July 19, 1927. 1,636,033

F. E. AGNEW

CENTRIFUGAL IMPACT PULVERIZER

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Fig. 1.

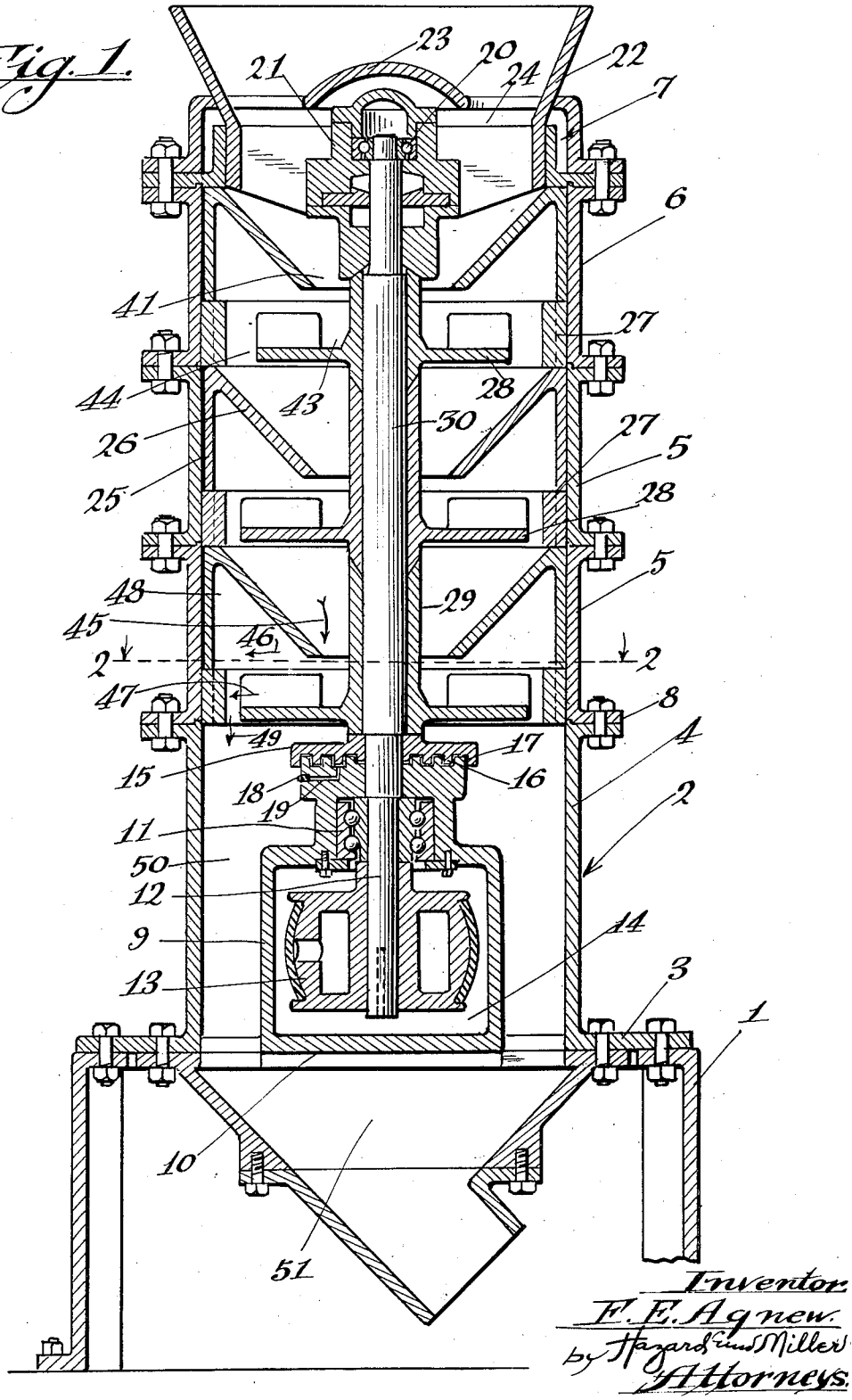

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Fig. 2.

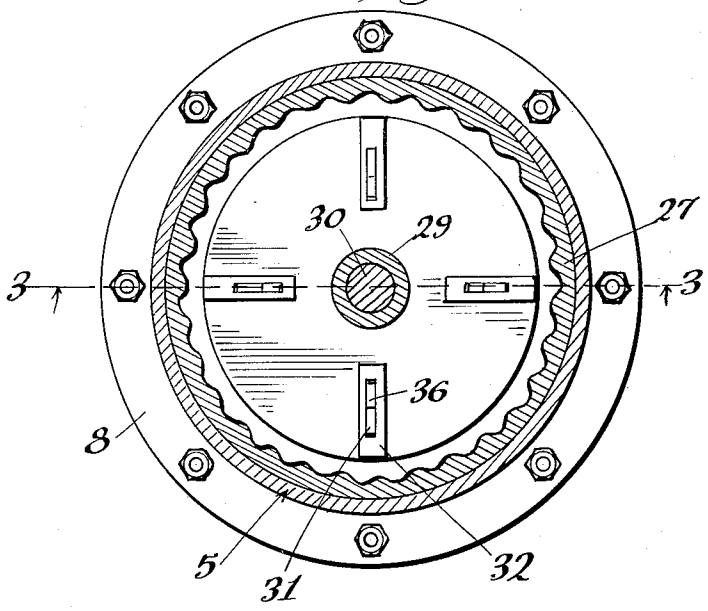


Fig. 3.

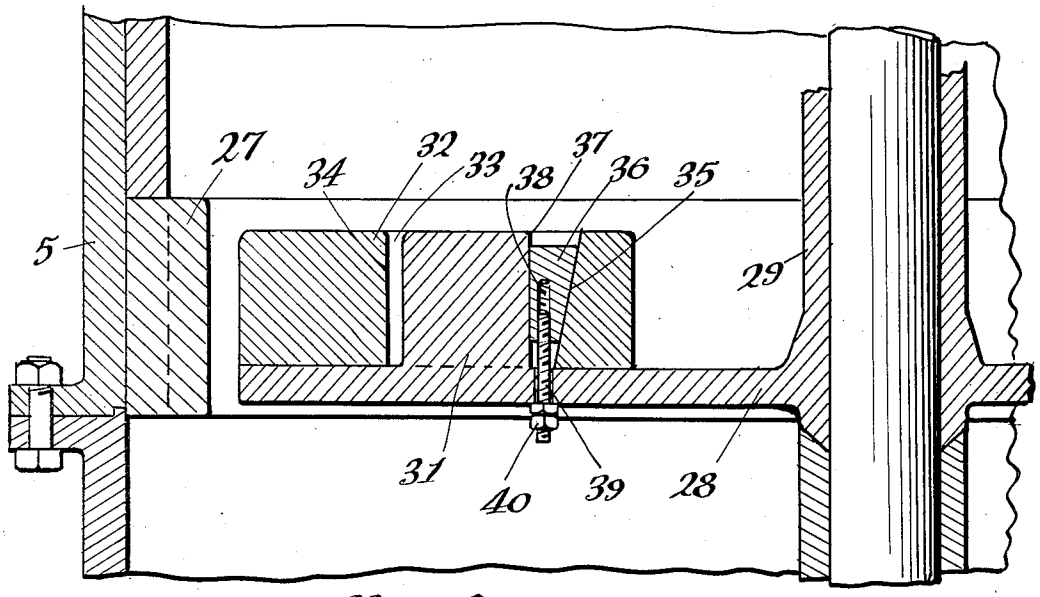
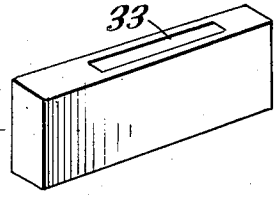


Fig. 4.



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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL IMPACT PULVERIZER.

Application filed March 10, 1926. Serial No. 93,600.

My invention is an impact grinder or pulverizer operated by centrifugal force and grinding and pulverizing material being treated by their impact with a breaker surface.

An object of my invention is to utilize a centrifugal machine to throw the material to be ground or pulverzed radially outward by centrifugal action at high velocities, whereby the impact of the individual particles of the material under treatment causes its shattering and pulverizing or grinds to small sizes.

Another object of my invention is to reduce the air cushion between the impellers and breaker rings so that the velocity of the finer particles will not be retarded and that they will strike the breaker rings with sufficient force to shatter such small particles and therefore grind or pulverize to smaller sizes.

An object of my invention is to make use of the fact that the momentum and therefore the kinetic energy of a moving body is proportional to the mass multiplied by the square of the velocity. Therefore as I give the particles being ground a high velocity, I materially increase the impact force which causes the shattering of said particles. However, as the material becomes finer ground the mass of each individual particle becomes much smaller and therefore the cushion of air through which it is necessary to drive the particles at high velocity, has a material effect on reducing such velocity and therefore reducing the impact force to shatter and thus grind the very small particles.

My centrifugal grinder may thus be made of use in successfully pulverizing such materials as magnesite, limestone, spar, silica, kaolin, gypsum, graphite, diatomaceous earth, cement-clinker, mica, coal, coke, etc., and it may also be utilized to replace stamp mills, ball mills or roller mills or the like in pulverizing ores containing gold, silver, copper, lead, zinc, or the like, in which it is required to reduce the particles to sizes passing through meshes of from say 20 to 350 to the inch. The above are mere illustrations of some of the materials successfully treated by my pulverizer.

For centrifugal grinding and pulverizing I utilize a vertical type of machine having a vertical shaft centered in a cylindrical shell with a hopper at the top and a discharge spout at the bottom. A series of impeller discs are mounted on the shaft, each having impeller blades extending upwardly therefrom and being radially positioned; these impeller blades forcibly throwing the material outward against a breaker ring secured to the shell. There is an annular space between the impeller discs and the breaker rings sufficient to allow the broken particles of material to pass downwardly; these materials being guided by secondary hoppers to the central portion of the impeller disc next below. I may utilize a considerable number of impeller discs superimposed, but find a stack of three sufficient for ordinary purposes.

Another feature of my invention is in the mounting for the vertical shaft with a drive pulley at the lower end and anti-friction elements supporting the shaft and forming a substantially dust proof bearing.

A further object and feature of my invention is positioning the impeller blades at different distances from the breaker rings and forming the internal structure of the grinder so that the current of air tends to carry the small particles into contact with the breaker rings instead of retarding such particles.

My invention will be more readily understood from the following description and drawings, in which;

Figure 1 is a vertical section through my centrifugal impact grinder.

Fig. 2 is a horizontal section of Fig. 1 on the line 2—2, in the direction of the arrows, indicating the adjustment of the impeller blades.

Fig. 3 is an enlarged section of Fig. 2, on the line 3—3, indicating the manner of adjusting the impeller blades.

Fig. 4 is a perspective detail of one of the wearing elements of the impeller blades.

My centrifugal impact grinder as illustrated herein is to a certain extent similar to that of my centrifugal impact pulverizer filed under Serial No. 74,291 and hence need not be minutely described in detail. However, it may be stated that a substantial base 1 is suitably supported on a rigid foundation which should not be subject to vibration; this base carrying a sectional shell 2 having a lower flange 3. The shell is shown with a lower section 4, intermediate sections 5 and a top section 6 with a cap 7

secured thereto; each of these sections having flanges 8. A journal housing 9 is suitably mounted on a transverse plate 10 extending between the lower end of the lower shell section 2, or formed integral therewith. This housing has a combined thrust and lateral anti-friction ball bearings 11. These bearings support the vertical shaft 12 which is suitably secured to the inner bearing element, the shaft having a drive pulley 13 secured to its lower end. The belt for driving the pulley passes through the open side 14 of the journal housing.

A dust cap 15 is keyed to the shaft and has a series of annular depending flanges 16 fitting inter-engaging with upper annular flanges 17 on the top of the housing; thus forming a series of grooves which are oiled through a pressure oiler 18 having a duct 19 leading to one of the grooves so formed.

The upper end of the shaft has an anti-friction bearing 20 mounted in an upper journal housing 21 which is preferably formed integral with the cap 7, this preferably being made as a casting. A hopper 22 fits inside of the cap and a cover plate 23 extends over the top of the journal, protecting it from the material being ground. A passage 24 is formed between the hopper and the cover plate to allow downward passage of the materials being ground.

The shell and the various sections thereof have a sectional liner 25 formed cylindrical with secondary hoppers 26 preferably cast integral therewith. Breaker rings 27, preferably of corrugated material of very hard nature, are situated on the inner face of the liners and are in the same horizontal plane as the impeller discs 28. In the illustration shown, three impeller discs are illustrated super-imposed, each having a sleeve 29 fitting on the central portion 30 of the vertical shaft and being rigidly secured thereto to be rotated by the shaft.

The impeller blades are constructed substantially as follows, being illustrated particularly in Figs. 1, 2 and 3.

Blade supports 31 extend upwardly from the upper surface of the impeller discs and are preferably formed integral therewith, the whole being formed as a casting. Impeller wearing blades 32 are illustrated as having a slot 33 extending therethrough, of sufficient length to allow the wearing blades to move in and out radially, according to the adjustment required. The outer end of the slot 34 is illustrated as being vertical and the inner edge 35 bevelled to engage with the wedges 36 between the said bevelled edge and the vertical edge 37 of the blade supports. The wedges have screw threaded sockets 38 engaging threaded screws 39 which extend through the impeller discs and are adjustable by nuts and lock nuts 40.

It will be understood that the wearing blades form a fairly tight fit on the lateral sides of the blade supports 31 and merely have adjustments radially thereof, this adjustment being obtained by the wedges 36. As the force exerted when the machine is under operation is centrifugal, the wearing blades are maintained in their proper position and it is not necessary to have wedges on opposite edges of the blade supports; however, such could be utilized if desired. It will be understood that the wearing blades are subjected to considerable attrition due to the materials being pulverized, striking and being thrown off said surfaces, and thereby should be made of extremely hard material.

The manner of operation of my centrifugal impact pulverizer is substantially as follows:

The material under treatment is introduced into the hopper 22 and passes through the opening 24, being guided by the upper secondary hopper 26 discharging downwardly through the open end 41 on to the central portion 43 of the upper impeller disc. This disc may have fixed impeller blades or adjustable blades as above described. However, as the materials at the first disc are rather large size, the adjustable features of the impeller blades are more or less unnecessary, but it is desirable to have removable wearing blades. The centrifugal force throws the particles outwardly against the upper breaker ring 27 at high velocity and causes the particles to crumble, passing downwardly through the annular space 44 between the impeller discs and the breaker ring. The material then passes through the next secondary hopper therebelow and is operated on by the impeller disc in the next stage and so on to the lowermost impeller disc.

In the illustration given it is presumed that the lowermost disc is the one pulverizing material to the finest size in which the air cushion between the disc and the breaker ring is such as to have a material effect on the velocity of the particles. In this case the breaker ring should not have as course corrugations as the upper rings and it is necessary to adjust the impeller blades radially to and from the breaker ring in order to obtain fine pulverizing or to substitute different impeller discs with fixed impeller blades thereon.

It will be noted that the air in my impact centrifugal pulverizer is subjected to centrifugal action in the same manner in which the particles are. However, when the material is coarse the current of air does not have a great effect on the velocity of the particles. In the lowermost or finest pulverizing portion of the machine the air is thrown downwardly as indicated by the arrow 45 at the discharge end of the hopper and thrown out-

wardly as indicated by the arrow 46 in a radial direction. The moving current of air may be regarded as being struck by the impeller blades just as much as the fine particles are struck thereby, being thrown as indicated by the arrow 47 in a radial direction against the breaker rings.

There may be a more or less dead air space 48 or a swirling annular back air space at the upper junction of the secondary hopper and its liner 25. However, the general tendency of the air is to be thrown with the particles being pulverized against the breaker ring and thence pass downwardly as indicated by the arrow 49 into the discharge chamber 50, from whence it passes out with the pulverized material through the spout 51.

In utilizing my centrifugal grinder and pulverizer it is preferable to aim at grinding the material to a certain degree of coarseness which is measured by passing the material through screens as discharged from the spout. The material which is of sufficient fineness passes through the screens and the portion which is not sufficiently fine is retained and passed through the machine again. This procedure prevents grinding too fine when it is not desired to have extremely fine grinding. However, this degree of grinding is regulated by positioning the impeller blades at varying distances from the breaker ring, the closer the blades being to the ring the finer the grinding within said elements, as the fine particles under treatment do not have to be thrown such great distances through a layer of air, which although traveling with the particles acts to a certain extent as a cushion. It is to be understood however, that the impeller blades and impeller discs are always at such a distance from the breaker rings that there is no contact therebetween and particles being treated are not subject to contact with both the breaker rings and the impeller discs or impeller blades at the same time.

From the above description it will be seen that for fine grinding it is necessary to reduce the distance through which the very fine particles are thrown. As they are retarded by any relative body of air, they are required to transverse, whereas larger particles are not so influenced by the layer of air and travel faster than the small particles. Therefore in the upper part of my machine, although the impact of the large particles on the breaker rings breaks these not only into smaller particles but into pulverized material, this pulverized material in the action of the succeeding breaker rings and impellers is not thrown with the same force as the larger particles incorporated therewith against such rings. This tends to a uniform pulverizing or grinding. However, in the later stages of the pulverizing or grinding it is desired that the product be as uniform as possible and as it is desirable that the particles be of more or less uniform size the adjustment of the distance of the impeller blades in relation to the breaker rings or the substitution of different breaker rings with a different spacing from the breaker rings, has a material effect on the fineness of the grinding or pulverizing.

It is also desirable that the impeller blades and the direction of the air currents be such that in the fine grinding the air travels with the particles being ground or pulverized and therefore functions to carry these particles instead of retarding them.

It will hence be seen that I have developed not only a machine for fine grinding or pulverizing, but also a method of grinding by utilizing centrifugal force. The general construction of my machine and its manner of operation may therefore be considerably changed in general structure and specific details to suit different types of grinding and pulverizing required. Such changes will be within the spirit of my invention as set forth in the drawings, description and claims.

Having described my invention, what I claim is:

1. In a centrifugal pulverizer, a stationary cylindrical breaker ring, a vertical shaft centrally positioned therein, a horizontal impeller disc mounted thereon, impeller blades attached to the upper surface of the impeller disc adjacent its periphery, said blades having vertical block supports with wearing blades surrounding said supports, wedges between the ends of the supports and the surrounding wearing blades, and screws extending through the impeller disc and engaging the wedges to adjust the position of the wedges and hence the wearing blades radially.

2. In a centrifugal pulverizer, a vertical shell, a vertical shaft extending therethrough, a journal housing at the lower end of the shell, a journal in said housing, said journal providing for downward and lateral thrust, a rotatable dust cap on the upper part of the journal housing having grooves and flanges interengaging with the said journal housing, said cap being connected to the shaft, means to oil the dust cap and the upper part of the journal housing by an oil duct leading to said grooves and flanges, and means to rotate said shaft.

In testimony whereof I have signed my name to this specification.

FRANCIS E. AGNEW.