D. O. MARKS.

CENTRIFUGAL IMPACT PULVERIZING APPARATUS.

APPLICATION FILED DEC. 17, 1907.

994,596. Patented June 6, 1911.

2 SHEETS—SHEET 2.

Fig. 4

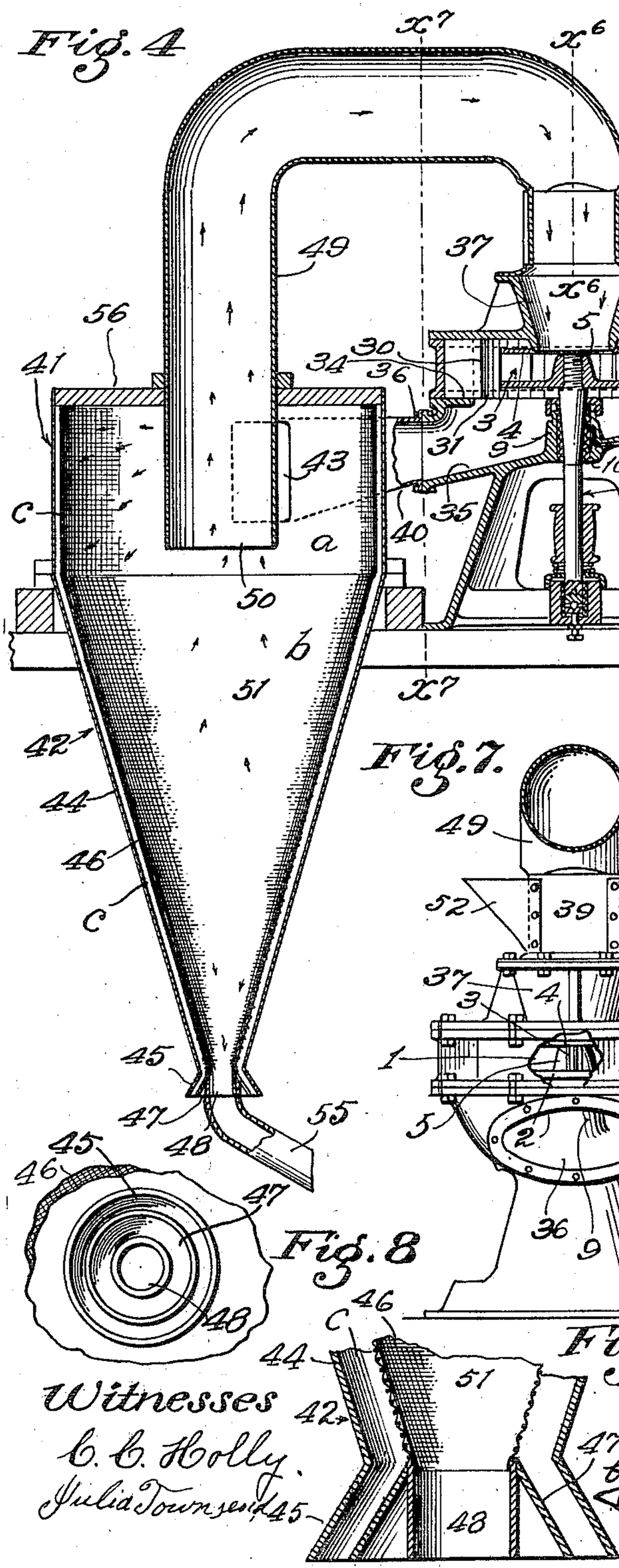


Fig. 6.

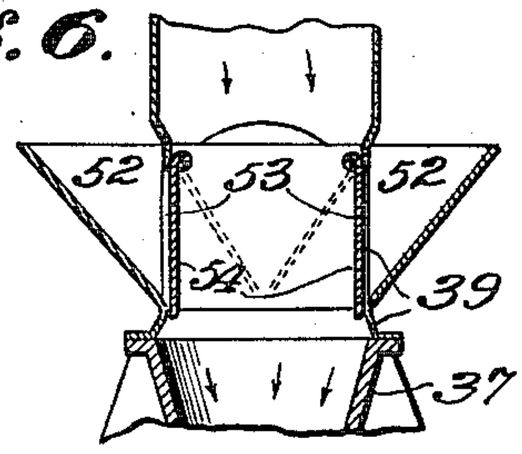


Fig. 5.

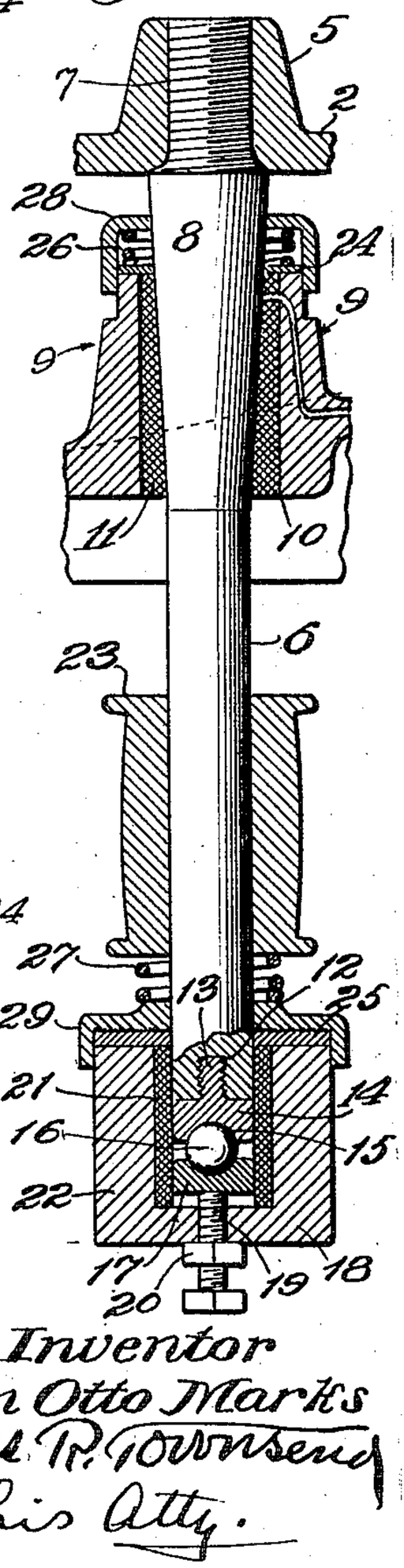


Fig. 7.

Fig. 8

Fig. 9

Witnesses
C. C. Holly.
Julia Townsend.

Inventor
Donn Otto Marks
by James P. Townsend
his Atty.

D. O. MARKS.

CENTRIFUGAL IMPACT PULVERIZING APPARATUS.

APPLICATION FILED DEC. 17, 1907.

994,596.

Patented June 6, 1911.

2 SHEETS—SHEET 1.

Fig. 1

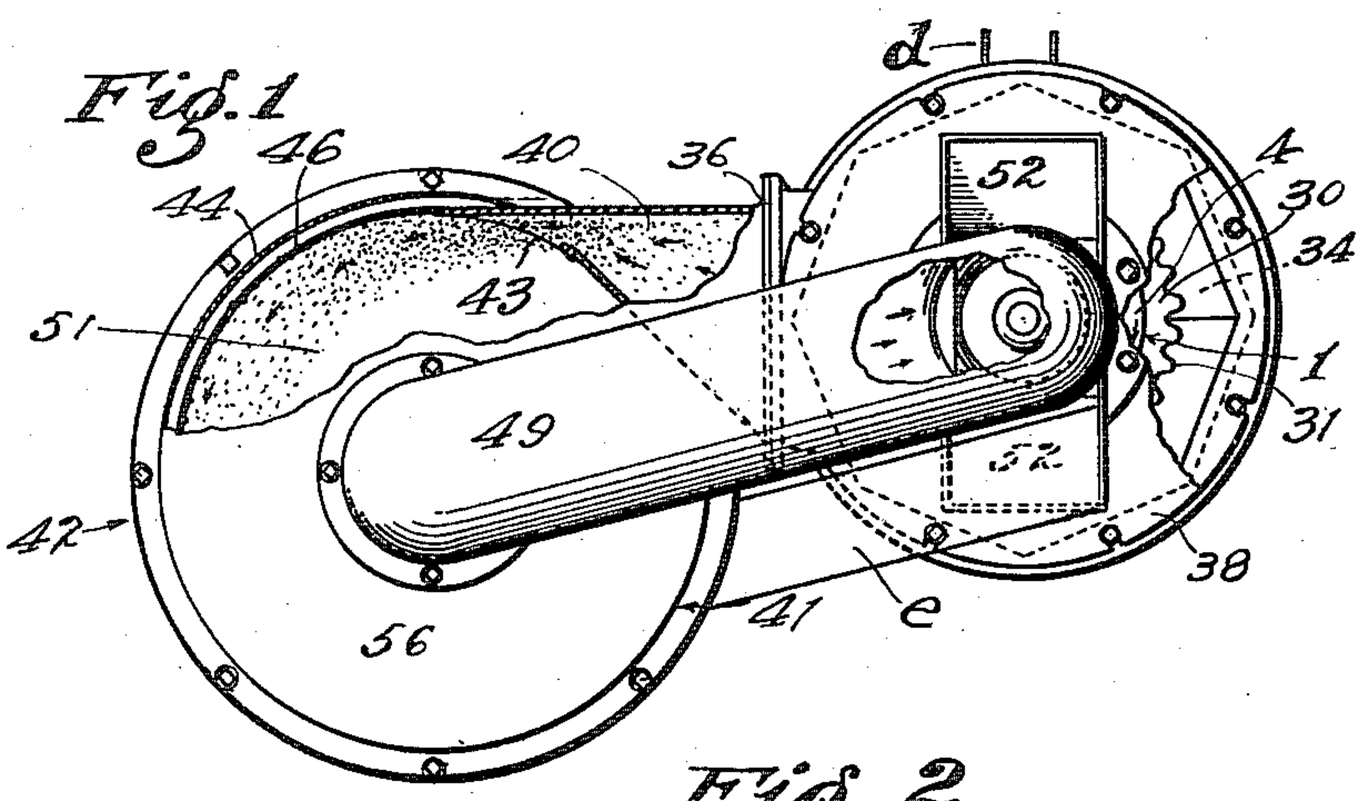


Fig. 3

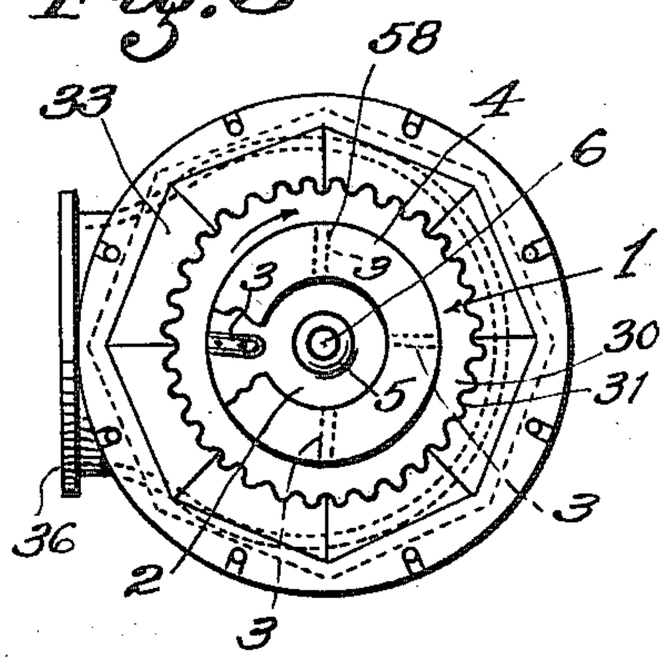


Fig. 2

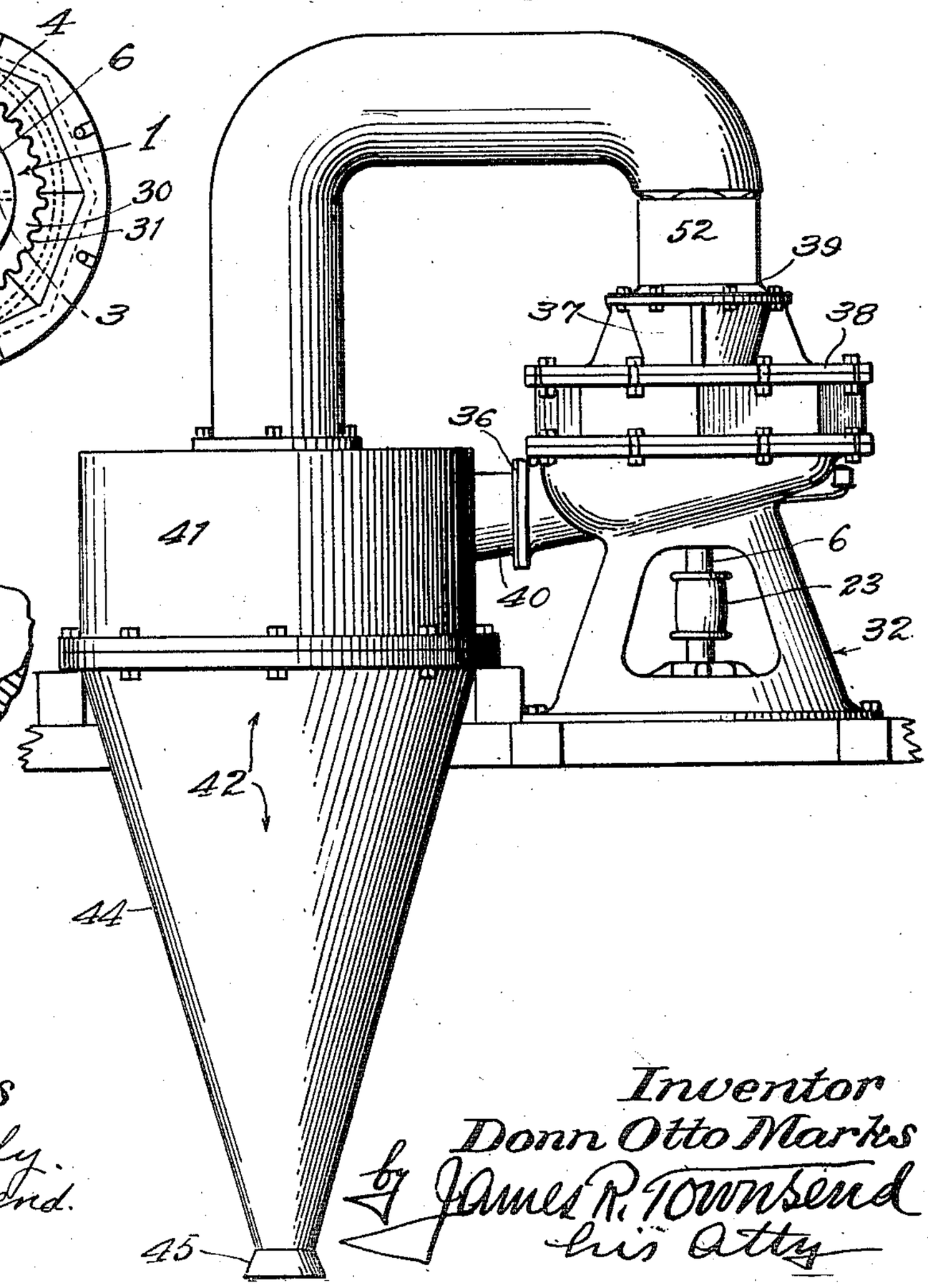
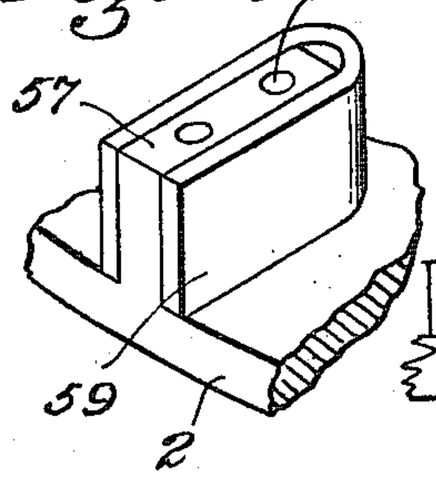


Fig. 10.



Witnesses

C. C. Holly.

Julia Townsend.

Inventor

Donn Otto Marks

by James R. Townsend

his Atty

UNITED STATES PATENT OFFICE.

DONN OTTO MARKS, OF DENVER, COLORADO, ASSIGNOR TO THE MARKS PULVERIZING, MINING AND MILLING MACHINERY CO., OF DENVER, COLORADO, A CORPORATION OF COLORADO.

CENTRIFUGAL IMPACT PULVERIZING APPARATUS.

994,596. Specification of Letters Patent. Patented June 6, 1911.

Application filed December 17, 1907. Serial No. 406,953.

To all whom it may concern:

Be it known that I, DONN OTTO MARKS, a citizen of the United States, formerly residing at Los Angeles, California, now a resident of the city and county of Denver and State of Colorado, have invented a new and useful Centrifugal Impact Pulverizing Apparatus, of which the following is a specification.

This invention relates to an apparatus designed for pulverizing substances of many kinds by impact of the same upon a corrugated wall against which said substances are impelled by centrifugal force from a rotary impeller; and relates to the further treatment of such substances by centrifugal force for the purpose of delivering the product in assorted sizes for subsequent treatment.

The apparatus is designed for alternative operation upon either wet or dry materials as occasion may arise, without any change in the construction or adjustment of the machine, and to perform the operation, without inconvenience or injury from dust, upon dry substances capable of being reduced to impalpable powder; and also to produce sloppy material like the pulp from stamp mills.

An object of the invention is to avoid excessive wear and to readily replace or compensate for any wear that may occur in any of the parts of the apparatus.

Other objects are effectiveness, cheapness, simplicity, compactness, convenience of operation, and avoidance of air friction and resistance within the pulverizing chamber.

The accompanying drawings illustrate the invention.

Figure 1 is a plan view of apparatus embodying this invention, portions being broken away to expose interior construction. Fig. 2 is a side elevation of the apparatus omitting the spout through which the coarser product may discharge from the separator, and also the elevator and belt shown in Fig. 1. Fig. 3 is a broken plan of the impeller-chamber with corrugated walls and a rotary impeller therein, a portion of which impeller is broken away to expose parts that would otherwise be concealed. Fig. 4 is a vertical, sectional elevation of the apparatus. Fig. 5 is an enlarged fragmental detail of the mounting for the rotary impeller. Fig. 6 is a fragmental, sectional detail on line x^6—x^6, Fig. 4. Fig. 7 is a sectional elevation on line x^7, looking into the mouth of the impeller-chamber. The wall of said chamber is broken to expose inside parts. Fig. 8 is a fragmental view to show the mouths of the separator. Fig. 9 is an enlarged sectional detail of the lower end of the separator. Fig. 10 is an enlarged perspective detail to illustrate an impeller-shoe in place on one of the radial walls or blocks, a fragment of the impeller being shown.

1 designates in a general way a rotary impeller provided with a horizontal base plate 2, upright, flat, radial impeller faces 3, an annular top plate 4, and a central hollow internally-threaded initial impulse hub or post 5 that rises from the base plate 2 and terminates approximately at the level of the top plate 4 to leave an unobstructed annular opening between the post 5 and the inner edge of the annular plate 4 and the inner ends of the impelling faces 3.

6 is the vertical impeller-shaft provided at its upper end with a threaded arbor 7 onto which is screwed the plate 2 and hub 5. A portion 8 of said shaft immediately below the arbor 7 tapers downwardly for adjustment in the upper shaft-bearing 9 which is provided with a cylindrical bore 10 that is filled with babbitting 11 around said tapering portion to form a bushing therefor. The portion of the shaft below the tapering portion 8 is cylindrical, and its lower end is provided with a screw-threaded socket 12, to receive a screw-threaded stem 13 of a hardened steel foot 14, which forms the lower end of the shaft 6 and is provided with a semispherical cavity 15 to rest on an antifriction hardened steel ball 16, which is carried by an adjustable hardened steel plate 17 arranged to move vertically in the bear-

ing-way 18, in which it is adjustably held by a screw 19 fixed by a jam-nut 20.

21 is babbitting for the lower bearing 22 through the bottom of which bearing the screw 19 screws.

23 is a pulley fixed on shaft 6 to rotate the same.

d is a belt to drive the pulley.

24, 25 designate upper and lower dust-excluding washers preferably made of felt and tightly fitting the shaft 6 above the top and bottom bearings therefor. These washers are held compressed by resilient means, as the springs 26, 27, operable by the shaft 6, the spring 26 being compressed by a cap 28 fixed to said shaft and inclosing and movable up and down on, and tightly fitting the upper reduced end of the bearing 9, while the spring 27 is compressed by the pulley 23 onto a cap 29 which incloses and slides up and down on the upper portion of the lower bearing 22, and tightly compresses the felt washer 25 around the shaft 6. By the means thus shown the upper and lower bearings are protected from dust, and the shaft and its rotary head or impeller are made adjustable vertically, thus to compensate for any wear that may occur in the upper bearing where wear is most liable to occur, and where it causes the greatest derangement when it does occur.

30 designates a chamber with corrugated walls 31 within which the impeller 1 rotates. Said chamber is formed inside the upper body of a frame 32 which carries the upper and lower bearings 9 and 22, and is of considerable depth below the corrugated walls 31 which are preferably formed in removable segments 33 and rest upon a ledge 34 in said frame. The floor 35 of the chamber slants from one side of the chamber to the outlet mouth 36 which is of considerable width so as to allow the material crushed by impact with the wall 30 to pass out freely below said wall.

37 is a hopper cast in a single piece with the top plate 38 of the frame 32. The lower edge of the hopper 37 extends into the unobstructed annular opening between the upper end of the post 5 and the inner edge of the annular plate 4 as the post 5 is adjusted up and down.

39 is a chute to discharge into said hopper.

40 is a conduit leading from the horizontally-distended discharge mouth 36 of the chamber to the cylindrical upper portion 41 of a frusto-conical screening and separating device 42. This conduit 40 is gradually reduced in its horizontal dimensions and distended in its vertical dimensions toward the outlet mouth 43 thereof, which discharges into the interior of the separator 42 so that the pulverized material will enter the separator tangentially. Said separator 42 comprises an exterior frusto-conical imperforate shell 44 having a flaring annular outlet mouth 45 at the bottom.

46 is a foraminate screen-like inner wall within the imperforate shell 44, the same terminating in a flaring imperforate portion 47 having a downwardly-opening tubular outlet 48 to discharge from the bottom of the inner screen-chamber any material that does not pass through the screen.

49 is a pipe having an intake mouth 50 inside the screen-chamber 51 below the level of the mouth 43 of the conduit 40. Said pipe extends upward from said mouth 50 and opens into the chute 39. Said chute is provided with open-topped feed entries or inlets 52 which communicate through valved ports 53 with the interior of the chute 39. Said ports are yieldingly closed by swinging doors 54.

In practice, the impeller is driven in a determined direction, as indicated by the curved arrow in Fig. 3, and the forward upright faces 3 of the impeller are arranged in a plane radial from the axis of the impeller, so that when any material enters the annular space in the rotating impeller between the annular plate 4 and the hub 5, the motion imparted thereto by the hub and base plate will cause the material to flow outward by centrifugal force until caught by an impeller face 3, whereupon the material is instantly put into motion at a high speed and therefore flies off from the impeller at a tangent, strikes the corrugated wall, and is thereby pulverized. At the same time, the impeller faces 3 operate in the nature of a blower so that a strong blast of air is thrown from the impeller and passes outward and downward underneath the corrugated wall and out the mouth 36 through the conduit 40 and into the screen-chamber 51 of the separator at the cylindrical top thereof.

By reason of the tangential arrangement of the mouth 43, quite clearly shown in Fig. 1, the material passing from the conduit 40 is directed in a circular path around the cylindrical portion *a* of the screen 46 and tends to fly outward. At the same time the force of gravity draws the particles downward onto the conical portion *b* of the screen-wall 46 around which the material will pass in a spiral course as it passes downward to the outlet-tube 48. By this construction and arrangement the material which enters the screen-chamber 51 is constantly acted upon by forces which tend to cause such material to pass through the screen into the outer chamber *c* between the screen 46 and the shell 44. When the material passes into the open space *c* it is guided downward in-

wardly by the outer shell 44 until it finds egress through the annular mouth 45. The material that is too coarse to pass through the screen, flows down and out at the tube 48. In this way the finer material will be discharged at one place and the coarser material at another.

55 designates a spout leading from the tube 48 to carry the coarser material out through the path of the finer material which may flow in an annular stream out of the mouth 45.

e in Fig. 1 designates the conveying tube of any well-known form of elevator for returning the over-size material from spout 55 to one of the feed entries 52.

56 is a removable cover for the chamber of the separator. By removing the pipe 49 and the cover 56, the screen 46 with its outlet tube 48 may be removed.

In practical operation the impeller will be rotated at a high speed, say, 2500 revolutions more or less per minute, thereby insuring high efficiency as to the comminuting action, and also great capacity for speedily handling large quantities of material.

The material to be pulverized or comminuted may be fed in at the hopper-like openings 52 down the slanting floors of which it will pass by gravity, forcing the swinging doors 53 inward, whereupon the material will flow into the chute 39 and hopper 37, and thence into the opening within the annular top-plate, and onto the hub and base-plate of the impeller where it will partake of the motion of said impeller and will thereby be driven tangentially in a horizontal course against the corrugated wall 31 from which it will pass downward and outward through the peripheral outlet 36, being impelled both by the force of gravity and by the air blast from the impeller, and thence at a very high rate of speed through the vertical slot-like outlet 43 tangentially into the separator where it whirls around and around, circling downward in a spiral course, the finer portions passing through the screen 46 and discharging at the annular mouth 45, while the coarser material passes down to and through the tube 48 and out through the spout 55, and thence to the elevator *e* and then to the feed-entry 52. During this operation the dust-laden air passes up out through the pipe 49 and down into the impeller-head by which it is again impelled as before, thus effecting a continuous circulation of air within the machine without escape of the dust-laden air exteriorly. The dust contained in the air thus returned to the impeller may now find its way through the screen 46 and thence out through the mouth 45. The downwardly-tapering separator causes the fine and coarse material to separately discharge within a small radius, so that the same may be readily directed where required.

Owing to the high speed of rotation of the impeller-shaft it is important that the upper bearing thereof shall not at any time be loose. When the impeller is first installed the adjusting screw 19 is fully screwed up, thus holding the impeller head at its upper limit. The chamber in which said head rotates is of greater depth than the head, thus allowing the operator to screw the adjusting screw downward to lower the impeller-shaft from time to time to compensate for wear and to bring the tapering portion 8 to seat snugly in the babbitting.

The tendency to wear loose is greatest at the upper bearing, and therefore the lower bearing and the lower journal of the impeller-shaft are made cylindrical, thus to allow the shaft to move freely up and down therein. When the shaft has reached its lowest limit of adjustment the screw may be screwed up again, thus bringing the shaft to its highest position, whereupon the bearings may be rebabbitted. Bushings of any suitable material may be substituted for the babbitting 10 and 21 when desired.

The base-plate 2 of the impeller may be provided with blocks 57 to which the annular top-plate 4 may be fastened by screws or bolts 58. On these blocks may be mounted reversible U-shaped shoes 59 having semi-cylindrical heels 60 at the inner margin of the top-plate 4, the purpose being to make the impeller faces easily renewable. The shoes may be inserted into and withdrawn from the hollow impeller and applied to the blocks through the annular opening inside the top-plate 4.

The central post tapers upwardly from the base plate to approximately the level of the top plate, and the inner ends of the impeller faces terminate approximately at the inner circular rim of the top plate, so that an annular unobstructed open space is provided around the post 5 so that material which may fall on or strike the post may be given a rotary impulse thereby, which may be imparted to much of the material fed into the opening in the top plate before the same reaches the base-plate, and in consequence, the material is started to rotate before being caught by the impeller faces and before reaching the level of the base-plate. This tends to cause an even distribution of the material from top to bottom of the vertical impeller faces and the portion of the impact wall that receives the discharge from the impeller.

It is to be understood that by reason of the high speed at which the impeller faces revolve, the material which reaches said

faces is discharged therefrom at a speed many times greater than that at which the force of gravity under ordinary circumstances will feed material to the impeller. That is to say, in the apparatus shown in the drawings, the material may, under the force of gravity, travel downward at the rate of about 16 feet per second, which is far less than the speed at which the material will be thrown outward by the action of the impeller. Consequently, there is never any accumulation of material in the impeller.

The impeller including the base plate, the hollow post, the top plate, and vertical blocks carrying the faces 3, may be cast in a single piece, as indicated in Fig. 4; or, if desired, the top plate may be secured to the bottom plate by bolts or screws *d* in said blocks, as indicated in Fig. 10.

What I claim is:—

1. In a centrifugal impact pulverizer, a frame provided with a chamber having a central inlet at its top and having a peripheral outlet at its bottom and having an annular impact wall, a rotary impeller inside of said chamber and comprising a base-plate provided with upright radial impeller faces extending upwardly and a central post spaced apart from said faces and extending upwardly and terminating approximately at the level of the tops of said impeller faces and forming an unobstructed open space around said post; an annular top plate above said impeller faces, a hopper discharging into said chamber, the lower edge of said hopper extending into the unobstructed annular opening between the upper end of the post and the inner edge of the annular plate as the post is moved up and down by the adjustment of the shaft, and means to adjust the shaft up and down.

2. In a centrifugal impact pulverizer, the combination of a frame provided with upper and lower bearings, and having a chamber above said bearings, and having a central inlet into said chamber and having a peripheral outlet at the bottom of the chamber, an annular impact wall formed in the chamber above said outlet and below the level of the inlet; a vertical shaft provided with a downwardly tapering portion in the upper bearing, and with a cylindrical portion in the lower bearing, babbitting in the upper bearing to fit said taper portion, a rotary impeller on said shaft in said chamber and spaced apart from said wall, and adjustable means for lowering said shaft to different heights to take up the wear in said upper bearing, said impact wall being adapted and arranged to receive the discharge from said head at various heights of adjustment.

In testimony whereof, I have hereunto set my hand at Denver, Colorado, this seventh day of December, 1907.

DONN OTTO MARKS.

In presence of—
LYNN S. ATKINSON,
A. RAND.