to each other. The term "bull-ring" denotes a horizontally disposed member or floor upon which, and supported by which, the "bull-roll" travels. Their coöperative crushing effect is derived from the weight of the bull-roll in its rolling travel upon the surface of the bull-ring. It is the function of each bull-roll in coaction with its coöperative member, for example, the bull-ring 135, to effect in addition to the usual crushing action of such roll and in contradistinction thereto, a grinding, rubbing, or abrasive action, to define which the comprehensive and generic term "triturative" or any cognate form of that term, is hereinafter employed, particularly in the claims. To that end, I provide on each bull-roll a cylindrical rolling surface 138, which travels over an annular floor 139 of the bull-ring and also a beveled face 140, which works abrasively against a beveled face 141 upon the bull-ring, the angle of inclination of the faces 140 and 141 being equal.

Each of the supports 107 carries on auxiliary-roll 145, whose bearings thereon substantially correspond to those by which the bull-rolls are carried upon their axles 97, and include a bushing 146 and grooved rings 147 and 148, between which work anti-friction balls 149, the ring 148 being secured to the support 107 as by a linch-pin 150. Anti-friction rollers, corresponding to rollers 122, may, of course, be used, if desired, but are not illustrated. The shoulder 151, which defines the inner end of the axle 152, is not recessed for the accommodation of a gasket as the shoulder 116 is, but instead thereof a gasket 153 is employed on the outside of the shoulder and secured by a recessed annulus 154, which fits snugly around the shoulder. By this means the same bolts 156 may be employed for securing both the annulus 154 and the cap 157 in place. A

plug-closed oil-duct 159 terminating in branches 160 and 161, may be employed for the purpose of lubrication.

The pestle and mortar action mechanically reproduced in my machine and involved in the principle of my invention, in one aspect thereof, and that an important one, is illustrated in the coöperative working faces of the respective bull-rolls and bull-ring previously specified, but that principle, as otherwise developed and carried, perhaps, to a higher degree of efficiency, is illustratively set forth in the coöperative relationship of the auxiliary-rolls and the bull-rolls. That coöperative relationship which is believed to introduce a new principle of operation in the art relating to pulverizers and which is exhibited in its simplest form of embodiment in the coöperation of the working faces 140 and 141 of the bull-roll and bull-ring respectively, previously set forth, is still further developed in the relationship of each auxiliary-roll 145 and bull-roll 115, inasmuch as in respect to those rolls both constitute traveling members, and as such are intended in this specification to represent traveling members generally, which, by reason of their separate movements, coöperate abrasively to produce pulverization of the material introduced between them, irrespective of the dispositions of those members except in so far as their abrasive relationship is concerned. With this provision, I now proceed to describe that relationship between the rolls 145 and 115 well illustrated in the sectional portion of Fig. I. The inner face 120 of the bull-ring has been referred to. It is now specified as constituting the bottom of a dish-shaped recess in the roll 115 whose side is defined by an inclined wall 165. Against the face 122, a cylindrical zone 166 on the auxiliary-roll 145 makes tangential contact, while against the wall 165 a bevel-wall 167 of inclination corresponding to the wall 165, engages. When the machine is in motion, the auxiliary-rolls 145 are urged by centrifugal force into contact with the aforesaid walls of the bull-ring 115 with which they engage, and the auxiliary-rolls derive motion, through such engagement, from the rotation of the ponderous bull-rolls traveling upon their floor 139 of the bull-ring. But by reason of the difference of diameters of the engaging surfaces 166 and 167, due to the inclination of the latter, a rubbing action, correspondent, but in an augmented degree, to the action of the faces 140 and 141, with increased abrasive effect, is attained. The abrasive action, derived from the coöperating effect of two traveling surfaces, in its simplest form of embodiment, is developed by contact between the surfaces 166 and 120, and modifications of means for obtaining that effect exclusively are shown in Figs. III and IV, respectively. Referring to the former, 170 indicates the bull-roll and 171 its bull-ring which are substantially identical with the bull-roll and bull-ring previously specified, with the exception that the bull-roll 170 is provided with a single annular face 172, against which works the vertical cylindrical face 173 of an auxiliary-roll 174, fixed, as by screw 175, to the end of a supporting-member 176, mounted in suitable anti-friction bearings in a swinging-box 177, mounted by means of a laterally disposed lug 178 upon a pin 179 within a recess 180 in a bull-roll-supporting member 181. A gland-like bushing 182 surmounting a packing ring 183 in the bottom of the box 177 supports the member 176 by aid of a ring 184 secured near its upper end upon interposed ball-bearing-members designated collectively by the numeral 185. A cap 186 provided with a screw-plug 187, secured to the top of the box 177, covers and protects the bearing-members 185 within the box and, when in place, affords an oil reservoir 188 on top of the box.

In Fig. IV a bull-roll 190 is shown with its bull-ring 191, both corresponding to the bull-rolls and rings previously specified, said bull-roll being carried upon its supporting-member 192. In the bull-roll 190 a cylindrical face 193, concentric with the bull-roll, is shown in contact with a cylindrical auxiliary-roll 194, whose axis is parallel with that of the bull-roll 190. Its supporting-member 195 is revolubly mounted within a box 196, which may correspond substantially with the box 177, previously specified, but is swung by aid of its lug 197, corresponding to the lug 178 previously specified, upon a pin 198 in a depending support 199 on the bull-roll-support 192. In this form of embodiment, the aid of centrifugal force for compelling engagement between the auxiliary-roll and the surface 193 of the bull-roll with which it makes contact being no longer available, the contact is preserved and regulated by the aid of mechanical means, such, for example, as the coil-spring 200, whose power may be regulated by the aid of an adjustment screw 201.

The operation of my machine may be described as follows. Power being applied to the pulley 77, motion is communicated through the shaft 76, pinion 75 and intermeshing gear-wheel 49 to the shaft 37. This causes the bull-rolls to travel around the annular floor 139 of the bull-ring 135, with abrasive rubbing contact between the surfaces 140 and 141. The centrifugal force generated by the rotation of the cross-head which carries the auxiliary-rolls upon their swinging supports 107, forcibly urges the said auxiliary-rolls 145 into contact with the bull-rings from which, as previously specified, the said rolls derive motion

through engagement of the surfaces 166 and 120. At the same time, contact between the surfaces 167 and 165 is made with an abrasive, rubbing action like that developed between the surfaces 140 and 141, but with augmented efficiency. Material fed into the machine through the hopper 41 is kept in agitation by the rotation of the working members within the case 4 and caught between the coöperative faces of the bull-roll and bull-ring, and the bull-roll and auxiliary-rolls, is ultimately and expeditiously reduced to a fine powder or a state of perfect pulverulence. In order that the material may not escape from the machine until the desired pulverulency of it is attained, the screen 25 is provided. It is obvious that this screen in machines of this kind must be of comparatively heavy weight of metal, and for that reason, it is impracticable to employ a screen of a mesh of otherwise desirable fineness or minuteness. It is, for that reason, that the lower end of the screen is constructed, as in the manner illustrated, by the employment of inclined sides 26 and 27. A gradual tapering of the screen might be employed, but at possible disadvantage of some waste of space. Now the pulverulent material produced by the operation of the machine descends through the screen toward the outlets 15, whence it is discharged, and if it fell upon a horizontally disposed screen, for example, it would find means of egress through it limited only by the size of the mesh of the screen; but by providing a screen which presents itself to the contents of the machine at an inclined angle, as specified, the actual mesh of the screen is, in effect, reduced in fineness, thereby effectually limiting the discharge of material through the screen to such only as shall have been reduced to the desired state of pulverulence, and at the same time, employing a screen of that mesh which is consistent with the weight of metal which, in practice, must be employed in it.

It may be observed that the construction of my machine and the arrangement of its several parts is such as to distribute the weight of the mechanism toward the bed-plate, thereby lowering its center of gravity and contributing to its solidity of installation and stability in operation.

What I claim is:—

1. In a pulverizing machine, the combination with a bed-plate, inclosed receptacle or housing, and roll-operating-shaft mounted therein, a pulley-shaft operatively connected with the first named shaft, and a supporting-member for said second shaft other than the receptacle mounted directly upon the bed-plate, said supporting member being provided with two branches, and a crown-cap upon the receptacle provided with an extension supporting said branches.

2. In a pulverizing machine, the combination with a bed-plate, receptacle or housing, driving shaft and bull roll carried thereon, of an auxiliary roll in operative contact with the bull-roll and deriving rotary motion from said bull-roll, said auxiliary roll being carried on a vertical, movable support, whereby it may be actuated by centrifugal force in the direction for making contact with the bull-roll.

3. In a pulverizing machine, the combination with a bed-plate, and a shaft, of bull-roll-supports movably secured to the shaft, bull rolls thereon, a coöperative bull-ring upon the bed-plate, an auxiliary-roll-support movably secured to each bull-roll-support, and an auxiliary roll thereon coöperative with the bull-roll, the inner face of each bull-roll dished and the external face of the auxiliary-roll shaped to correspond thereto for coöperation, as specified.

4. In a pulverizing machine, the combination of an inclosing receptacle with inner abrasive surface, principal crushing members having outer abrasive surfaces complementary to the abrasive surface of the receptacle and also inner abrasive surfaces and auxiliary swinging crushing members having abrasive surfaces complementary to the inner abrasive surfaces of the principal crushing members.

5. In a pulverizing machine, the combination of an inclosing receptacle with an inner abrasive surface, principal crushing members having outer abrasive surfaces complementary to the abrasive surface of the receptacle and also inner abrasive surfaces and auxiliary swinging crushing members having abrasive surfaces complementary to the inner abrasive surfaces of the principal crushing members, the auxiliary crushing members being connected with the principal crushing members but having a centrifugal swinging movement of their own against such principal crushing members.

6. In a pulverizing machine, the combination of an inclosing receptacle with an inner abrasive surface, principal crushing members having outer abrasive surfaces complementary to the abrasive surfaces of the receptacle and also inner abrasive surfaces and auxiliary swinging crushing members having abrasive surfaces complementary to the inner abrasive surfaces of the principal crushing members, the abrasive surfaces of the receptacle, the principal and auxiliary crushing members being in the same line of pressure.

7. In a pulverizing machine, the combination of an inclosing receptacle with an inner abrasive surface, principal crushing members having outer abrasive surfaces complementary to the abrasive surface of the receptacle and also inner abrasive surfaces and auxiliary swinging crushing members having abrasive surfaces complementary to

the inner abrasive surfaces of the principal crushing members, the auxiliary crushing members being connected with the principal crushing members but having a centrifugal swinging movement of their own against such principal crushing members, the abrasive surfaces of the receptacle, the principal, and auxiliary crushing members being in the same line of pressure.

8. In a pulverizing machine, the combination of an inclosing receptacle having inner abrasive surface, principal crushing members having abrasive surfaces complementary to those of the receptacle and also inner abrasive surfaces auxiliary swinging crushing members having abrasive surfaces complementary to the inner abrasive surfaces of the principal crushing members, the portions of the principal crushing member having the abrasive surfaces being between the portions of the inclosing receptacle and the auxiliary crushing members provided with abrasive surfaces.

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

WILLIAM FRANCIS TRENARY.

Witnesses:

JOSEPH L. ATKINS,

CHAS. E. RIORDAN.