

May 26, 1931.

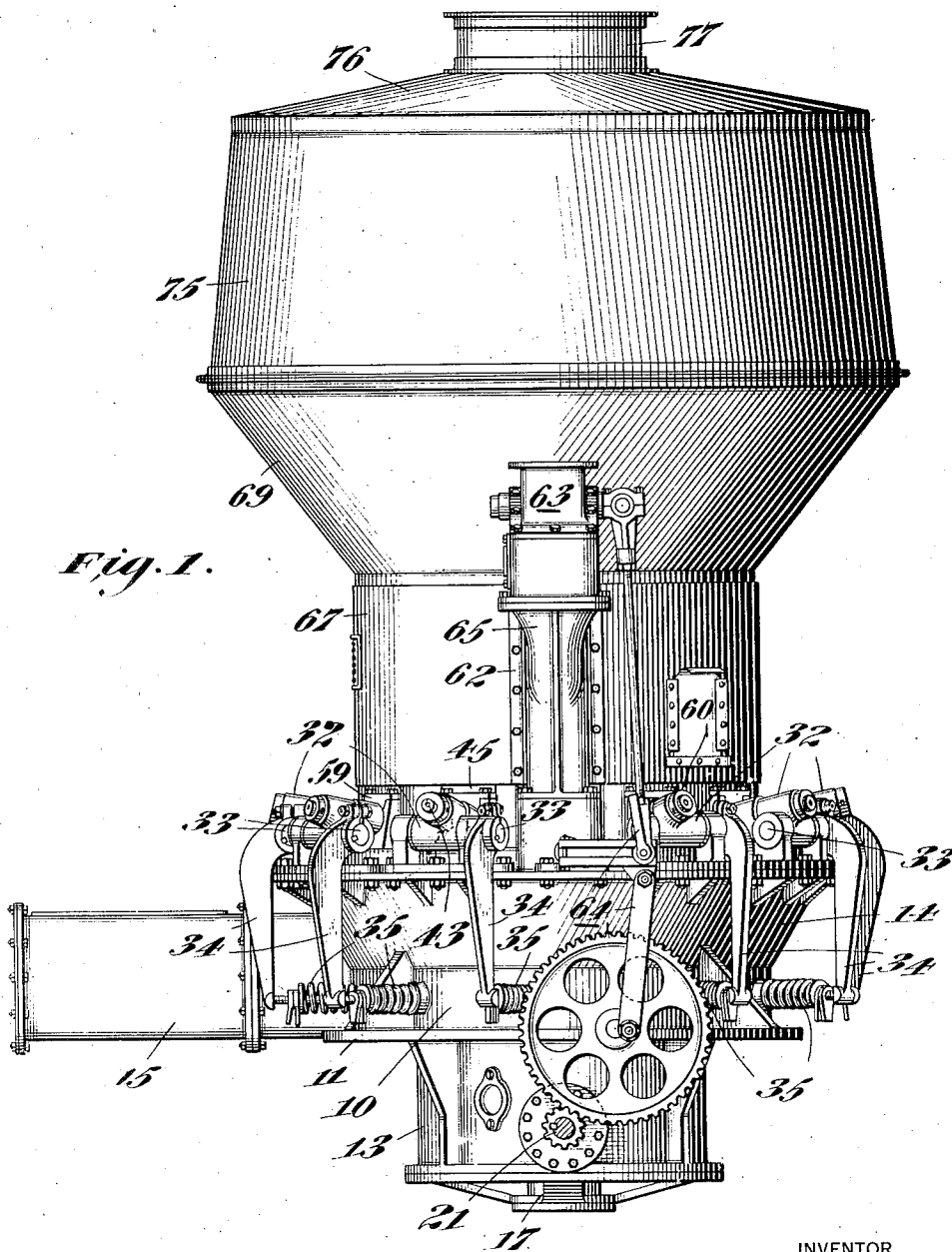
O. A. KREUTZBERG

1,806,980

PULVERIZER

Filed Nov. 5, 1926

6 Sheets-Sheet 1



INVENTOR

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BY

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May 26, 1931.

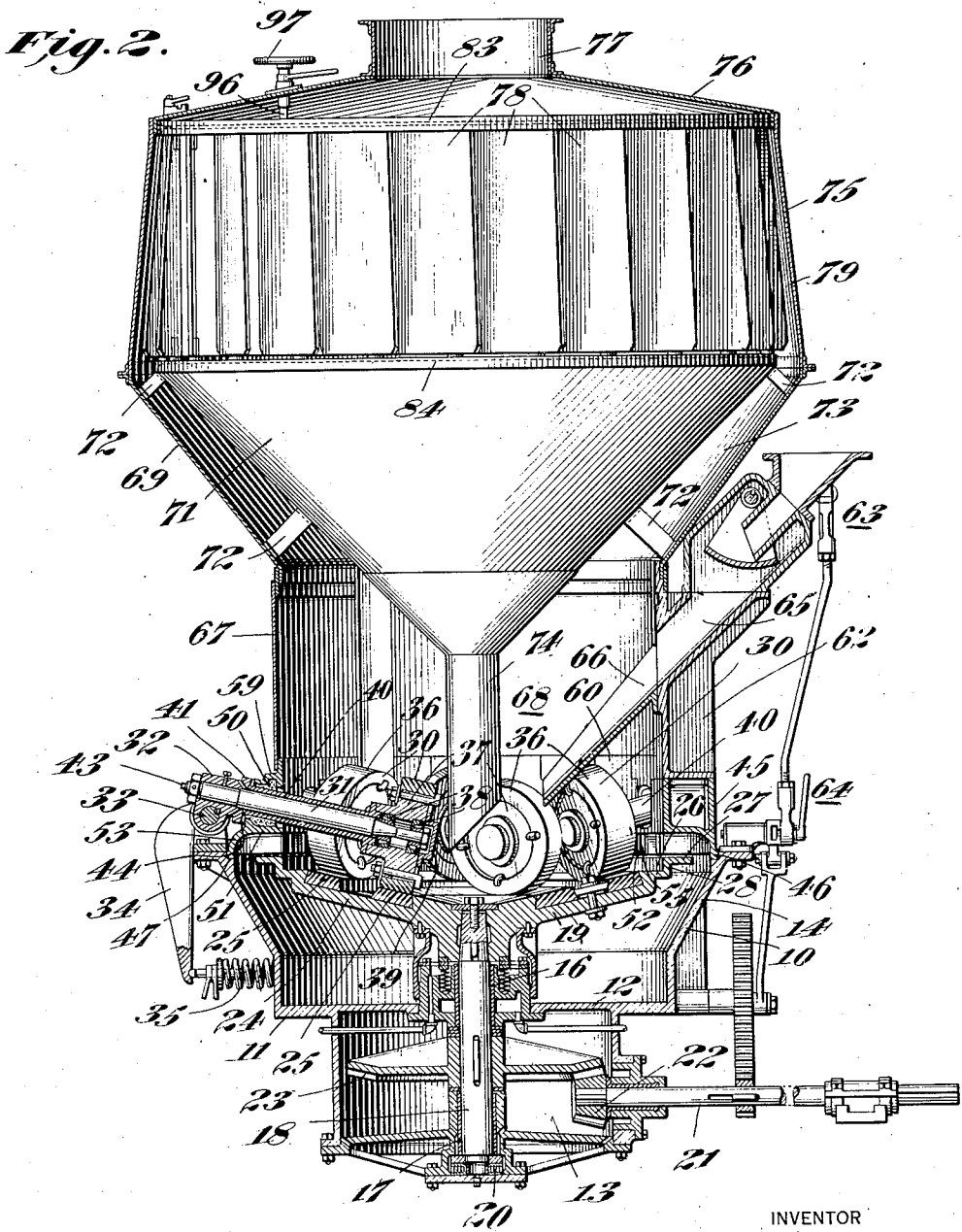
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Fig. 3.

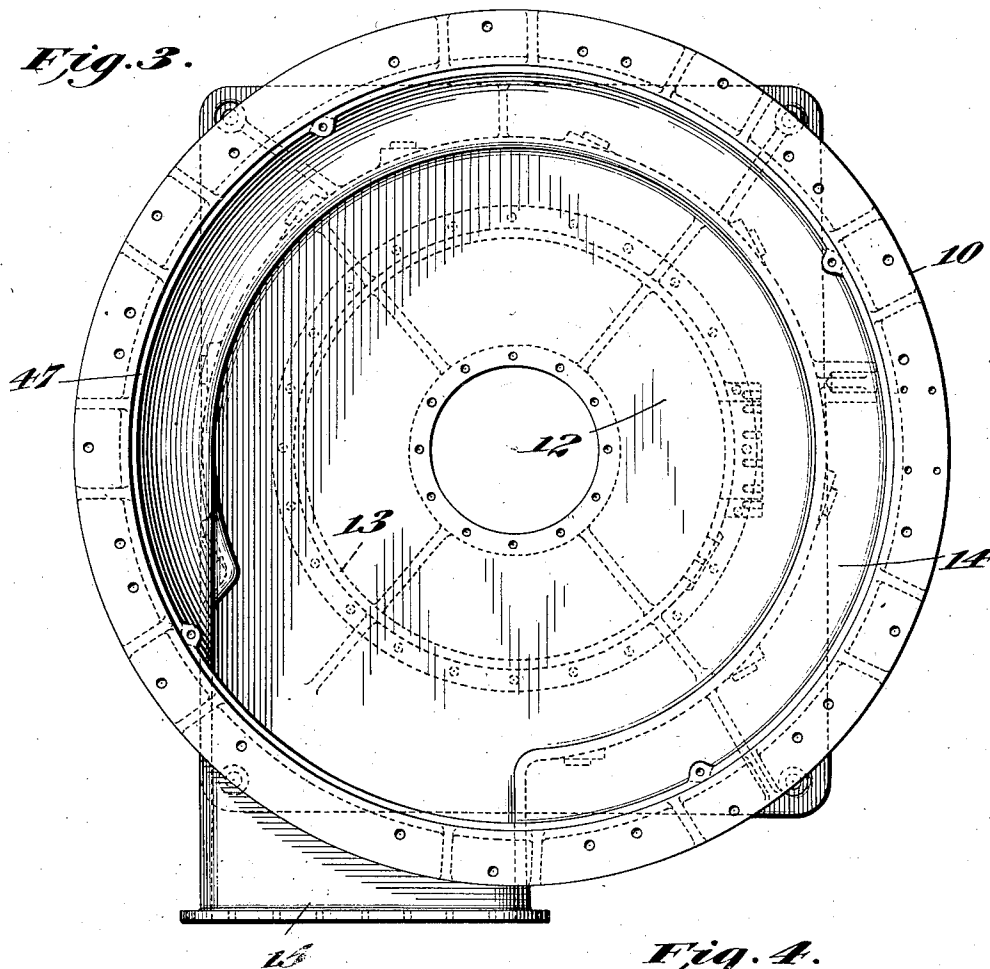
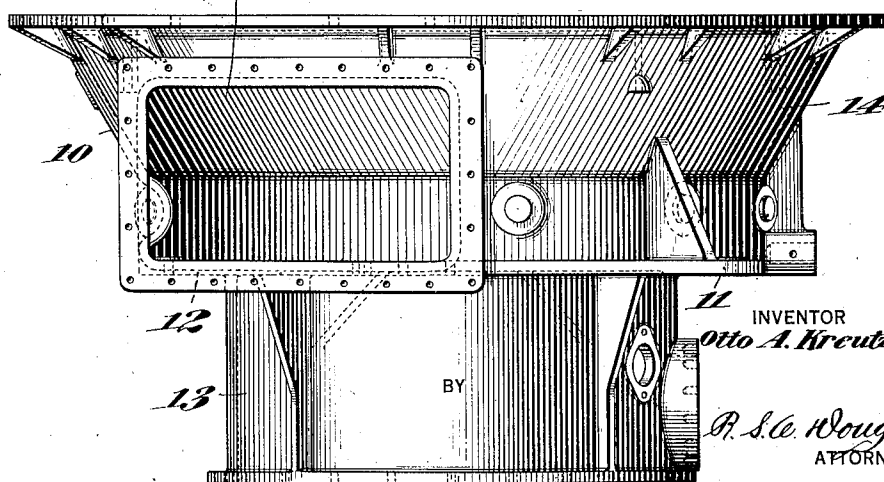


Fig. 4.



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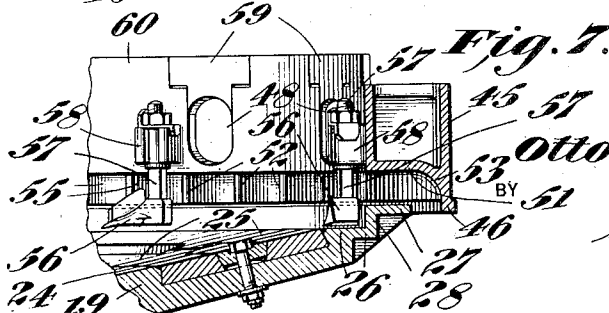
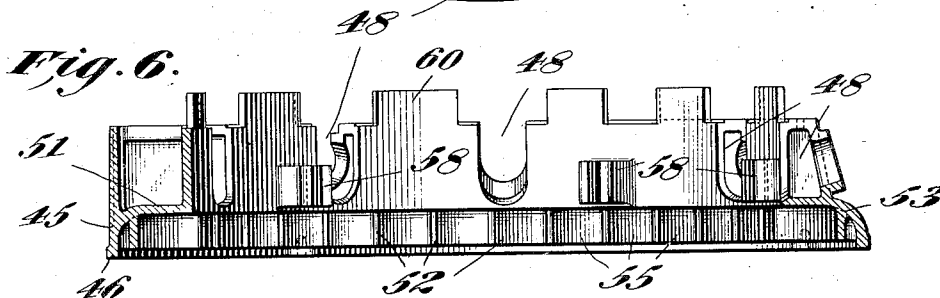
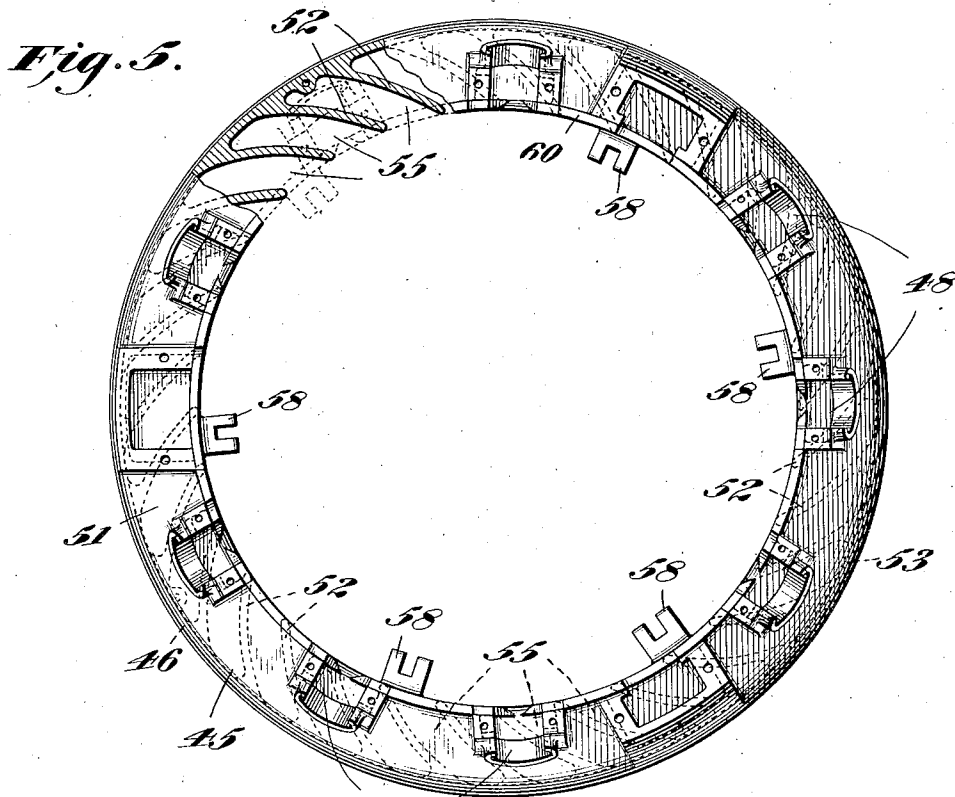
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Fig. 8.

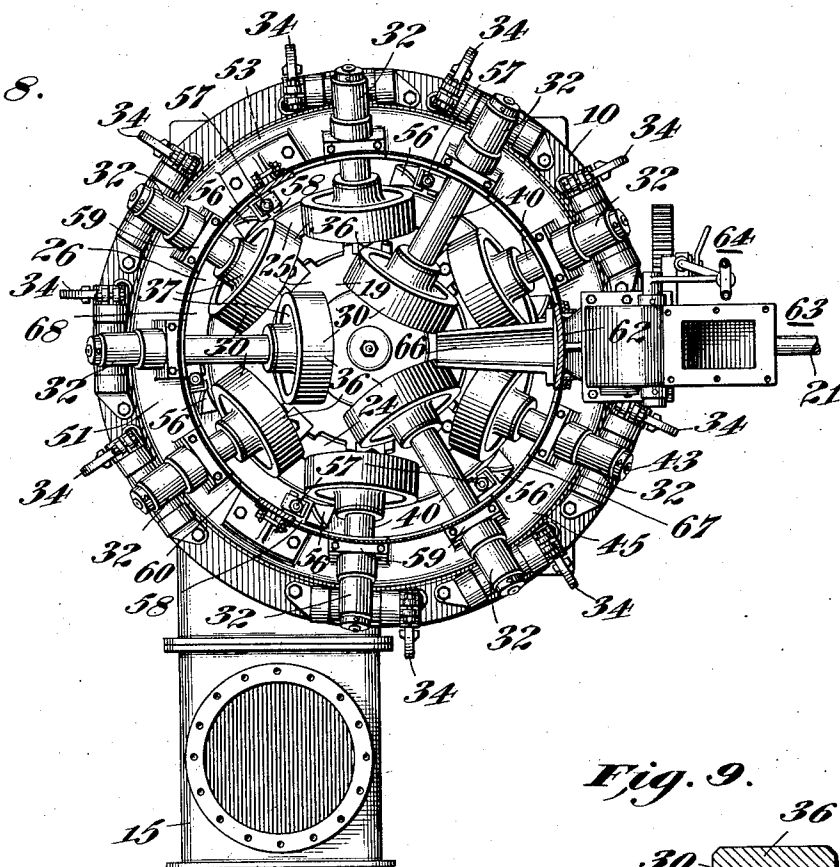


Fig. 9.

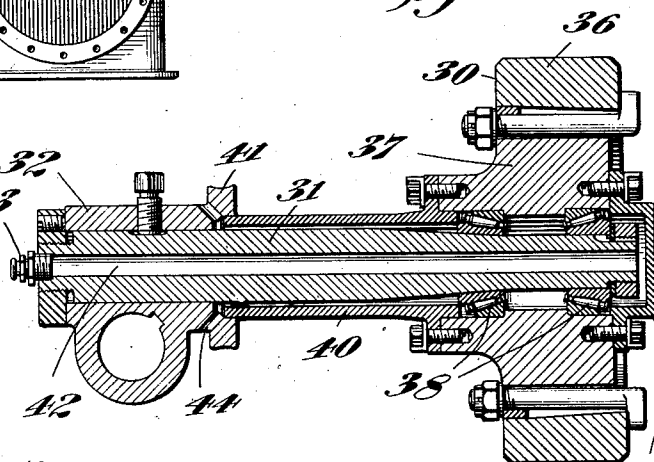
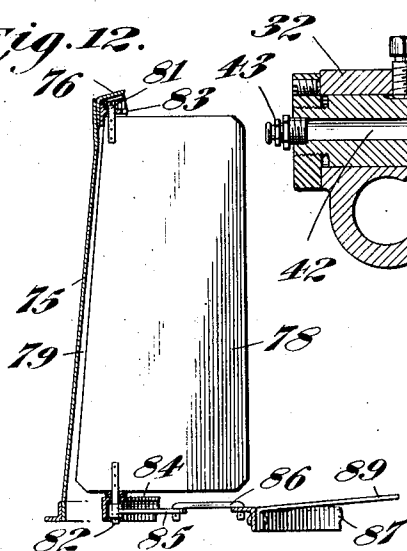


Fig. 12.



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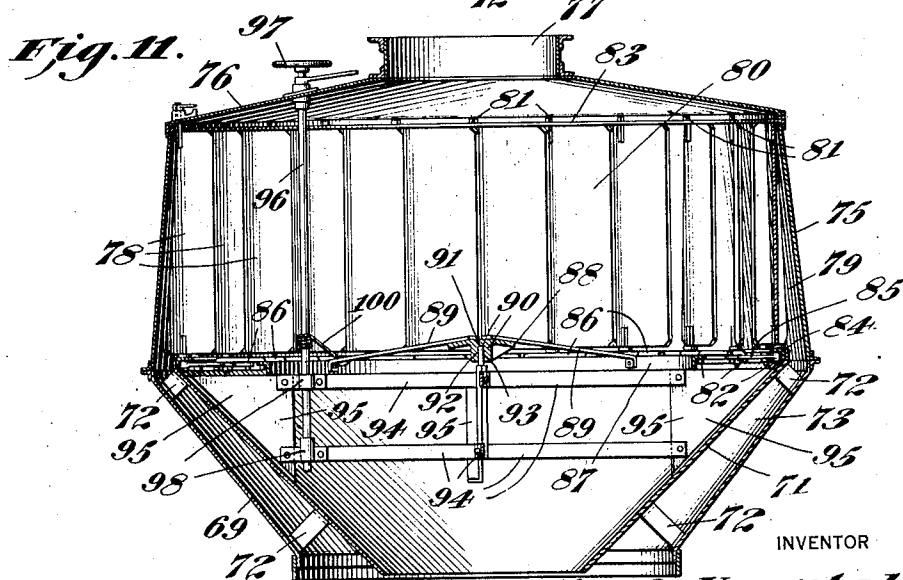
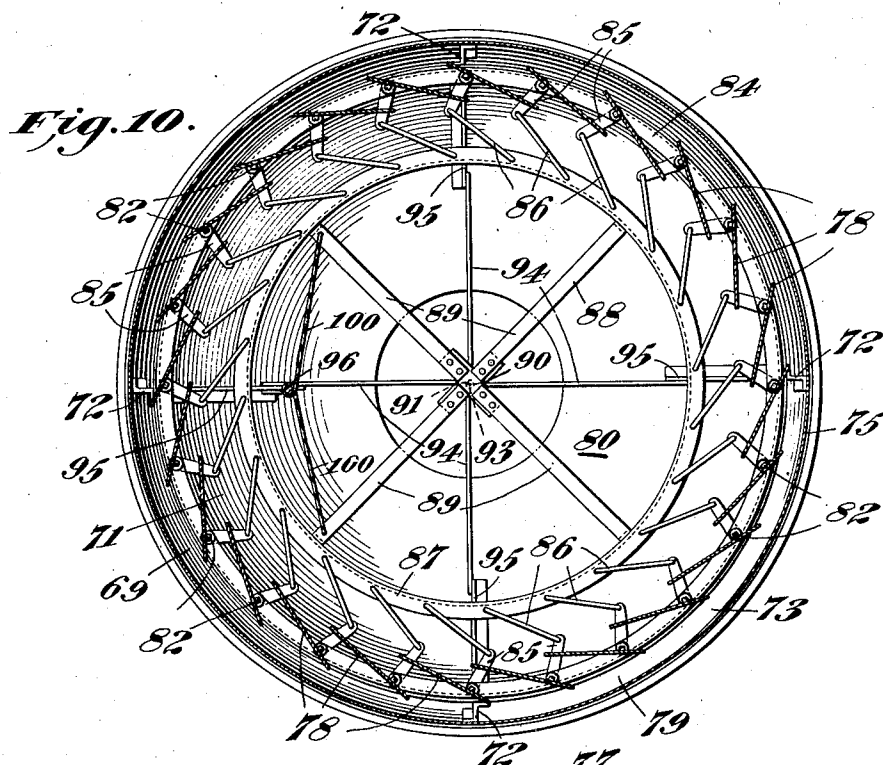
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PULVERIZER

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6 Sheets-Sheet 6



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OTTO A. RAEUTZBERG, OF BETHLEHEM, PENNSYLVANIA

PULVERIZER

Application filed November 5, 1926. Serial No. 146,321.

My invention relates to pulverizers of the general type disclosed and claimed in my Patents Nos. 1,478,478, 1,480,767 and 1,523,881, and has for an object to improve apparatus of this character so as to secure a thorough pulverization to any desired degree of fineness, with a high degree of efficiency and a minimum consumption of power, by the manner in which air currents are introduced and caused to circulate through the apparatus, and by the manner in which choking of the air passages by the accumulation of fine particles may be avoided.

More particularly, my improved pulverizer includes a special form of housing and a modified revolving table, which permits of air being blown over the outer portion of the table in inwardly-directed tangential jets to a precipitation chamber containing the crushing rolls, the revolving table forming the bottom of the chamber so that particles thrown out by centrifugal force may be returned to the center of the table. In this manner a whirling motion is given to the inwardly-directed air jets, and their velocity is retarded by their expansion into the volume of the chamber. The initial velocity of the air is sufficient to sweep back and entrain any particles thrown out and due to its whirling motion the air is susceptible of entraining further particles from above the table. Before leaving the first precipitation chamber, the air has followed a spiral course and has been retarded to a substantial degree, both of which factors tend to promote precipitation.

In order to grind material to the finest degree, the air which normally entrains suspended particles and dust on leaving the first precipitation chamber should be subjected to a further stage of precipitation for the recovery, and return to the crushing stage, of a substantial portion of the suspended solids. To this end, I provide a second precipitation chamber surrounded by circumferential vanes radially adjustable about their vertical axes so that the air and the entrained particles coming from the first precipitation chamber may be caused to follow a whirling course in the second chamber. The direction of rotation of the air currents entering the first

and second chambers are preferably the same, so as to take advantage of the rotation of the air leaving the first chamber and ascending spirally, the annular passage leading from the latter to the vanes. The vanes are disposed vertically and at an angle to the radius of the chamber so that the passages therebetween shall not become clogged or restricted by dust. Furthermore, by giving a substantially horizontal whirling effect to the air, it is assured that the retardation in velocity and the elongation in travel of the air current may be sufficient to secure precipitation of the residual particles to a degree of considerable fineness. By varying the angle of the vanes, the degree of angular travel of the air in the second chamber may be varied—the longer its travel, the greater the degree of precipitation.

Accordingly, it is an object of my invention to provide a pulverizer including crushing apparatus and two precipitation stages, one arranged above the other; in which each precipitation stage is equipped with vertically disposed vanes for directing air or dust-laden air, so that the latter may whirl around with a large horizontal component of direction. By this method of construction, the particles may be caused to travel along paths of substantial length in respect to the size of the apparatus and in this manner a very fine degree of pulverization may be attained. The degree of fineness may be readily controlled by changing the angle of the vanes at the entrance of the second precipitation chamber.

These and other objects may be attained by apparatus of the character described in this specification and as illustrated in the drawings, forming a part thereof, in which:

Fig. 1 is a side elevation of my improved pulverizer;

Fig. 2 is a vertical sectional view of the apparatus shown in Fig. 1;

Figs. 3 and 4 are detail views of the supporting housing member;

Figs. 5 and 6 are detail views of the housing ring member or deflector;

Fig. 7 is a fragmentary sectional view showing deflectors for the ground material;

Fig. 8 is a detail plan view showing the table and supporting structure;

Fig. 9 is a detail sectional view showing the construction of one of the crushing rolls and its supporting apparatus;

Fig. 10 is a horizontal sectional view through the upper precipitation chamber;

Fig. 11 is a vertical sectional view of the apparatus shown in Fig. 10; and

Fig. 12 is a detail sectional view showing the method of attachment of one of the vanes.

Referring to the drawings, I show a supporting and housing member 10 having a bearing surface 11 adapted to rest on any suitable supporting structure. The housing 10 is provided with an intermediate partition 12 which defines a lower casing 13 for suitable gearing and an upper casing 14 in communication with the air conduit 15. The partition 12 and the housing 10 are provided with bearings 16 and 17 for the vertical shaft 18 which supports the table 19. A suitable step-bearing 20 is arranged beneath the lower end of the shaft 18 to take the thrust of the table.

A drive shaft 21 enters the gear chamber 13 and has a bevel pinion 22 thereon which meshes with a bevel gear 23 keyed to the vertical shaft 18.

The table 19 is provided with a conically-dished portion 24 having hardened roller paths 25 arranged thereon and outer flat portions 26 and 27 joined by a substantially vertical annular portion 28.

The rollers 30 are journaled on axles 31 and fit the roller paths 25 and are caused to revolve by the movement of the latter. Movement of the axles 31 is confined to the vertical plane as they are each mounted in a bracket 32 connected to shaft members 33, keyed to downwardly-depending crank arms 34 which have spring tension devices 35 co-operating with their lower ends, said devices serving to tilt the axles 31 downwardly and so apply the rollers 30 to the roller paths 25 with any desired degree of pressure.

Referring to the roller structure shown in greater detail in Fig. 9, it will be seen that each roller 30 consists of a hardened rim 36 taper fitted to a hub 37, which is mounted on roller bearings 38 carried by the axle 31. The inner face of the hub 37 is provided with a cap 39, and to its outer face is secured a sleeve 40 extending outwardly to engage an enlargement 41 provided in the bracket 32. Each axle 31 is made hollow as indicated at 42 so that a lubricant may be inserted under pressure through a suitable cup or connection at 43. The lubricant passes through the hollow shaft to the interior of the cap 39, thence through the roller bearings 38, returning about the shaft 31 and within the sleeve 40, and escapes at the outer end of the sleeve, the surplus lubricant passing out through the space 44. With a roller of this design, the bearings are protected and adequately lubri-

cated, even though the rollers are running constantly in a place filled with dust of a character known to be very destructive to the bearings.

A housing ring 45 is superposed on the supporting and housing member 10. This ring (as detailed in Figs. 5, 6 and 7) has preferably a downwardly depending flange 46 to fit an annular groove 47 on the housing 10 inwardly of the supports for the axles 33. It is also provided with suitable oblong recesses 48 for the sleeves 40, these recesses being preferably provided with packing 50 as indicated in Fig. 2, to render the construction dust tight. The ring 45 is provided with a lower horizontal surface 51 which overlaps the surface 27 of the table and from which the fixed vanes 52 depend.

Referring to Figs. 2, 6 and 7, it will be seen that the fixed vanes 52 have their lower edges arranged contiguously to the upper surface of the flat portion 27 of the table, and extend outwardly beyond the outer edge of the table to join a flange 46 which extends downwardly below the lower edges of the vanes and has its inner surface registering with the inner surface of the casing 10, and also that the surface 51 is joined to the inner surface of the flange 46 by a curved surface 53. In this way, the air entering the chamber 14 will pass upwardly about the outer edge of the table 19 in an annular stream, the direction of which will, however, be changed by the curved deflecting surface 53 to pass through the passages 55 between the vanes 52. Due to the tangential setting of these passages with respect to the table, the air enters the table tangentially and induces a whirling effect immediately above the flat surface 27.

In operation, the revolving table 19 tends to throw material outwardly under centrifugal force; however, the table is sloped as indicated at 24 in order to oppose this tendency, the degree of inclination depending upon the size and speed of the table and being preferably determined so that the material will be slowly displaced outwardly, to be crushed by the rolls. In this manner, the particles of material as they move outwardly are overridden by a plurality of rolls and are thereby submitted to an intensive degree of crushing. As the material moves into the outer regions of the table it encounters the streams of air moving directly over the surface of these regions of the table, which have an inward component of motion counter to the outward motion of the material on the table, with the consequence that particles of material are carried inwardly of the table by the air, the coarser of them thus being returned to the inner regions of the table for further grinding and the finer of them being entrained and elevated by the air as it finally passes upwardly in the chamber.

In order to prevent the material in its out-

ward travel from banking up against the annular vertical portion 28 of the table, I provide the plows or deflectors 56 which are carried by stems 57 secured to lugs 58 on the housing ring 45. These plows agitate the material and deflect it upwardly into the whirling air current caused by the tangential jets introduced through the passages 55. This air current returns the particles inwardly towards the center of the table. This structural arrangement of the table and housing and the method of admitting air about its outer edge, positively prevent any particles from being thrown off the edge of the table. As shown in Figs. 2 and 7, the oblong openings 48 for the sleeve 40 are preferably crossed by T-shaped members 59, so that the ring presents an upwardly extending and continuous flange 60.

A standard 62 is secured to the ring and carries feed mechanism 63, operable by transmission mechanism 64, and drive shaft 21, the mechanism 64 being adjustable for varying rates of feed to the trough 65. The standard also carries a trough element 66, aligned with the trough 65 having its lower end arranged to discharge material within the inner series of crushing rolls 30.

In addition to the standard 62, the ring 45 also carries a casing 67 which fits about the flange 60 and defines a first precipitation chamber, shown at 68. As previously described, the whirling current of air introduced through the passages 55 so as to pass over the table, entrains the particles which have been deflected into it. Due to its retardation in the first precipitation chamber 68 and to the comparative length of its spiral course, the coarser particles drop out onto the table for further crushing by the rollers. Only the finer particles in suspension are entrained from the first precipitation chamber 68.

A shell 69, flared upwardly, is secured to the upper end of the casing 67 and a conical hopper 71 is disposed coaxially of the shell 69, and held in place by suitable supports 72 so as to define a space forming a flaring conduit 73 from the first precipitation chamber 68. The lower or apical extremity of the conical hopper 71 is provided with an outlet 74 to discharge material from the hopper, onto the table and within the inner series of rolls.

An upper shell 75 is superposed on the conical shell 69 and is provided with a cover plate 76 having a centrally-disposed outlet 77 for the removal of air and suspended particles entrained thereby. An annular series of vanes 78 is interposed between the top edge of the hopper and the cover plate 76 so as to define conjointly, with the casing or housing 75 an annular admission chamber 79 in open communication with the flaring passage 73, and also so as to define conjointly with the hopper 71 and the cover 76, a second precipi-

tation chamber 80. The vanes 78 are arranged to introduce air, carrying particles in suspension, tangentially into the second precipitation chamber 80, so that the air and suspended particles may follow a whirling course within the chamber; and, be substantially retarded because of the great increase in volume of the chamber. The degree to which the suspended particles may be precipitated is determined by the length of flow of the carrying medium in the chamber 80 and upon the extent of retardation in the flow. From the above, it will be obvious that, by changing the angle of entry provided by the passages between the vanes 78, the course of the whirling current in the chamber 80 and, therefore, the distance traveled by the entrained particles may be varied, in other words, the longer their travel corresponding to a small angle of entry the greater the degree of precipitation.

It will be noted that both the fixed vanes 52 and the movable vanes 78 are arranged to define horizontal passage for the introduction of air or air carrying suspended particles, into the precipitation chambers in whirling streams, which are substantially in the horizontal plane. Also that these vanes are inclined in the same direction because the air follows a whirling course through the annular passage 73 into the admission chamber 79. Furthermore, the vanes 78 are inclined in the same direction as the vanes 52 so that they may receive the air in the admission chamber 79 with a minimum degree of resistance.

Referring more particularly to the circumferential series of vanes 78 and to the mechanism for supporting and operating the latter, it will be seen, upon reference to Figs. 10, 11 and 12, that each vane 78 is provided with upper and lower trunnions 81 and 82, respectively, the trunnions fitting in openings provided in the rings 83 and 84, respectively. The ring 83 is preferably located at the joint between the cover 76 and the upper end of the casing 75, while the lower ring 84 is supported by the upper edge of the conical hopper 71. Below the ring 84, the trunnions or pivots 82 have crank arms 85 keyed thereto, being connected by links 86 to an actuating ring 87, which constitutes the rim of a turntable, at 88.

The turntable 88 consists of the rim 87 and cross members 89 connected to a hub portion 90 having a socket 91 which fits about the upper end of the pivot support 93, the latter being maintained centrally of the hopper by cross members 94, which are connected to gusset plates 95, arranged interiorly of the conical hopper. The upper cross members 94 and the hopper or horizontal edges of the gusset plates 95 are preferably in alignment, and the lower edge of the rim 87 preferably bears against the upper edge of the gusset plates.

The turntable 88 may be revolved in either direction by means of a vertical shaft 96, having a hand wheel 97 at its upper end, while the lower end of the shaft is mounted in bearings 98 carried by a pair of cross members 94. A chain or cord 100 is connected to a pair of adjacent spokes or cross members 89 and this chain is wrapped one or more times about the shaft 96, so that, when the shaft is turned, the chain will be traversed relatively thereto and the turntable 88 will be turned.

From the above, it will be evident that the mechanism for changing the angularity of the vanes is entirely open, is of simple design, and does not have any parts which would tend to accumulate dust or parts which would be injured by dust. Also, that the arrangement permits of substantial flexibility between the actuating rim 87 and the vanes, thereby preventing any possibility of binding. Furthermore, that the weight of the turntable 88 is largely carried by the rim 87 which rests on the top edges of the gusset plates 95, so that the bearing 92 and the pivot 93 serve principally to center the turntable.

Another feature of my construction is, that the trunnions or pintles 83 are riveted to one side of each of the vanes 78, all of the pintles being secured on like sides of the vanes in the circumferential series. The turntable 88 may be actuated to move the vanes until they come in contact with the pintles, whereby it is impossible to completely cut off or restrict the flow of air and entrained solids from the admission chamber 79 to the second precipitation chamber 80. As shown, the second casing or housing 75 preferably converges upwardly so as to effect a better distribution of air between the vanes.

The apparatus as above described operates in the following manner. The outlet 77 is connected to a suitable exhaust fan, the latter discharging to a cyclone in a manner well known in the art. In the cyclone, any particles entrained from the pulverizer are dropped from the air current, so that air, substantially dust free, may enter the housing 14 through the air trunk 15. It will, therefore, be apparent that, in the pulverizer, the velocity of the air successively drops, being at a maximum in the passage 55 and being retarded in the precipitation chamber 68. The increased velocity of the air passing through the tangential passages 55 moves material inwards, as previously described. On leaving the second precipitation chamber 68 it entrains dust particles to an extent, depending on its velocity and the duration of its passage through the second precipitation chamber. In this manner the particles will move outwardly across the revolving table 19 and, on reaching its outer edge, will be returned to the table by the incoming whirling stream of air, whereby those particles that are not

entrained drop back on to the table for further grinding.

The annular flaring passage 73 has preferably a substantially constant area of flow from end to end, said area being smaller than the cross sectional area of the precipitation chamber 68 but greater than the total inlet area of the passage 55. The air carrying suspended particles, increases in velocity in its travel out of the precipitation chamber 68 up the passage 73 to the admission chamber 79. On entering the second chamber 80 this velocity is considerably diminished and furthermore, the air is subjected to some degree of rarefaction in the free space of the chamber.

Due to the angularity of the vanes 78, the air enters the chamber in a more or less tangential direction, and, because of its lateral confinement in a cylindrical chamber, is caused to whirl therein in an annular course, the extent of which may be varied by changing angularity of the vanes from a tangential to an arcuate direction. Particles in suspension in the current of air are, in consequence, subjected to the combined effects of retarded velocity and decreased density of the carrying medium, whereby their sedimentation from the medium is promoted. In view of the rotation of the air current there is, however, a tendency for the particles to also travel outwards towards the periphery of the whirling current. This would result in a return and consequent accumulation of solids in the vane passages, if the vanes were not set in angular fashion in the manner already described. In actual operation, that portion of the material which does pass to the periphery of the whirling current, merely slides down the flat surfaces of the vanes immersed in the current and is collected in the hopper, together with the other precipitated material, and passes back to the table for further grinding, by means of the outlet 74.

Certain advantageous features are attained by my design, principally its dust proof character and its ability to grind material to an intensive degree and at a high capacity, in spite of the comparatively restricted space occupied by the pulverizer. The latter is due to the passage of air through the grinding stage and through the chambers in the horizontal plane, and to the rotary movement imparted to the air current in the chambers.

While it is old to provide a plurality of precipitation chambers in connection with a pulverizer of the present type, this broad arrangement being shown in my Patent No. 1,480,767, it is apparently new to provide upper and lower precipitation chambers in combination with means for obtaining horizontal whirling effects in each chamber. The arrangement, I have shown, presents the further novelty of having its upper vanes adjustable about their vertical axes, in a manner

which avoids any tendency in the material to bank against the vanes, as has hitherto been the case with pulverizers of this general type.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon, as are imposed by the prior art or as are specifically set forth in the appended claims.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. In a pulverizer, the combination of a rotatable table having a conically dished portion and a flat border portion, crushing rolls cooperating with the dished portion, means for passing a current of air about the edge of the table, and a deflector member extending inwardly, over, above and substantially parallel with respect to the flat portion of the table for deflecting air inwardly and directly over the latter.

2. In a pulverizer, the combination of a rotatable table having a conically dished portion and a flat border portion joined by an annular portion having a substantially vertical offset annular wall, crushing rolls cooperating with the dished portion, means for passing a current of air about the edge of the table, a deflector member extending inwardly, over, above, and substantially parallel with respect to the flat portion of the table for deflecting air inwardly and over the latter, and agitator means cooperating with the table for agitating material collecting in the annular corner formed by the wall.

3. In a pulverizer, the combination of a rotatable table having a conically dished portion and a flat border portion, a member extending over the flat portion and having channels directed tangentially of the table, said channels being open at the bottom and extending directly over the flat portion.

4. In a pulverizer, the combination of a rotatable table, rollers resting thereon and rotated thereby, a housing member surrounding the table and having a portion extending over and above the outer edge thereof and forming an annular inlet passage for air, and vanes disposed tangentially of the table and carried by the upper overhanging portion of the housing and defining open-bottomed tangential passages partially covered by the table and communicating with an annular air supply passage.

5. In a pulverizer, the combination of a rotatable table having a conically-dished portion and an annular flat portion joined by an annular portion having a substantially vertical wall, crushing rolls resting on and rotated by the dished portion, means cooperating with the annular flat portion of the table for pass-

ing inwardly-directed tangential streams of air thereover, and deflector means cooperating with the table to deflect material collecting adjacent to the wall into the air streams.

6. In a pulverizer, the combination of a supporting housing member, a rotatable table carried by the housing member, crushing rolls resting on and rotated by the table, an annular housing member, carried by the supporting housing member and having vanes at its underside extending inwardly and tangentially of the table, means for supplying air under pressure for passage between the vanes and against the table, and means for conducting air and material in suspension away from the table.

7. In a pulverizer, the combination of a rotatable table having a conically-dished portion and an upwardly offset flat portion joined by an annular portion having an annular vertical wall, crushing rolls resting on and rotated by the conically-dished portion, means for feeding material to be crushed onto the dished portion of the table, a housing construction surrounding the table and having a portion which overhangs the flat portion of the table, vanes carried by the overhanging portion and having the inner portions of their lower degrees disposed contiguously to the flat portion of the table, said vanes extending inwardly and tangentially of the table, means for inducing air under pressure for passage inwardly between the vanes and against the table, deflector means for deflecting material collecting on the table adjacent to the vertical annular wall into the tangential air streams, and means for conducting air and material in suspension away from the table.

8. In a pulverizer, the combination of a rotatable table adapted during rotation to move material outwardly thereon, crushing means operatively engaging the table, the table having an outer region not engaged by said crushing means, means directly over said outer regions of the table for directing inwardly moving streams of air, and mechanical means for agitating the material in said outer regions.

In testimony whereof I hereunto affix my signature.

OTTO A. KRUEZBERG.

CERTIFICATE OF CORRECTION.

Patent No. 1,806,980.

Granted May 26, 1931, to

OTTO A. KREUTZBERG.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, line 94, claim 7, for the word "degrees" read edges; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of July, A. D. 1931.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.