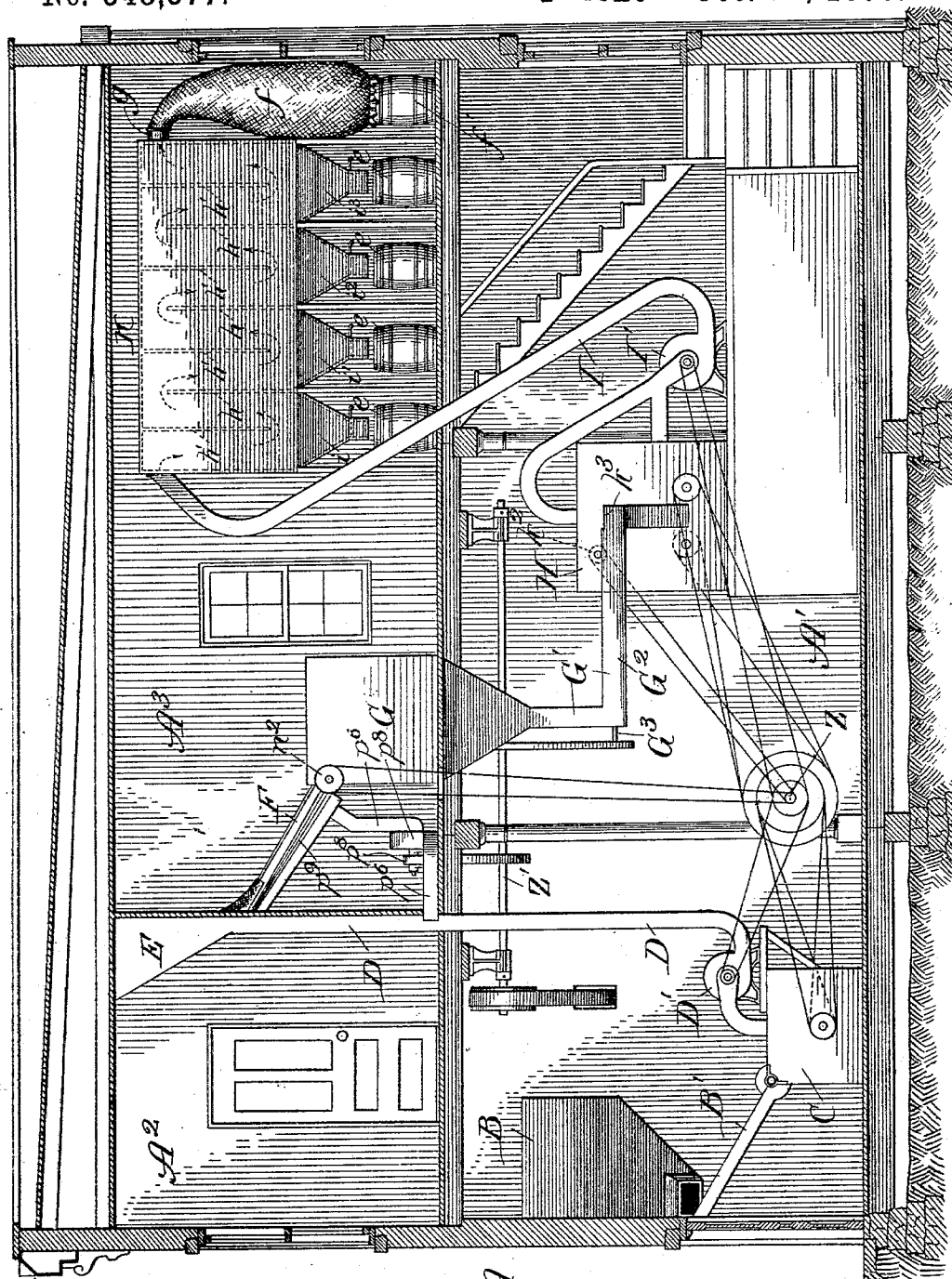


4 Sheets—Sheet 1.

METHOD OF AND APPARATUS FOR PURIFYING AND PULVERIZING MICA.

Patented Oct. 22, 1895.



Witnesses:
Chas. E. Gaylord,
Lulu J. Allen

Fig. 1.

A

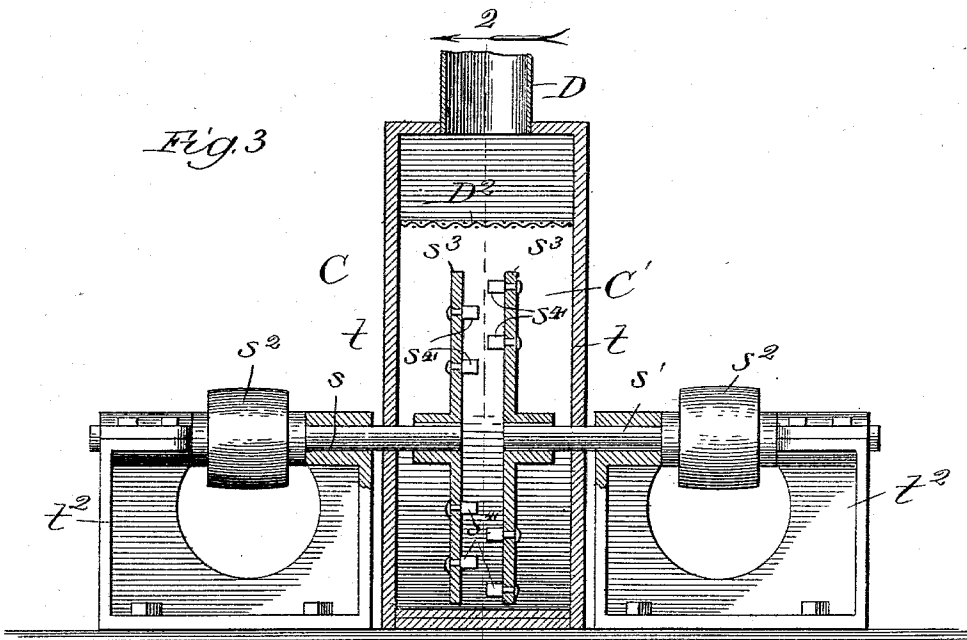
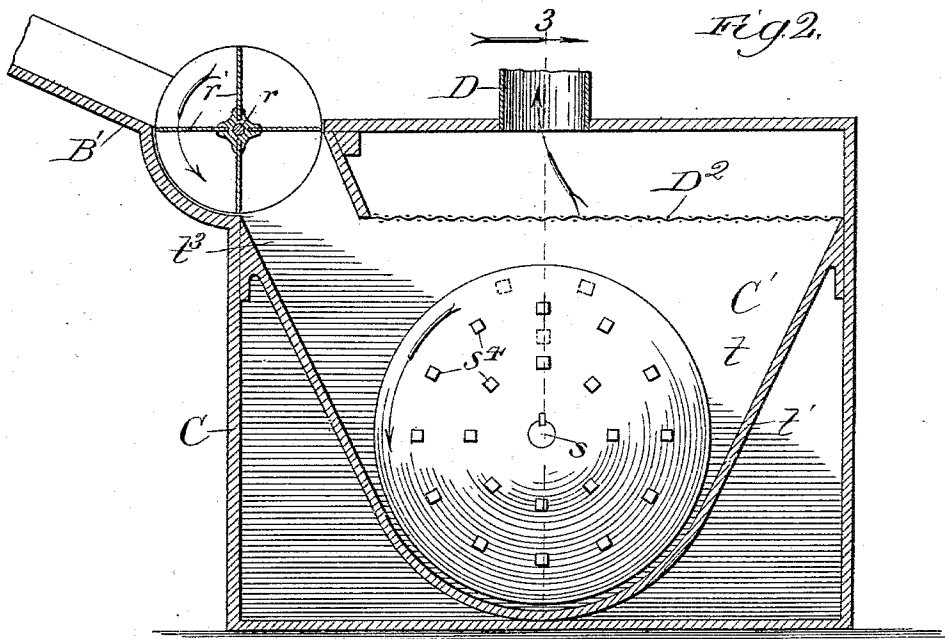
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T. J. LOVETT.

METHOD OF AND APPARATUS FOR PURIFYING AND PULVERIZING MICA.

No. 548,377.

Patented Oct. 22, 1895.



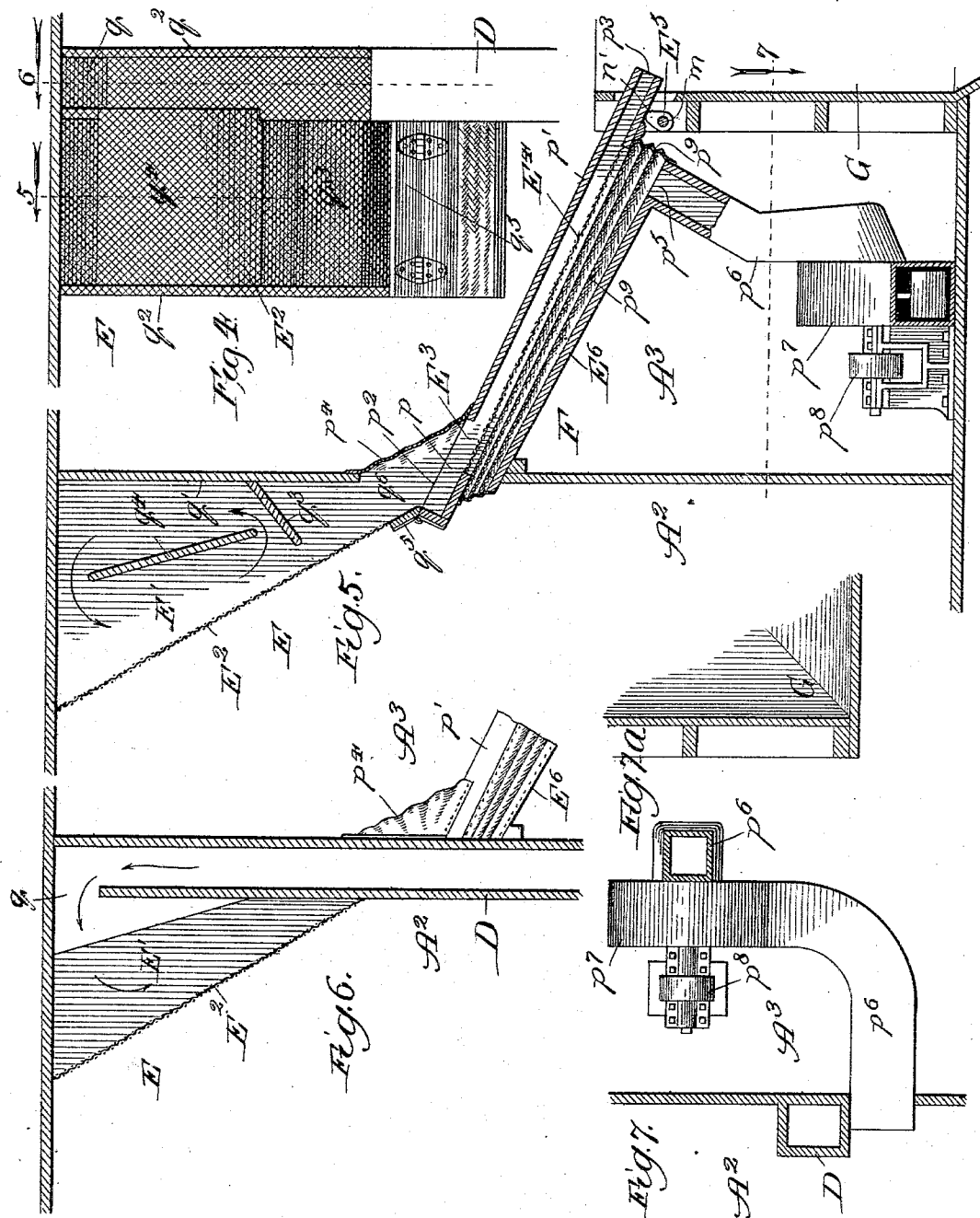
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4 Sheets—Sheet 3.

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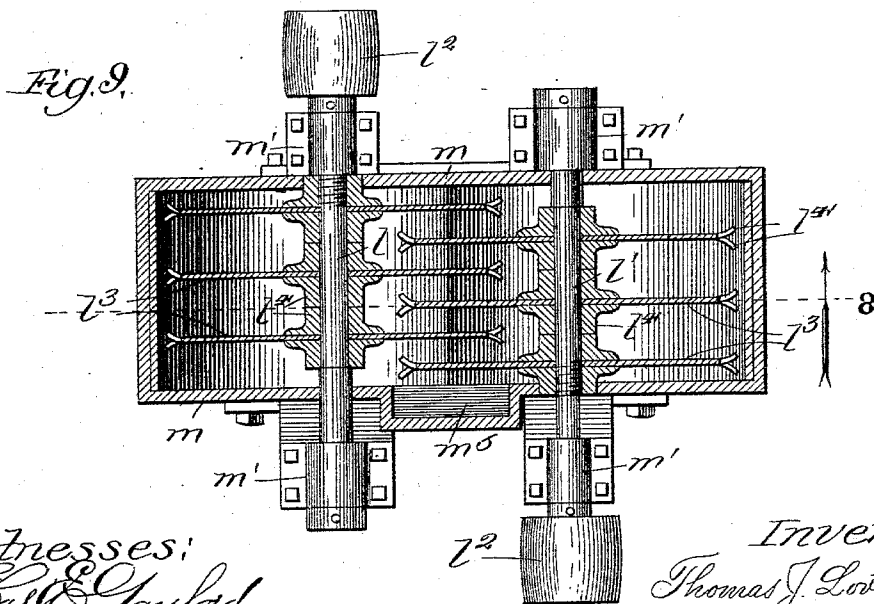
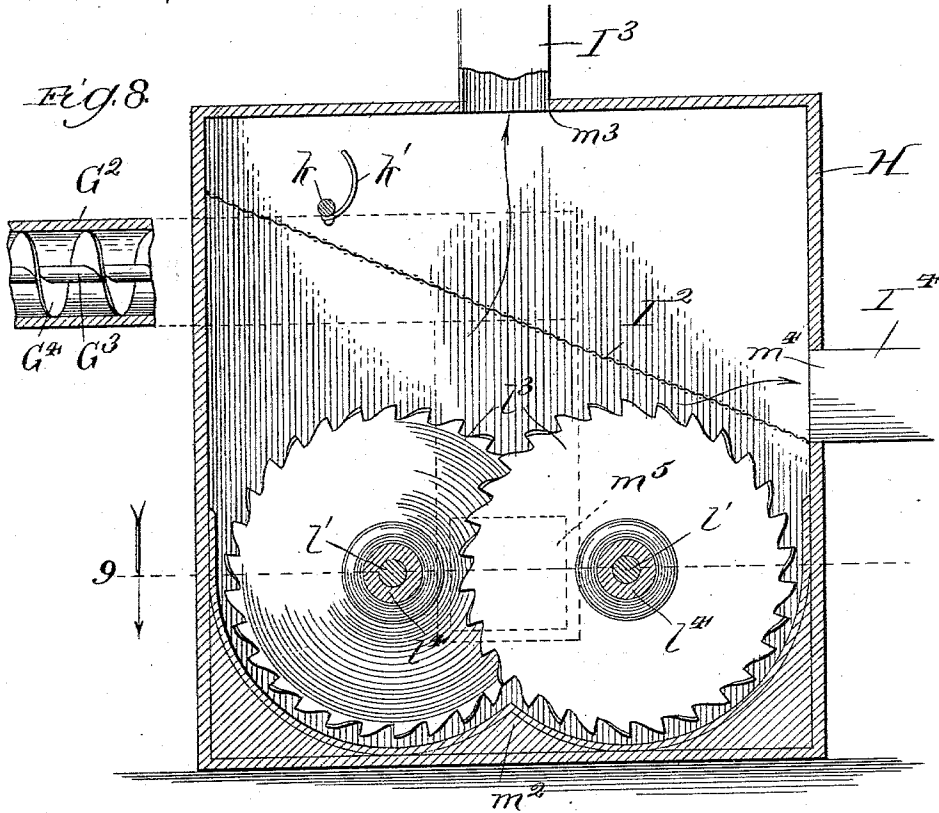
Inventor
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Attorneys

T. J. LOVETT.

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UNITED STATES PATENT OFFICE.

THOMAS J. LOVETT, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE ALLERTON LUBRICANT COMPANY, OF SAME PLACE.

METHOD OF AND APPARATUS FOR PURIFYING AND PULVERIZING MICA.

SPECIFICATION forming part of Letters Patent No. 548,377, dated October 22, 1895.

Application filed April 10, 1895. Serial No. 545,181. (No model.)

To all whom it may concern:

Be it known that I, THOMAS J. LOVETT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Methods of and Apparatus for Purifying and Pulverizing Mica, of which the following is a specification.

My invention relates to an improved method of producing from mica ore granular or pulverulent mica free from grit, and it also relates to improved apparatus which I employ in carrying out my said method.

The inherent lubricating properties of mica, its toughness, and its incombustibility render it an exceedingly desirable ingredient for lubricating compounds, and while this desirability has long been recognized the difficulties hitherto existing in the way of reducing the mica to the necessarily finely-divided state and of freeing it from all gritty substances have prevented its employment to any great extent in the manufacture of axle-grease and other lubricating compounds for general use.

So far as I am aware the absence of a sufficiently practical method of and appliances for reducing the mica and freeing it from gritty substances has not only made the matter of the production of pure and finely-divided mica slow and laborious, but has also made it necessary to employ blocks of mica practically free from grit, instead of mica ore, all of which rendered the product too expensive to compete commercially with other lubricating compounds.

My object is to provide an improved method of treating mica ore, especially that of low grade, carrying other and gritty minerals in more or less large proportion, and also to provide apparatus for carrying out the method whereby the ore may be treated in large quantities and the mica separated practically from every particle of grit and reduced to the desired degree of fineness, all in a manner which renders the product particularly inexpensive and desirable for its purpose.

In carrying out my improved method the mica ore is fed to a machine which acts upon the mica to the extent of reducing it to flakes or scales comprising laminae so thin that no gritty material will exist between its sur-

faces and upon the gritty minerals to the extent of reducing them to a powder or at least to a more finely-divided state than the mica. The mass reduced as described is then subjected to a separating operation, which causes every particle of gritty mineral substance to be eliminated from the mass of mica flakes and the latter to be left in a practically pure state. The flaked and purified mica is then fed to a pulverizing-machine, which reduces the flaky mass to a more or less pulverulent state. From the pulverizer the mass may be, and preferably is, passed to a separating or sorting apparatus, where the mica scales of different degrees of fineness are sorted out and deposited in different receptacles.

In order that I may successfully carry out my improved method on a commercial scale, I have devised special and improved machines and apparatus, the equivalents of which, so far as their operations upon mica ore and mica are concerned, do not exist, so far as I am aware, in the same or any other art. It being necessary to protect the mica when freed from the gritty constituents of the ore, if it is to be used as an ingredient of a high-class lubricating compound, from access thereto of any gritty material, such as dust carried by the atmosphere, it is desirable that the process of disintegrating the ore, eliminating the grit, and then pulverizing the mica be carried on in one continuous operation and that the apparatus be inclosed.

In the drawings, Figure 1 is a sectional view in the nature of a diagram, showing a building fitted with apparatus of my improved construction for carrying out my improved method; Fig. 2, a broken and enlarged section of the initial or mica-flaking machine, the section being taken on line 2 of Fig. 3; Fig. 3, a section taken on line 3 of Fig. 2; Fig. 4, a broken elevation of separating apparatus for freeing the mica flakes from the gritty material; Figs. 5, 6, 7, and 7^a, broken sections taken, respectively, on lines 5, 6, and 7 of Fig. 4, and viewed as indicated by the arrows; Fig. 8, a section taken on line 8 of Fig. 9 and showing the mica-pulverizer, and Fig. 9 a section taken on line 9 of Fig. 8.

A is a building having a lower apartment

or chamber A' and upper apartments or chambers A² A³.

B is a chute or hopper which empties upon a grizzly B', leading to the mica-flaking machine C.

D is the discharge-pipe of the mica flaking machine, interposed in which is a fan or blower D'. The pipe D communicates with initial separating apparatus located in the apartment A² and communicating with secondary separating mechanism F, located in the apartment A³. The separating mechanism F discharges into a bin or hopper G, from the lower end of which extends a pipe G', leading to the mica-flaking machine H. Extending from the machine H is a discharge-pipe I, provided with a fan or blower I' and leading to a settling device K, which is divided internally into sorting-chambers.

Owing to the peculiarly soft and tough characteristics of mica, it presents much greater resistance to disintegration under impact, abrasion, or attrition than the more brittle minerals present in mica ore. I have found in practice that to successfully reduce mica from lumps or sheets to a flaky state it is necessary to provide a machine in which the moving parts shall have a cutting and tearing effect upon the lumps or sheets in addition to the pounding and grinding effect produced by beaters and the abrasion of the particles against each other.

The flaking-machine C acts upon the mica in the manner stated and upon the other and more brittle minerals in a manner to reduce them to fine powder.

The machine C comprises a shell containing a chamber C', formed with side walls or cheeks *t t* and a base-wall *t'* rounded in the direction of the length of the machine, as indicated in Fig. 2. Mounted in bearings *t*² on opposite sides of the machine and extending through openings in the cheeks into the chamber C' are separate rotary shafts *s s'*, provided with pulleys *s*². On the inner ends of the shafts are vertical disk-heads *s*³, provided with annular concentric series of disintegrating-fingers *s*⁴, the fingers upon the two disks being mutually intercurrent, as indicated in the figures. At the upper side, at one end of the chamber C', is an inlet-spout *t*³, to which the grizzly B' leads. Extending across the grizzly at the spout *t*³ is a rotary shaft *r*, provided with radial plates *r'*. At the top and center of the chamber C' is the outlet-pipe D, and below the said outlet is a screen D².

The pulleys *s*² are belted to a pulley on a drive-shaft Z in a manner to cause the shafts *s s'* to rotate in opposite directions. The fan D' is also belted to the drive-shaft. In practice I prefer to rotate the disks at a speed approximating twelve hundred revolutions per minute, and the disks are preferably so adjusted with relation to each other that the fingers nearly, but not quite, intermesh. Mica ore in lumps sufficiently small to pass between the shaft *r* and base of the chute is fed

from the bin or hopper B down the grizzly B' and passed into the chamber C' by the rotating feed-plates *r'*. As the ore drops between the disks *s*³, the action of the fingers *s*⁴, which are angular and preferably square in cross-section, is to tear and cut the lumps of mica ore by repeated engagement therewith and reduce the mica portion to a flaky mass and the other and more gritty minerals to a powder. The strong air-currents produced by the rotating disks and their fingers tend to keep the lumps between the disks until they are properly reduced, and as the lighter flakes and other particles are driven to the upper part of the chamber they pass through the screen D² and are drawn through the pipe D by the suction action of the fan D', whence they pass to the separating apparatus next to be described.

It is found in practice that in the reduction of the mica to flakes not exceeding, say, one-quarter inch area in the manner described the separated laminæ are so thin that no foreign or gritty particles will exist between the surfaces and substantially all the gritty mineral will be so reduced that its largest particles will be smaller than the smallest mica flakes. The screen D², which regulates the size of flakes which may be discharged from the machine, is therefore made with a mesh preferably of about one-quarter inch. Constructed as described the machine is capable of treating the ore in the manner stated very quickly, thus giving it great capacity, and as the disks and fingers and other impact-surfaces are formed of hardened steel the machine is very durable.

The pipe D extends to the ceiling of the apartment A² and is provided at the top in its forward side with an outlet-opening *q* leading to a compartment E', closed at the back by a wall *q'* and the sides by walls *q*², and fitted at its forward side with an inclined screen E². Extending between the pipe D on one side and the opposite wall of the compartment E' is an inclined shelf *q*³ and a diaphragm *q*⁴, the shelf being toward the lower part of the compartment and the diaphragm *q*⁴ extending from a short distance above the shelf nearly, but not quite, to the top of the compartment and inclined preferably to an angle between the vertical plane and that of the screen E². The screen at its lower edge is secured to a cross-piece or cleat *q*⁵, and the lower end of the compartment between the cleat *q*⁵ and wall *q'* is open to afford an outlet *q*⁶. Hinged to the cleat *q*⁵ and extending through the wall *q'* to the apartment A³ is the frame E³ of a screen or sieve E⁴, which is inclined in the downward direction from the cleat *q*⁵, the frame resting at its opposite end portion upon an agitator E⁵. The frame E³ is provided with side bars *p* and a top plate *p'*, the latter extending short of the upper end of the frame to afford an opening *p*². The frame is open at its lower end portion to afford an outlet *p*³. Extending from the up-

per edge of the plate p' to the wall q' above the opening q^6 is a flexible covering p^4 , which renders the passage from the compartment E' to the screen E^4 close. Extending below the screen E^4 is a stationary and inclined base E^6 , provided toward its lower end with an outlet p^5 leading to a pipe p^6 , which extends back to the apartment A^2 . Interposed in the pipe p^6 is a fan p^7 , which is driven by a pulley p^8 , belted to a line-shaft Z' . Fastened to the edges of the base E^6 and around the screen E^4 are a strip or strips of flexible material, forming sides p^9 and giving to the device the functions of a bellows. The agitator E^5 , as I provide it, comprises a shaft n , carrying cam fingers or wipers n' and driven by a pulley n^2 , belted to the drive-shaft Z . In the rotation of the shaft n the cams n' cause the lower end of the screen to rise and fall, thus giving an up-and-down shaking motion to the screen.

In the operation of the separating apparatus the air-current from the fan D' enters the compartment E' through the opening q and strikes the screen E^2 . The shelf q^3 and diaphragm q^4 causes the air-current as it enters the compartment to whirl around the diaphragm through the openings above and below the latter and strike the screen several times before it spends itself by passing through. The screen E^2 should have a mesh smaller than the smallest size flakes of mica, but larger than the largest size particles of grit, whereby as the current is driven more or less repeatedly against the screen the gritty particles will pass through and cause no material waste of the mica. The air-current will spend its force entirely by passing through the screen E^2 , so that the mica flakes will fall down the screen E^2 below the shelf q^3 and drop through the discharge-opening q^6 onto the screen E^4 . The screen E^4 is of a mesh approximating that of the screen E^2 , and as the mass falls upon the screen E^4 the agitation given to the latter causes it to slide and roll down through the spout p^3 to the bin or hopper G . Any particles of gritty mineral which have escaped separation from the mica in the initial separator will as the mass rolls down the screen E^4 drop through onto the base E^6 , whence it runs to the pipe p^6 and is carried by the fan p^7 back to the apartment A^2 . The suction action at the opening p^5 tends in practice to aid the progress of the flakes from the initial separator through the secondary separator to the bin G and the bellows action tends to keep the screen E^4 from becoming clogged. After the flakes have passed through the initial and secondary separator they will be freed entirely from grit and be sufficiently pure for use in a lubricating compound, while all the gritty material will have been deposited in the apartment A^2 .

Extending from the bin or hopper G is a pipe G' , having a horizontal section G^2 leading to the mica-pulverizer H . In the pipe or passage G^2 and extending longitudinally thereof is a shaft G^3 , provided with a spiral

blade or screw G^4 . The shaft G^3 carries a pulley and is belted, as indicated in Fig. 1, to the line-shaft Z' .

To reduce mica from a flaky state to powder in the quantities and at the necessary speed for my purpose, it must be subjected to a peculiar tearing and cutting operation, differing radically from the operations of machines employed in pulverizing any other material of which I am aware.

The pulverizer H comprises a shell or casing closed on all sides, except at the outlets hereinafter mentioned, and having side walls or cheeks m . Extending across the lower part of the shell and journaled in bearings m' at the sides of the cheeks are parallel shafts $l'l'$. The shafts occupy the relative positions shown in the drawings and are provided with pulleys l^2 . Keyed to the shafts and intermeshing with each other are series of disks l^3 , held in place at proper distances from each other on the shafts by means of spacing-collars l^4 . The disks l^3 are circumferentially serrated, the teeth l^5 being set to project alternately from opposite sides of the disks, as shown in the figures. The base m^2 is rounded under each set of disks, as indicated in Fig. 8, to extend close to, but out of contact with, their peripheries. Extending across the chamber, preferably at an angle from one side to the other, as shown in Fig. 8, is a screen l^2 , and two outlets are provided above the screen, one m^3 at the top of the chamber and the other m^4 above the lower end of the screen l^2 . Extending across the chamber and journaled in the cheeks m above the screen l^2 is a rotary shaft k , carrying a flexible beater k' . The shaft k carries a pulley k^2 , which may be belted, as shown in Fig. 1, to the shaft Z . The inlet to the pulverizer-chamber is at m^5 .

In operation the pulleys l^2 are belted to the shaft Z to rotate the shafts $l'l'$ in opposite directions and at a very high speed. The worm-feed G^3 is rotated to move the mass of flaky mica fed from the bin G with desired speed and in desired quantity to the feed-opening m^5 of the pulverizer. The currents produced by the rotating disks draw the material from the feed-opening between the disks, whereby it is acted upon by the teeth l^5 and reduced in a comparatively short time to powder. In the pipe G' and preferably at k^3 is an opening for the inward passage of air which flows through the pulverizer-chamber and screen l^2 to the outlets m^3 m^4 , being drawn through the sections I^3 I^4 of the pipe I by the action of the fan I' . The screen I^2 is of very fine mesh, which will only allow the mica to pass through it in a powdered or more or less finely-granulated state. As fast as the mica is reduced, it is drawn through the screen by the air-current and through the outlets m^3 m^4 . The shaft k causes the flexible beater k' to slap the screen with each revolution and thus tend to free it from any adhering particles of mica and prevent its becoming clogged. The mica, after being reduced, is forced by the

fan I' through the pipe I to the settling device K, which will be next described.

The settling device is provided with a series of hopper-shaped bases i i' i^2 i^3 having 5 valved outlets. In the device at opposite sides of the said bases are partitions h extending upward nearly to the top of the chamber afforded by the casing, and intermediate of the said partitions are downward extending partitions h' , which extend from the top of the 10 chamber downward, as indicated. The partitions act as baffle-walls, causing the current entering from the pipe I to take the course indicated by the arrows to the outlet g . The 15 baffle-walls tend to precipitate the particles of mica into the hoppers out of the path of the current, and as a consequence of the arrangement shown the coarser and heavier particles tend to fall into the hopper i , those 20 of a finer grade into the hopper i' , those of a still finer grade into the hopper i^2 , and those still finer into the hopper i^3 , while any particles carried through the outlet g will be in the form of flour or impalpable powder too 25 light for separation from the moving current. In order to save this impalpable powder, which is the finest grade and most valuable for certain lubricating compounds, I attach to the outlet g the mouth of a bag or "balloon" 30 f , of material sufficiently porous to permit the passage through it of air, but too fine to allow the mica to pass through to any great extent. The bag or balloon f may be open at its lower end and there fastened over a receptacle f' . 35

In the manufacture of lubricating compounds of different grades or for different purposes mica of different grades of fineness is desirable. By means of the settling and sorting 40 ing device K described I obtain mica of five grades of fineness, the grades being separated. Under each hopper a receptacle e may be provided, and these receptacles may be in the form of barrels or casks, as shown, in 45 which the various grades may be stored until wanted for use.

What I claim as new, and desire to secure by Letters Patent, is—

1. The method of reducing mica-bearing 50 ore to obtain therefrom, in a pure and finely divided condition, its contained mica, which consists in first disintegrating the ore, by subjecting it to the action of rotary beaters, until the mica is reduced to thin flakes and the 55 gritty constituents of the ore are reduced to a degree of fineness greater than that of the mica, and are completely detached therefrom, then through the medium of an air-blast subjecting the disintegrated mass to the action 60 of sifting-mechanism, thereby separating the finer gritty constituents from the larger mica flakes, whereby only the pure mica is intercepted, and finally reducing the resultant pure mica to the desired finely divided condition, substantially as described. 65

2. Apparatus for the reduction of mica-ore, to obtain therefrom its contained mica in a

pure and finely divided state, comprising, in combination, a mica-flaking device consisting of a shell having a close chamber provided 70 with a feed-opening and a discharge-opening, shafts extending into the chamber from opposite sides thereof, disks on the shafts, fingers on the disks angular in cross section to present cutting edges, a screen between the 75 disks and discharge opening, means for rotating the shafts at high speed in opposite directions, whereby the ore entering through the feed-opening is engaged by the fingers and disintegrated until the mica is reduced to thin 80 flakes and the more brittle gritty constituents are reduced to a degree of fineness greater than the mica, a conduit extending from the said discharge-opening, air-blast mechanism in the conduit, a separating chamber, at the 85 end of said conduit, provided with a screen serving to sift, through its mesh, the finer gritty constituents, impelled against it by the air-blast, from the larger mica flakes, whereby only the pure mica is intercepted, a discharge 90 conduit for said separating chamber, a mica-pulverizing device, to which said conduit leads, comprising a close chamber having a discharge-outlet, a rotary pulverizer in the chamber, and a screen between the said pulverizer and outlet, a settling-device, and a conduit provided with air-blast mechanism and 95 extending from the pulverizing-device outlet to the settling-device, all constructed and arranged to operate substantially as and for the 100 purpose set forth.

3. The combination with a machine for treating mica ore to reduce the mica to flakes and the gritty constituents to a state of greater 105 fineness than the mica flakes, of apparatus for separating the mica from the gritty material, comprising a compartment closed at one side with a screen formed with a mesh which will arrest the flakes and permit the grit to pass through, an air-blast conveyer, for feeding 110 the mass of reduced ore to the separating apparatus, opening into the said compartment, a diaphragm in the compartment having a passage around it to produce a whirl of the current from the conveyer and thus tend to 115 carry the mass repeatedly against the screen, and an outlet for the mica flakes, substantially as described.

4. The combination with a machine for treating mica ore to reduce the mica to flakes 120 and the gritty constituents to a state of greater fineness than the mica flakes, of apparatus for separating the mica from the gritty material, comprising a compartment closed at one side with a screen formed with a 125 mesh which will arrest the flakes and permit the grit to pass through, an air-blast conveyer, for feeding the mass of reduced ore to the separating apparatus, opening into the said compartment, a diaphragm in the compartment 130 having a passage around it to produce a whirl of the current from the conveyer and thus tend to carry the mass repeatedly against the screen, a deflecting shelf below

the said diaphragm, and an outlet passage for the mica between the said shelf and screen, substantially as described.

5 The combination with a machine for treating mica ore to reduce the mica to flakes and the gritty constituents to a state of greater fineness than the mica flakes, of apparatus for separating the mica from the gritty material, comprising a compartment closed at one side with a screen formed with a mesh which will arrest the flakes and permit the grit to pass through, an air-blast conveyer, for feeding the mass of reduced ore to the separating apparatus, opening into the said compartment, a diaphragm in the compartment having a passage around it to produce a whirl of the current from the conveyer and thus tend to carry the mass repeatedly against the screen, an outlet for the mica at the lower end of said compartment, an inclined screen, extending from said outlet, and means for agitating the same, substantially as and for the purpose set forth.

6. The combination with a machine for treating mica ore to reduce the mica to flakes and the gritty constituents to a state of

greater fineness than the mica flakes, of apparatus for separating the mica from the gritty material, comprising a compartment closed at one side with a screen formed with a mesh which will arrest the flakes and permit the grit to pass through, an air-blast conveyer, for feeding the mass of reduced ore to the separating apparatus, opening into the said compartment, a diaphragm in the compartment having a passage around it to produce a whirl of the current from the conveyer and thus tend to carry the mass repeatedly against the screen, an outlet for the mica at the lower end of said compartment, an inclined frame E^3 hinged at its higher end at said outlet, having a close top p' p^4 and sides p^2 , a screen E^4 in its base, and an outlet p^3 at its lower end, means for oscillating the frame on its hinge, and a base E^5 below the screen having close bellows sides connected with the sides of said frame, all constructed to operate substantially as and for the purpose set forth.

THOMAS J. LOVETT.

In presence of—

M. J. FROST,
J. H. LEE.