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W. A. SCOTT

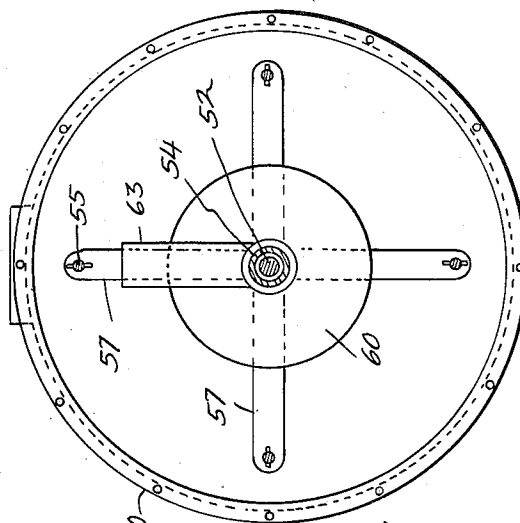
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GRINDING APPARATUS FOR PULVERIZING MATERIALS

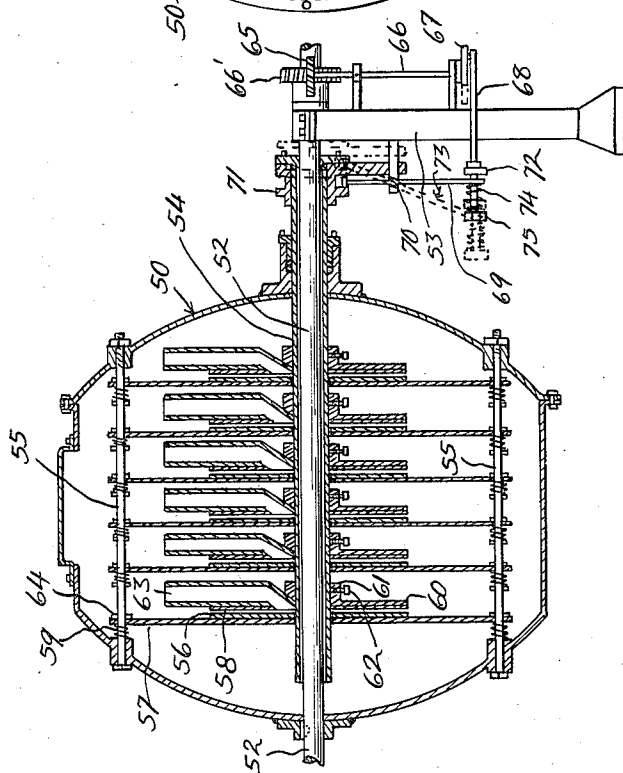
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2 Sheets-Sheet 2

Fig. 4.



Job



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GRINDING APPARATUS FOR PULVERIZING MATERIALS

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17 Claims. (Cl. 83—22)

This invention relates generally to grinding machines and more particularly to grinding apparatus especially designed for pulverizing materials.

Although the present invention may be employed for grinding various kinds of materials, nevertheless, it finds particular utility when used in connection with the manufacture of paints, lacquers and the like for pulverizing the pigments commonly employed in the manufacture of various kinds of paints and lacquers.

One of the principal objects of this invention is to provide a compact relatively simple apparatus having cooperating grinding members designed to pulverize various kinds of pigments to a relatively small size suitable for the manufacture of high grade paints and lacquers.

Another advantageous feature of the present invention resides in the provision of apparatus of the type specified wherein means is provided for automatically and periodically relatively moving said grinding members axially away from each other to increase the width of the space between the cooperating grinding surfaces of the members and thereby provide for intermittently discharging pigment between the latter surfaces.

A further object of the present invention which contributes materially to pulverizing pigments to a relatively small size resides in the provision of means for automatically adjusting the grinding members by relatively moving the same toward each other as the pigment therebetween is diminished in size thereby.

A still further object of the present invention consists in the provision of apparatus of the type previously set forth which is thoroughly automatic in operation and which is capable of pulverizing large quantities of pigments in a relatively short time.

Other objects of the invention will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a semi-diagrammatic longitudinal sectional view through a grinding machine constructed in accordance with this invention;

Figure 2 is a side elevational view of the machine illustrated in Figure 1 with certain parts removed for the sake of clearness;

Figure 3 is a view similar to Figure 1 showing a modified form of construction; and

Figure 4 is a side elevational view of the construction shown in Figure 3 with the cover of the housing removed.

Referring now to the specific construction of the pulverizing apparatus illustrated in Figures 1

and 2, it will be noted that the same comprises a stationary housing 10 having a front wall 11 removably secured to the annular side wall 12 as at 13 so as to permit access to the interior of the housing when desired. The annular side wall 12 is provided with an opening 14 in the upper side thereof through which the material to be pulverized may be inserted within the housing and the opening 14 is normally closed by means of a removable cover 15. In order to provide for removing the material from the housing after the same has been thoroughly pulverized, the lower section of the housing is provided with a drain opening 16 normally closed by a suitable plug 17 threadedly engaging the opening 16.

Extending axially through aligned openings formed in the front and rear walls of the housing 10 is a pair of coaxially aligned shafts 18 and 19 having the inner ends thereof terminating short of each other as clearly shown in Figure 1. The shaft 19 is mounted within the front wall 11 of the housing for limited axial movement relative to the shaft 18 and has fixed to the inner end thereof a hub shell 20 provided with a radially extending portion 21 forming an anchorage plate for a grinding disk 22. The grinding disk 22 is fixed in any suitable manner to the plate 21 so as to move axially as a unit with the shaft 19. The grinding disk 22 is provided with a centrally arranged enlarged aperture 23 therethrough registering with the inner open end of the hub shell 20 and communicating with the delivery end of a suitable hopper or funnel 24. The funnel 24 extends upwardly through the upper wall of the hub shell 20 and the receiving end thereof is positioned outwardly beyond the periphery of the disk 22 in registration with the filler opening 14 in the upper side wall of the housing.

The shaft 18 is preferably fixed against axial sliding movement, but is mounted in the rear wall of the housing for rotation by any suitable type of prime mover and is provided at the inner end thereof with a disk 25 formed of relatively hard material and cooperating with the disk 22 to pulverize the material therebetween. The disk 25 is rigidly secured in any suitable manner to a relatively thick plate 26 which in turn is secured to the drive shaft 18 so as to provide for rotation of the disk by the shaft. If desired, the plate 26 may be provided with jackets for receiving a cooling medium to prevent the rotatable grinding disk 25 from overheating.

In order to agitate the pigment in the housing and provide for delivering the same within the receiving end of the funnel, a plurality of agita-

tors 27 are arranged within the housing in proximity to the annular side wall 12 of the latter and are secured, through the medium of the radially extending arms 28, to the plate 26 for rotation therewith as a unit. The arrangement is such that rotation of the grinding disk 25 relative to the disks 22 to pulverize the pigment therebetween also effects a rotation of the agitators 27 to agitate the pigment in the lower portions of the housing and deliver the pigment to the funnel 24 whereupon it is conveyed to the space between the cooperating grinding disks 22 and 25.

As previously stated, it is one of the objects of the present invention to provide means for relatively moving the grinding disks away from each other to provide for the delivery of pigment to the space between the grinding disks. In the present instance, the grinding disk 22 is intermittently moved relative to the grinding disk 25 to provide for securing the above results and this is accomplished herein by providing a crank shaft 29 extending at substantially right angles to the drive shaft 18 and having a gear 30 fixed to the upper end thereof adapted to mesh with a relatively larger sized gear 31 on the shaft. The gear ratio between the shafts 18 and 29 is such as to rotate the latter shaft at a relatively slow rate of speed from the former and is determined in accordance with the intervals it is desired to move the grinding disk 22 relative to the disk 25. Fixed to the lower end of the crank shaft 29 is a suitable crank 32 having the outer end thereof fixed to a suitable rod 33 for reciprocating the latter. The rod 33 has a lost motion connection with the lower end of an oscillatable lever 34 pivotally connected intermediate the ends thereof to the housing 10 as at 35 and having a fork 36 at the upper end thereof adapted to engage a suitable collar 37 which in turn is fixed to the shaft 19. The lost motion connection between the lower end of the lever 34 and the rod 33 comprises a pair of axially spaced abutments 38 and 39 fixed to the rod 33 on opposite sides of the lower end of the lever 34. The lower end of the lever 34 is normally spaced from the abutment 38 by means of a spring 40 arranged under tension between the abutment 38 and the lower end of the lever 34 and encircling the rod 33. As will be observed from Figure 1, the location of the tension spring 40 is such as to normally urge the lower end of the lever 34 in the direction of the arrow 41 about its pivotal connection 35 and in so doing causes the fork 36 to act upon the collar 37 to slide the shaft 19, together with the grinding disk 22, axially inwardly toward the rotatable grinding disk 25. Thus, it will be apparent that the above arrangement provides for securing another of the previously mentioned objects of the present invention in that it serves to lessen the space between the cooperating grinding disks as the pigment therebetween diminishes in size.

Referring now to the operation of the construction previously described and assuming that the housing is substantially filled with the material to be ground and that the grinding disk 25 is rotating through the medium of the drive shaft 18, it will be noted that the agitators will serve to continuously agitate the material within the housing and distribute the same into the receiving end of the funnel 24. After the material has been delivered to the funnel 24, the same is discharged by the delivery end of the funnel to the space between the cooperating grinding disks 22 and 25, and since the former disk is non-rotatable and continuously urged toward the disk 25 by the ac-

tion of the spring 40 previously described, the material between these disks will be thoroughly pulverized. After the disk 18 has been rotated a predetermined number of revolutions depending upon the ratio of the gears 30 and 31, the crank 32 will be moved from the full line position thereof shown in Figure 1 to the dotted line position of the same causing the abutment 39 to engage the free end of the lever 34 and positively rock the same about its pivotal connection 35 in a direction to effect outward sliding movement of the shaft 19 and since the grinding disk 22 is fixed to the shaft 19, it necessarily follows that the same will be moved away from the disk 25. Movement of the disk 22 away from the disk 25 increases the area of the space between the disks and thereby permits the funnel 24 to deliver a quantity of pigment to this space. Thus, from the foregoing it will be seen that while the disk 22 is normally yieldably urged toward the disk 25 by the spring 40, nevertheless, the same is periodically and positively moved away from the disk 25 by the crank 32 and abutment 39. In this connection, it is to be noted that the abutment 39 is so positioned on the rod 33 that the same will not engage the lower end of the lever 34 to positively oscillate the same about its pivot 35 until the crank 32 approaches its dotted line position shown in Figure 1. As the crank 32 moves from its dotted line position shown in Figure 1 to the full line position thereof also illustrated in Figure 1, the abutment 39 gradually moves away from the lower end of the oscillatable lever 34, thereby permitting reaction of the spring 40 upon the lever 34 to yieldably urge the grinding disk 22 towards the cooperating grinding disk 25.

The modification illustrated in Figures 3 and 4 differs from the previously described form of the invention in that the housing 50 is rotatably mounted and contains a plurality of pulverizing or grinding units 51. The housing 50 is substantially the same in details of construction as the housing 10 described in connection with the first embodiment of this invention, but differs therefrom in that it is fixed to the drive shaft 52 which extends axially through the housing and is journaled at the forward end thereof upon a suitable support 53. Encircling the drive shaft 52 in concentric relation therewith and extending through the front wall of the housing 50 is a sleeve 54 non-rotatably supported and capable of axial sliding movement relative to the drive shaft and housing.

As indicated above, a plurality of grinding units 51 are provided within the housing 50 having cooperating members carried respectively by the axially movable sleeve and rotatable housing. In detail, the housing is provided with a plurality of circumferentially spaced shafts 55 located within and extending substantially parallel to the axis of the housing. The front and rear ends of the shafts 55 are suitably rigidly secured to the corresponding end walls of the housing so as to provide for rotation of the shafts 55 as a unit with the housing about the axis of the drive shaft. Each of the grinding units 51 are provided with rotatable grinding disks 56 centrally apertured for the passage of the sleeve there-through and rigidly secured to suitable backing plates 57 having the periphery thereof apertured for receiving the shafts 55. The plates 57 are preferably slidably mounted upon the shafts 55 and are normally yieldably urged toward the non-rotatable grinding disks 58 by means of suitable coil springs 59 carried by the shafts 55 in the manner clearly shown in Figure 3 of the draw-

ings. The cooperating grinding disks 58 are rigidly secured in any suitable manner to backing plates 60 having hub portions 61 rigidly secured to the sleeve by means of the set screws 62. The arrangement is such as to provide for axial movement of the cooperating disks 58 as a unit with the sleeve 54. Rigidly secured to each of the backing plates 60 are funnels 63 having the delivery ends extending through the grinding disks 58 in communication with the space between the latter disks and the rotatable disks 56. The receiving ends of the funnels 63 project upwardly beyond the peripheries of the disks 58 and are adapted to receive the material or pigment within the housing to be pulverized as the latter housing is rotated by the drive shaft.

With the construction as thus far described, it will be apparent that rotation of the housing by the drive shaft will also effect a rotation of the grinding disks 56 relative to the grinding disks 58. It will further be seen that the grinding disks 56 are yieldably urged toward the cooperating disks 58 by means of the springs 59 so as to lessen the space between the disks as the material therebetween is diminished in size. In this connection, it is to be noted that axial movement of the rotatable disks 56 relative to the cooperating non-rotatable disks 58 is limited by means of suitable pins 64 extending transversely through the shafts 55 in advance of the plates 64 for engagement therewith. By rotating the housing in the manner specified above, the pigment or material to be pulverized within the housing is delivered to the funnels without the provision of agitators of the type set forth in the above described form of the invention.

Movement of the disks 58 relative to the cooperating rotatable disks 56 in a direction away from the latter to provide for delivering the pigment in the funnels 63 to the space between the aforesaid disks is also accomplished in the present instance periodically and automatically. In the present modification, the above results are secured by intermittently sliding the sleeve 54 relative to the drive shaft 52 and the means provided herein for sliding the sleeve in the above manner is identical in principle to the means set forth in connection with the first described form of the invention for axially moving the disk 22. In detail, a crank shaft 65 is journaled upon the support 53 and is driven from the drive shaft 52 through the gearing 65 and 66. The ratio of the gearing is such that the crank shaft will be rotated at a relatively slow rate of speed from the drive shaft depending upon the intervals it is desired to move the grinding disks 58 away from the cooperating disks 56. As in the first described form of the invention, the crank shaft 66 is provided with a crank 67 secured to a rod 68 for reciprocating the latter. The rod 68 in turn has a slidable lost motion connection with the free end of a lever 69 pivotally connected intermediate the ends thereof as at 70 to the support 53 and having the upper end engaging a suitable collar 71 fixed to the sleeve 54. Mounted upon the rod 68 is a suitable abutment 72 operable upon movement of the crank 67 to the dotted line position thereof illustrated in Figure 3 to engage the lower end of the lever 69 and rock the same about its pivotal connection 70 in the direction of the arrow 73. Rocking movement of the lever in the aforesaid direction obviously provides for movement of the disks 58 away from the disks 56 through the medium of the sleeve 54 and collar 71. Movement of the lever by the

abutment 72 is normally resisted by a spring 74 encircling the rod 68 on the opposite side of the lever and arranged under tension between the lever and a second abutment 75. As will be apparent from Figure 1, the spring 74 tends to urge the lever 69 in a direction opposite the arrow 73 and accordingly cooperates with the springs 59 to yieldably urge the disks 58 and 56 toward each other.

While two embodiments of the invention have been shown and described herein somewhat in detail, nevertheless, it is to be understood that the several novel features of the present invention may be secured by various different types of arrangements and accordingly, reservation is made to make such changes as may come within the purview of the accompanying claims.

What I claim as my invention is:

1. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of relatively rotatable grinding members mounted in axial alignment within the housing and having cooperating grinding surfaces spaced axially from each other, means for collecting the material within the housing and discharging the same into the space between the cooperating grinding surfaces including a funnel, a rotatable agitator within the housing for delivering the material therein to said funnel and means for relatively rotating said grinding members to pulverize the materials introduced between the aforesaid grinding surfaces thereof.

2. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of grinding disks mounted within the housing in axial alignment and having cooperating grinding surfaces spaced axially from each other, means for collecting the material within the housing and discharging the same into the space between the cooperating grinding surfaces of the disks including a funnel carried by one of said disks and communicating with said space, means for rotating the other of said disks relative to said first named disk, and means carried by said rotatable disk for agitating the material in the housing and conveying the same to said funnel.

3. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of relatively rotatable grinding members mounted within the housing and having cooperating grinding surfaces positioned opposite each other in spaced relationship for receiving therebetween materials to be pulverized, means for mounting the grinding members within the housing permitting relative movement of the members in directions to increase and decrease the space between the cooperating grinding surfaces thereof, means for relatively rotating the grinding members to pulverize the materials between the aforesaid grinding surfaces, and means for automatically moving the members relative to each other to decrease the space between the cooperating grinding surfaces thereof as the material therebetween diminishes in size.

4. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of relatively rotatable grinding members arranged within the housing in axial alignment and having cooperating grinding surfaces spaced axially from each other, means for delivering the material within the housing to the space between the co-

operating grinding surfaces aforesaid, means for relatively rotating the grinding members to pulverize the materials between the grinding surfaces thereof, means for mounting said grinding members within the housing permitting relative axial movement thereof to diminish the space between the cooperating grinding surfaces thereof, and yieldable means normally urging said grinding members toward each other as the materials between the said cooperating grinding surfaces decrease in size.

5. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of grinding members located within the housing in axial alignment with each other and having cooperating grinding surfaces positioned opposite each other in spaced relationship, means for rotating one of said grinding members, means for moving the other of said grinding members axially toward and away from the grinding member aforesaid, means for automatically moving said second grinding member toward the first named member to diminish the space between the grinding surfaces as the material in said space diminishes in size, and means for periodically moving said second mentioned grinding member axially away from the first named grinding member to increase the space therebetween and provide for the delivery of material to said space.

6. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of relatively rotatable grinding members having cooperating oppositely positioned grinding surfaces spaced from each other to permit the materials to be pulverized to assume a position therebetween, means for mounting said grinding members within the housing permitting relative movements thereof in directions to increase and decrease the space between the grinding surfaces aforesaid, means for relatively rotating said grinding members to pulverize the materials therebetween, means for automatically relatively moving said grinding members in a direction to decrease said space as the material between the grinding surface diminishes in size, and means for periodically relatively moving said grinding members away from each other to increase the space therebetween so as to permit the introduction of additional material to said space.

7. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of relatively rotatable grinding members having cooperating oppositely positioned grinding surfaces spaced from each other to receive therebetween the materials to be pulverized, means for relatively rotating said members to pulverize the materials between the grinding surfaces thereof, means for mounting said grinding members within the housing permitting relative movements thereof in directions to increase and decrease the space between the grinding surfaces aforesaid, means for automatically relatively moving said grinding members in a direction to decrease said space as the material between the grinding surfaces diminishes in size, means for periodically relatively moving said grinding members away from each other to increase the space therebetween, and means operable during the interval said grinding members are moved relatively in the last mentioned direction to deliver material from the housing to said space.

8. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of grinding members arranged in axial alignment within the housing and having cooperating grinding surfaces positioned opposite each other in spaced relationship, a drive shaft connected to one of said members for rotating the same relative to the other, means mounting said second mentioned grinding member for axial movement toward and away from said first mentioned grinding member, yieldable means normally urging said second grinding member toward the first mentioned member to diminish the space between the grinding surfaces aforesaid thereof, and means operated by said drive shaft for periodically moving said second member away from said first named member to increase the space between said grinding surfaces.

9. In a machine for pulverizing materials, a rotatable housing adapted to contain the material to be pulverized, means for rotating the housing to agitate the materials therein, a pair of relatively rotatable grinding disks mounted within the housing in axial alignment and having cooperating grinding surfaces positioned opposite each other in spaced relationship, means positioned within the housing for collecting the material agitated thereby and for delivering the material to the space between the grinding surfaces aforesaid and means for relatively rotating the disks to pulverize the materials therebetween.

10. In a machine for pulverizing materials, a rotatable housing adapted to contain the material to be pulverized, means for rotating the housing to agitate the materials therein, a grinding disk mounted within the housing coaxially with the axis of rotation of the latter, means connecting said grinding disk to the housing for rotating the former as a unit with the latter, a non-rotatable grinding disk mounted within the housing in axial alignment with the disk aforesaid and in spaced relation thereto, and means fixed to said last mentioned disk for collecting the material agitated by the housing and for delivering said material to the space between said disks.

11. In a machine for pulverizing materials, a rotatable housing adapted to contain the material to be pulverized, means for rotating the housing to agitate the materials therein, a plurality of grinding units arranged within the housing for pulverizing the material therein, each of said units comprising, a grinding disk rotatable as a unit with the housing, a non-rotatable grinding disk spaced axially from the rotatable disk, and a hopper for delivering material from the housing to the space between said disks.

12. In a machine for pulverizing materials, a housing adapted to contain the material to be pulverized, a plurality of grinding units arranged within the housing for pulverizing the material therein, each of said grinding units comprising, a rotatable grinding disk, a non-rotatable grinding disk arranged in axial alignment with the disk aforesaid and in spaced relation thereto, means for rotating the first named disk of each unit to pulverize the materials between the latter and non-rotatable disks, means for automatically and simultaneously moving all of said non-rotatable disks axially toward the rotatable disks as the material between the grinding surfaces thereof diminishes in size, means for simultaneously and periodically moving all of said non-rotatable disks axially away from the rotatable disks to increase the space between the

grinding surfaces thereof, and means for delivering material from the housing to the space between each of said cooperating disks.

13. In a machine for pulverizing materials, a rotatable housing adapted to contain the material to be pulverized, means for rotating the housing to agitate the materials therein, a plurality of grinding units arranged within the housing for pulverizing the material therein, each of said units comprising, a disk rotatable as a unit with the housing, a non-rotatable disk arranged in axial alignment with the disk aforesaid and in spaced relation thereto, means for automatically and simultaneously moving all of said non-rotatable disks axially toward the rotatable disks as the material between the grinding surfaces thereof diminishes in size, means for simultaneously and periodically moving all of said non-rotatable disks axially away from the rotatable disks to increase the space between the grinding surfaces thereof, and means for delivering material from the housing to the space between each of said cooperating disks.

14. In a grinding machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of relatively rotatable grinding members mounted within the housing and having oppositely arranged cooperating grinding surfaces spaced from each other, means for collecting the material within the housing and discharging the same into the space between the cooperating grinding surfaces on said members, means for periodically relatively moving said grinding members axially, and means for relatively rotating said members to pulverize the materials therebetween.

15. In a machine for pulverizing materials, a housing adapted to contain the material to be

pulverized, a plurality of grinding units arranged within the housing for pulverizing the material therein, each of said units comprising, a rotatable grinding disk, a non-rotatable grinding disk arranged in axial alignment with the disk aforesaid and in spaced relation thereto, means for periodically relatively moving the grinding disks of each unit away from each other to increase the space therebetween for receiving the material to be pulverized, means for rotating the first named disk of each unit, and means for simultaneously relatively moving the disks of each unit axially toward each other.

16. In a machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of opposed relatively rotatable grinding members mounted within the housing with the adjacent grinding surfaces spaced from each other to receive the material to be pulverized, means for periodically relatively moving said grinding members axially, and means for simultaneously relatively rotating said members to pulverize the material therebetween.

17. In a grinding machine for pulverizing materials, the combination with a housing adapted to contain the material to be pulverized, of a pair of opposed grinding members mounted within the housing with the adjacent grinding surfaces spaced from each other to receive therebetween the material to be pulverized, means for relatively rotating said grinding members, means for relatively moving the grinding members toward each other during relative rotation of the same to pulverize the material therebetween, and means for periodically relatively moving the grinding members away from each other.

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