Feb. 28, 1939. P. B. BUCKY 2,148,529

DEVICE FOR CRUSHING AND PULVERIZING MATERIALS

Filed June 30, 1937 3 Sheets-Sheet 1

Fig. 1.

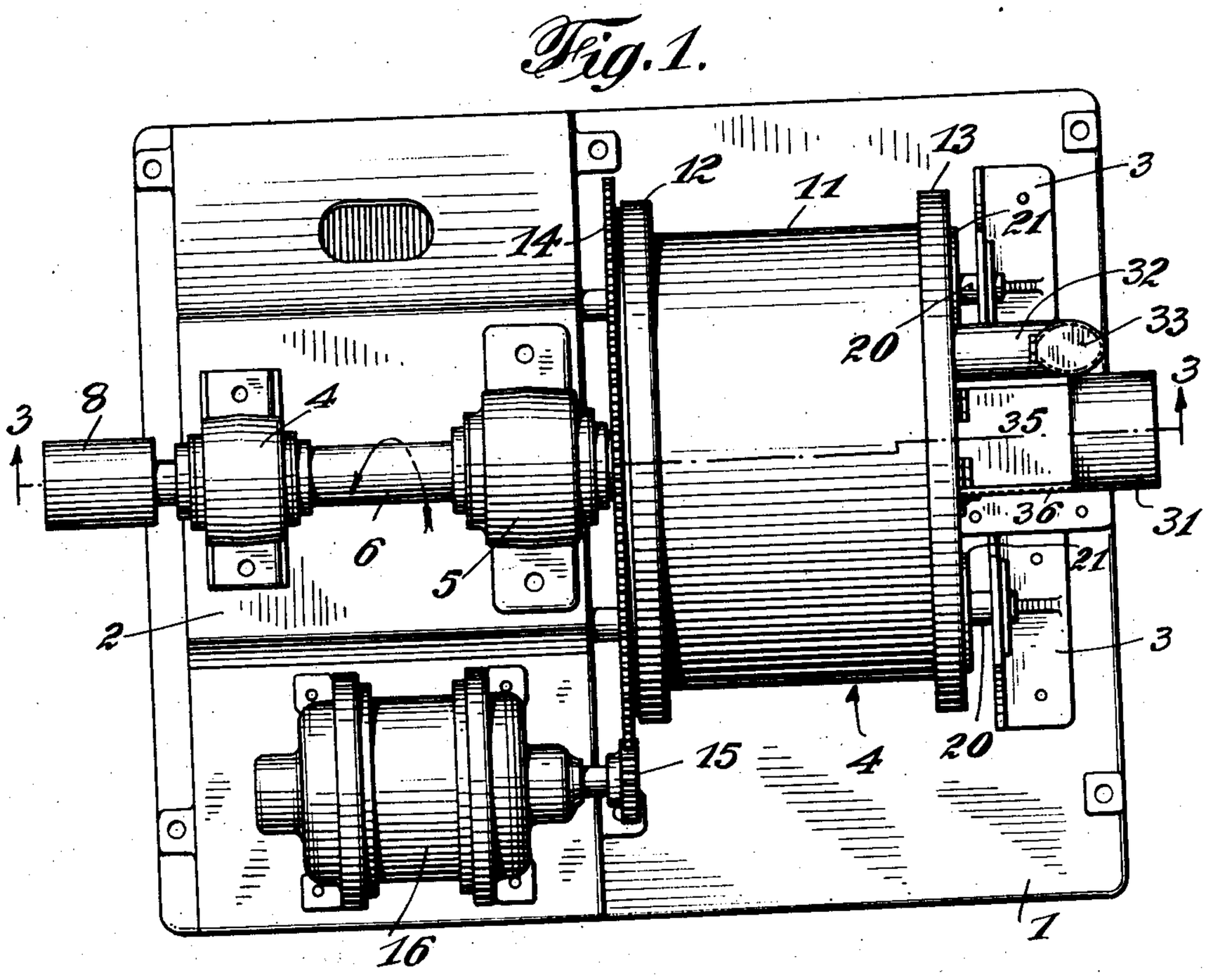
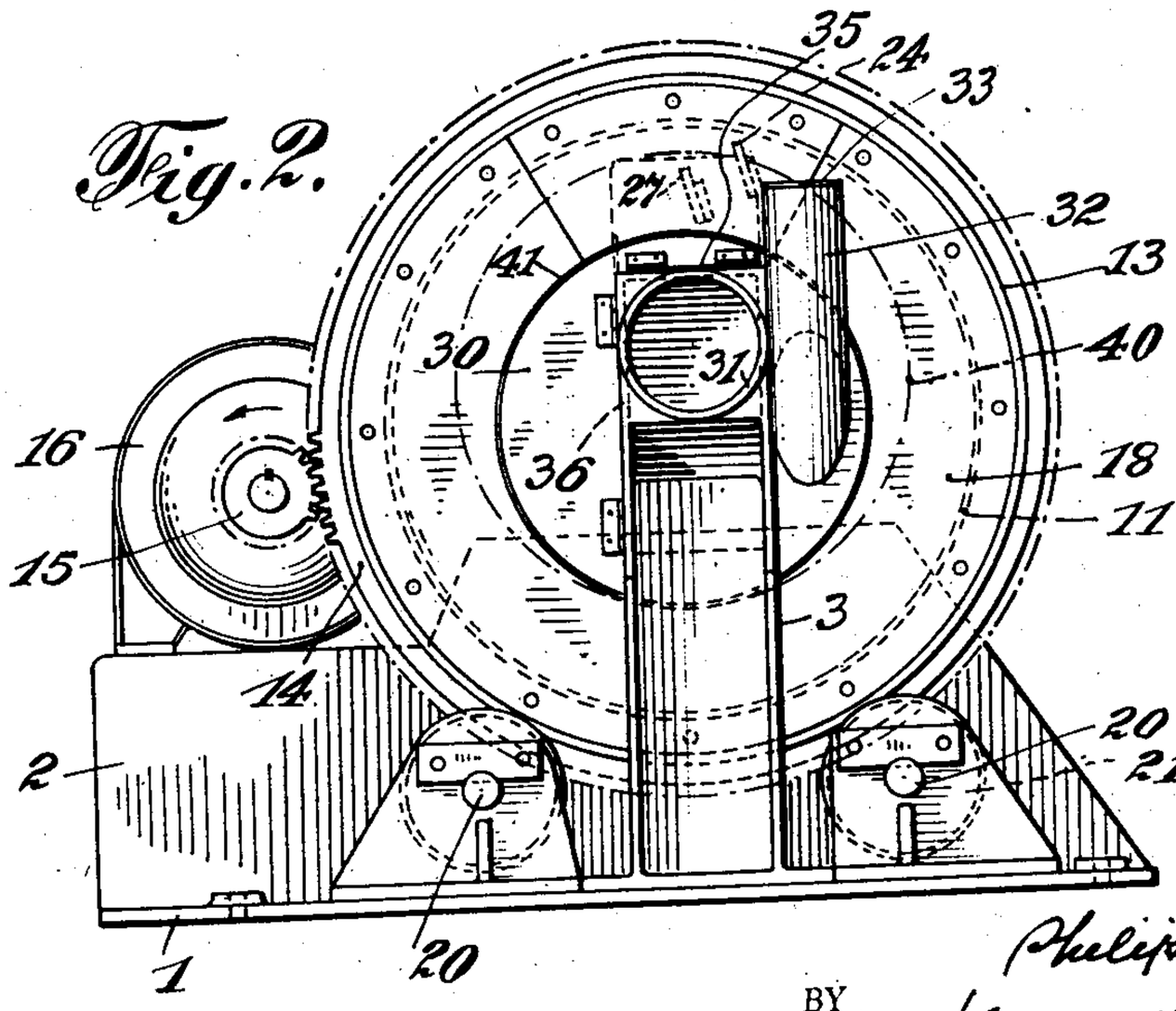


Fig. 2.



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DEVICE FOR CRUSHING AND PULVERIZING MATERIALS

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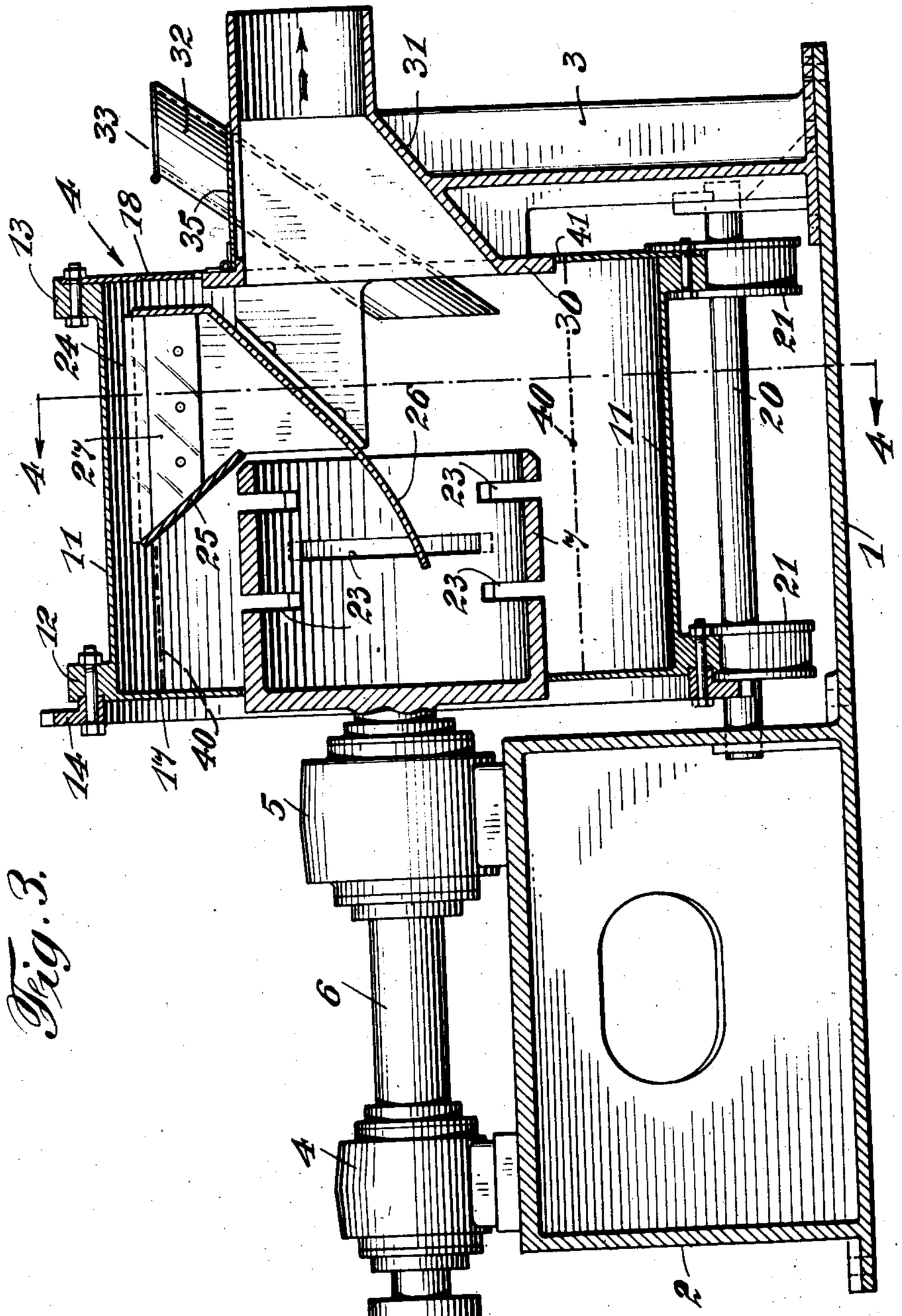

Fig. 3.

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DEVICE FOR CRUSHING AND PULVERIZING MATERIALS

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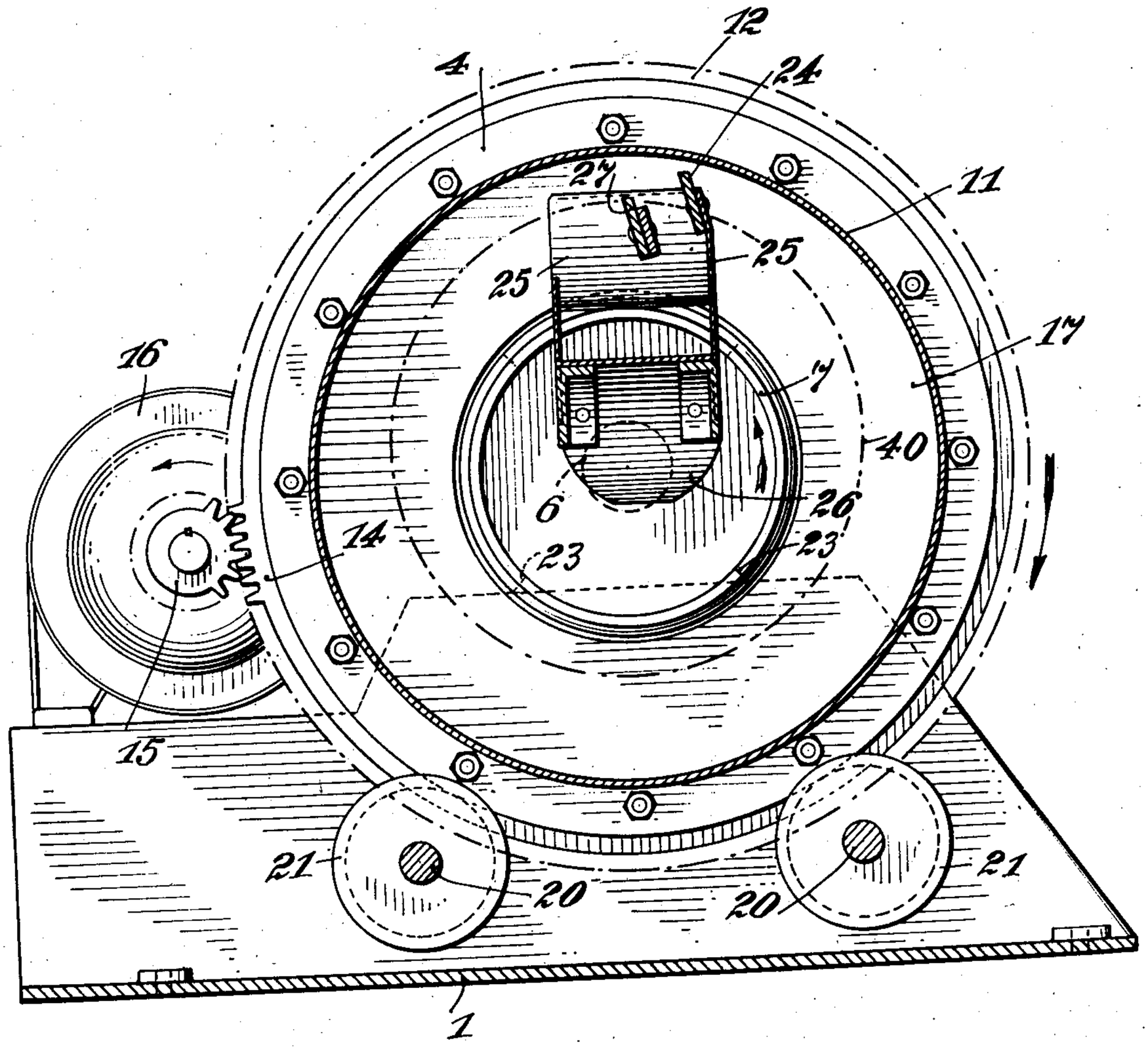
Fig. 4.



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Patented Feb. 28, 1939

2,148,529

UNITED STATES PATENT OFFICE

2,148,529

DEVICE FOR CRUSHING AND PULVERIZING MATERIALS

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Application June 30, 1937, Serial No. 151,110

6 Claims. (Cl. 83—46)

My invention relates to a process of crushing and pulverizing materials and to a machine for carrying out such process, and refers more particularly to such processes and machines of the centrifugal type.

One of the principal objects of my invention is a simple and efficient process for pulverizing material capable of being applied to the crushing of a wide variety of materials, such as quartz, coal, sulphur and the like.

Another object of my invention is to provide a cheaply and compactly constructed machine of large capacity for its size, capable of operating at high speed and having its bearing surfaces wholly outside the pulverizing chamber so that the dust resulting from its operation does not reach such surfaces and cause wear.

Other desirable attributes of my invention will hereinafter appear.

In carrying out the process of my invention, fragmentary material is reduced to the desired degree of fineness by projecting it against the interior surface of a drum rotated at a speed such that the centrifugal force at such surface is in excess of that of gravity, removing material pressed against such surface by centrifugal force, and re-projecting it against such surface. This cycle of operations is repeated until the particle size has been reduced sufficiently to permit the material to be carried away by a cross-current of air.

More particularly in accordance with my invention, the fragmentary material is thrown obliquely against the inner surface of the drum by centrifugal force in a direction opposite to that in which the drum is rotating so as to produce the maximum crushing impact. Further, to reduce wear on the drum and at the same time ensure that substantially all the energy of the centrifugally produced crushing impact shall be utilized in breaking up the particles, part only of the material pressed against the interior of the drum is removed and returned to the projecting means. The particles thrown outwardly strike, not the inner surface of the drum, but a layer of particles to be pulverized, so that, by the impact, both sets of particles are crushed and abraded simultaneously.

A machine for carrying out my invention may comprise two concentric rotating drums, an outer relatively low speed drum, and an inner relatively high speed drum, preferably rotated in the opposite direction to the outer drum, and a scraper and chute for removing the excess of material pressed against the inner surface of the outer drum by centrifugal force and delivering it to the interior of the inner drum.

More particularly, in such a machine, both drums are supported and driven by means wholly external to the pulverizing chamber, and the cross-current of air is produced by suction, so that dust produced by the pulverizing action cannot reach the supporting and driving machines and cause wear.

The centrifugal pulverizer of my invention also includes various features of construction and combinations of parts, as will appear from the following description and the appended claims.

For further description, reference will now be had to the accompanying drawings, illustrating a practical embodiment of my invention, similar parts being designated by similar reference numerals, and in which:

Figure 1 is a top plan view of a pulverizer embodying my invention.

Figure 2 is an end view of the same from the right-hand side of Figure 1.

Figure 3 is a vertical longitudinal section on the line 3—3 of Figure 1.

Figure 4 is a vertical transverse section on the line 4—4 of Figure 3.

The practically workable exemplification of the pulverizer of my invention will now be particularly described as to its construction and manner of operation.

A base 1 is provided with two pedestals 2 and 3 between which is rotatably mounted a drum 4. On the pedestal 2 are ball, roller, or other high-speed bearings 4 and 5 for a shaft 6, carrying a drum 7 at one end and a driving pulley 8 at the other.

The drum 4 comprises a cylindrical shell 11 having flanges 12 and 13 at its ends. To one of these flanges, as 12, is secured a toothed ring 14 for engagement with a pinion 15 driven by a motor 16. The drum 4 also has annular ends 17 and 18, the end 18 being detachably secured to its adjacent flange 13 so that it can be detached when it is desired to insert or remove the scraper to be later described.

These flanges, in addition to aiding in the uniting together of the various parts of the drum, have the further, and, in fact, their chief, function of acting as the supporting means for the drum. Between the pedestals 2 and 3 and having their ends journaled therein are two shafts 20. On each of these shafts are a pair of wheels 21 having peripheral grooves wide enough to receive the flanges 12 and 13 respectively. So

mounted, the drum 4 is free to be rotated by the motor 16.

The drum 7 is mounted in the central aperture in the end 17 for rotation about the same axis as the axis of rotation of the drum 4. The outer end of the drum 7 is closed so that it acts as a closure for the aperture in the end 17. The small gap around the periphery of the drum 7 serves to permit the air to be drawn into the interior of the drum 4 and produce the desired cross-current of air for carrying away the material acted upon when the particle size has been reduced sufficiently to enable it to be air-borne.

In the periphery of the drum 7 are one or more apertures, or, as shown, slots 23 through which material introduced into the interior of the drum is thrown by the centrifugal force produced by the rotation of the drum. For a machine between twice and three times the size shown on the original patent drawings, a suitable speed of rotation is 3000 to 8000 R. P. M. or more depending on the material used. The drum 4 is preferably rotated in the opposite direction at any speed more than sufficient to produce a centrifugal force on particles at its inner periphery in excess of that of gravity. As a result, particles thrown from the drum 7 against the inner face of the shell 11 tend to be held there by centrifugal force.

To return such particles to the interior of the drum 7, a scraper 24 is provided at the rear edge of a hopper 25 at the bottom of which is a chute 26, extending into the open mouth of the drum 7. To take a part of the work off the scraper 24, a second scraper 27 may be placed in front of it but set further away from the shell 11.

It will be noted that the scraper 24 does not extend the full length of the drum 4, so that material thrown out through the left-hand set of slots 23 will build up in the corner between the end 17 and the shell 11 until the angle presented by such layer is sufficient to permit further additions of material to slide or roll towards the scraper. Further, the scraper 24 is set so that the inner layer only of the material pressed against the shell 11 is removed thereby. The result of this construction is that the shell is always covered with a layer of material to be further crushed, so that the impact resulting from the projection of particles from the drum 7 is substantially wholly between two sets of particles and rarely, if ever, between one set of particles and the inner wall of the shell 11.

The circular central opening in the end 18 of the drum 4 is closed by a disk 30 attached to or made integral with the pedestal 3. Extending outwardly from this disk is a casing or pipe 31 leading to any suitable dust separator and exhaust fan or the like (not shown). To one side of the casing and passing through the disk is an inclined tubular chute 32 for the admission of material to be pulverized. A lid 33 prevents entry of air when material is not being introduced into the machine.

It will be noted that the supporting and driving means for both drums are outside of the pulverizing chamber, and as the flow of air is into such chamber and out through the suction pipe there is practically no possibility of dust from the pulverizer reaching such supporting and driving means.

Explosion doors 35 and 36 may be provided, as shown, if desired.

The process and machine are admirably adapted for pulverization with the aid of hard balls, or hard rock, since when such balls or rocks are used they are thrown by the drum 7 with great force against a bed or layer of material to be pulverized.

The operation is as follows:

The drums are placed in rotation, the suction fan started, and then a charge of material is introduced through the tubular chute 32. This material is carried around by the drum 4 until it strikes the scrapers 24 and 27, when it drops down through the hopper 25 and is deflected by the chute 26 into the interior of the drum 7 and discharged therein along its length. The material travels inside the drum until it comes opposite one or other of the slots 23, or the edge, when it is thrown out tangentially at high speed to impact the layer of material traveling around on the interior of the shell 11. Any fine dust produced by such impacts becomes suspended in the air in the drum, which is continuously flowing from the annular space between the end 17 and the drum 7 towards the suction pipe 31. Some air enters through the annular space between the end 18 and the disk 30, but such air short-circuits around into the suction pipe without taking any vital part in the removal of the dust.

Material too coarse to be air-borne accumulates on the inside of the shell 11 until it is once more scraped off and returned to the interior of the drum 7. The cycle of operations is repeated until the particles have all been reduced to a size small enough to permit them to be carried away by the longitudinal flow of air through the drum 7.

When it is desired to employ my device in the wet crushing of material, water and the material to be crushed are introduced into the device through the chute 32, and the drum element revolved at a speed which will maintain the surface of the water in the position shown by the dot-and-dash line 40, additional water escaping through the space 41 between the members 18 and 31 and into any conveniently positioned receptacle, the escaping water carrying off the finely ground material. During this operation, additional water may be introduced through the chute 32, if desired.

It is evident that suitable means other than the one described may be employed for the removal of the water and finely ground material.

It is obvious that various modifications may be made in the process and in the construction of the machine of my invention shown in the drawings and above particularly described, within the principle and scope of my invention as defined in the appended claims and that by the introduction of water and the removal of the wet material by any well known and suitable means the device can be employed in wet treatments.

I do not limit myself unduly to specific details of procedure in the process nor of construction in the machine, nor to size, nor to specific proportions or relationship of parts, these being given simply as a means for clearly describing the process and machine of my invention.

What I claim is:

1. A pulverizer, comprising two rotatable drums mounted concentrically, means for rotating the inner drum, means for rotating the outer drum at a speed sufficient to create a centrifugal force at the inner periphery of the outer drum in excess of that of gravity, a scraper for removing material held against the inner wall of the outer drum by centrifugal force, a chute for delivering material so removed into the interior of the inner drum, the latter having a balanced group of orifices in its periphery for discharge

of material towards the inner surface of the outer drum, and means for producing a current of air through the outer drum to carry away such material as has been reduced to powder.

2. A pulverizer, comprising two rotatable drums mounted concentrically, means for driving the inner drum at relatively high speed, means for driving the outer drum at a speed which is relatively low but yet high enough to create a centrifugal force at the inner periphery of the outer drum in excess of that of gravity, a scraper for removing material held against the inner wall of the outer drum by centrifugal force, a chute for delivering material so removed into the interior of the inner drum, the latter having a balanced group of orifices in its periphery for discharge of material towards the inner surface of the outer drum, and means for producing a current of air through the outer drum to carry away such material as has been reduced to powder.

3. A pulverizer, comprising a rotatable drum including a cylindrical shell, ends to said shell, each end being formed with a circular central aperture concentric with respect to the axis of rotation of the drum, supporting and driving means for said drum wholly external with respect to the same for rotating said drum at a speed such that the centrifugal force at the inner surface of said shell is in excess of that of gravity, a second drum rotatably mounted in one of said apertures and having its inner end open, its outer end closed and a balanced group of apertures in its periphery to permit material to be thrown therethrough towards the inner surface of said shell, a driving shaft attached to such closed outer end and extending outwardly therefrom, driving means and bearings for said shaft both outside of both drums, a fixed circular closure mounted in the other of said apertures, said closure having therein material-inlet and air-suction-outlet passages, and means for removing material pressed against the inner surface of said shell by centrifugal force and for delivering it to the interior of said second drum.

4. A pulverizer, comprising two rotatable drums mounted concentrically, means for rotating the inner drum, means for rotating the outer drum at a speed sufficient to create a centrifugal force at the inner periphery of the outer drum in excess of that of gravity adapted to allow of the introduction of material and water into the outer drum, a chute extending externally from the outer drum, a scraper for removing water and material held against the inner wall of the drum by centrifugal force, a chute for delivering water and material so removed into the interior of the inner drum, the latter having a balanced group of orifices in its periphery for discharge of material towards the inner surface of the outer drum, and an opening in the outer drum adapted to allow of the removal of said water and finely pulverized material from said drum.

5. A pulverizer, comprising two rotatable drums mounted concentrically, means for driving the inner drum at relatively high speed, means for driving the outer drum at a speed which is relatively low but yet high enough to create a centrifugal force at the inner periphery of the outer drum in excess of that of gravity, a scraper for removing water and material held against the inner wall of the drum by centrifugal force, a chute for delivering water and material so removed into the interior of the inner drum, the latter having a balanced group of orifices in its periphery for discharge of material towards the inner surface of the outer drum, and an opening in the outer drum adapted to allow of the removal of said water and finely pulverized material from said drum.

6. A pulverizer, comprising a rotatable drum including a cylindrical shell, ends to said shell, each end being formed with a circular central aperture concentric with respect to the axis of rotation of the drum, supporting and driving means for said drum wholly external with respect to the same for rotating said drum at a speed such that the centrifugal force at the inner surface of said shell is in excess of that of gravity, a second drum rotatably mounted in one of said apertures and having its inner end open, its outer end closed and a balanced group of apertures in its periphery to permit water and material to be thrown therethrough towards the inner surface of said shell, a driving shaft attached to such closed outer end and extending outwardly therefrom, driving means and bearings for said shaft both outside of both drums, and an opening in the outer drum adapted to allow of the removal of said water and finely pulverized material from said drum, and means for removing water and material pressed against the inner surface of said shell by centrifugal force and for delivering it to the interior of said second drum.

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