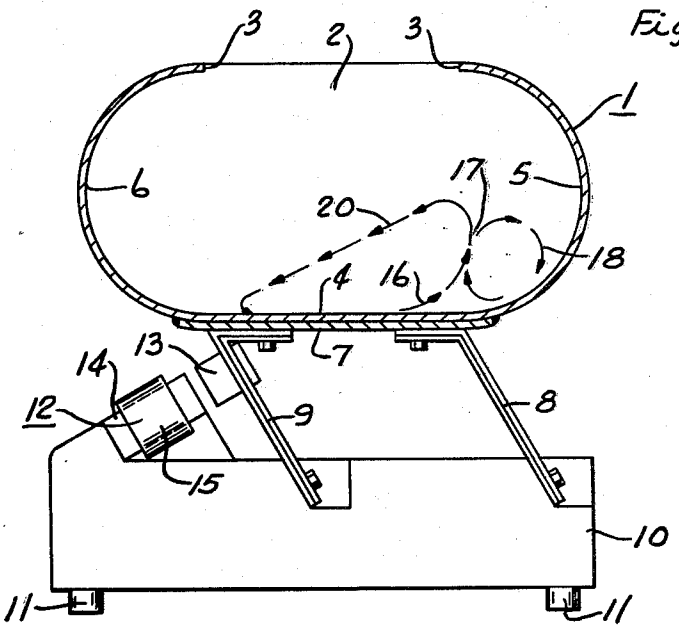
Oct. 29, 1963 E. F. DAHLQUIST ETAL 3,108,408

APPARATUS FOR ABRADING BY VIBRATORY FLOWING OF THE ABRADING MATERIAL

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Fig. 1



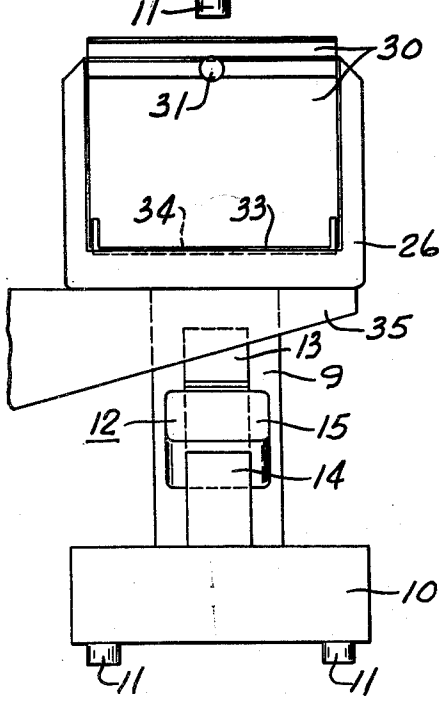


Fig. 5

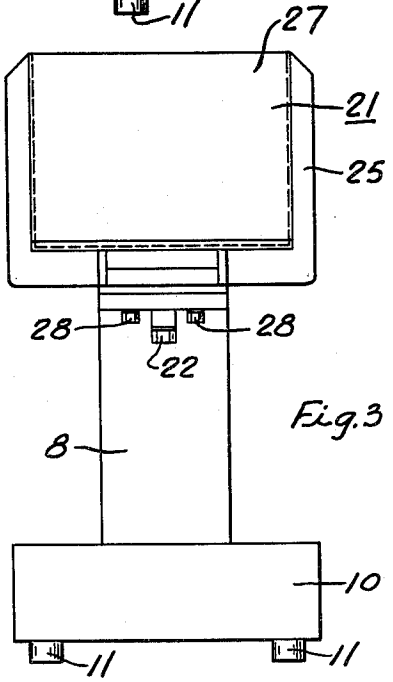


Fig. 3

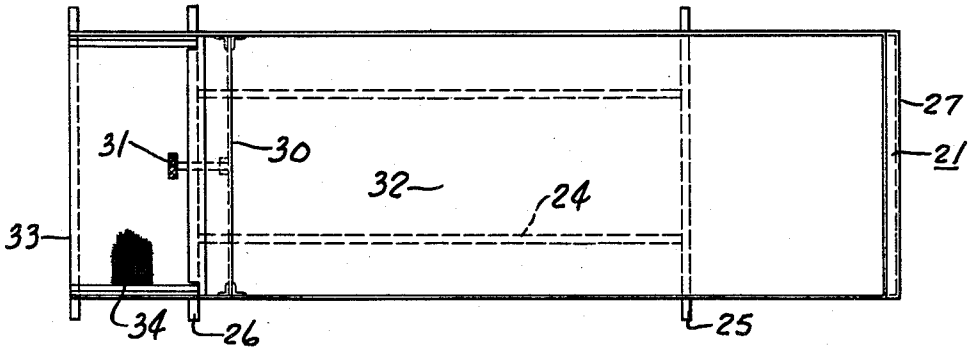
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Fig. 4



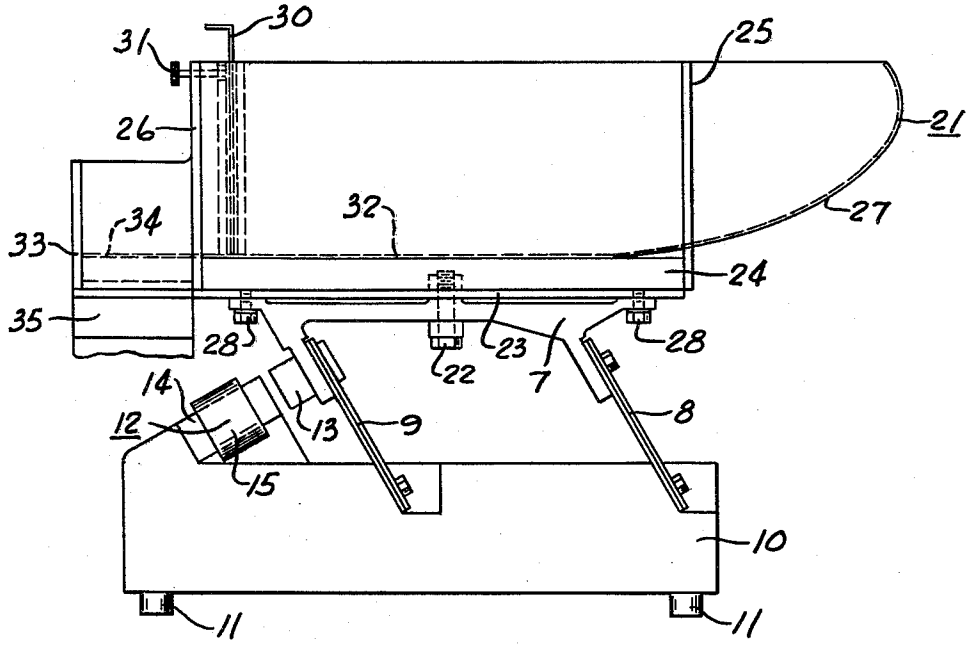
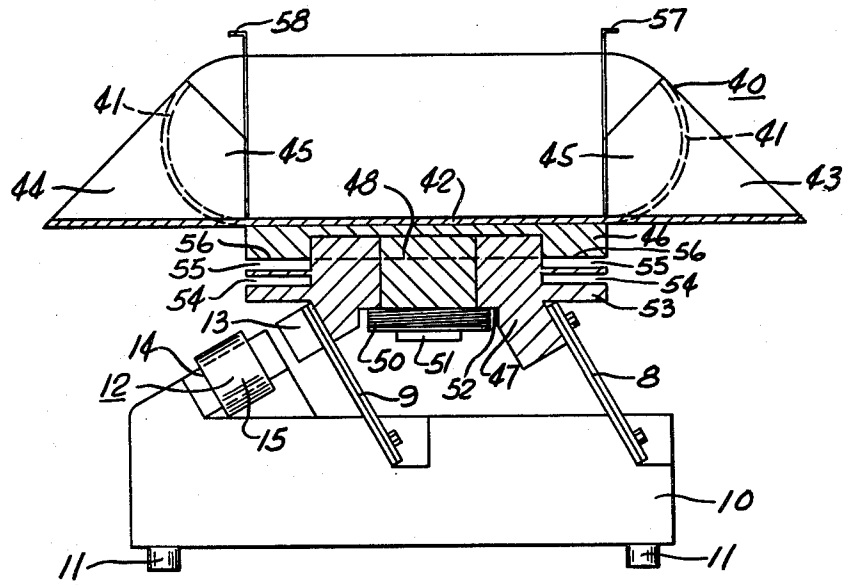


Fig. 2

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Fig. 7



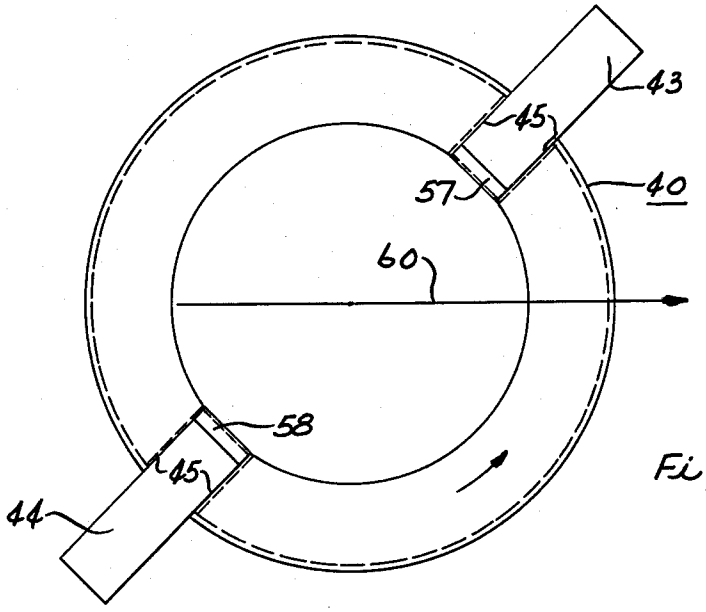


Fig. 6

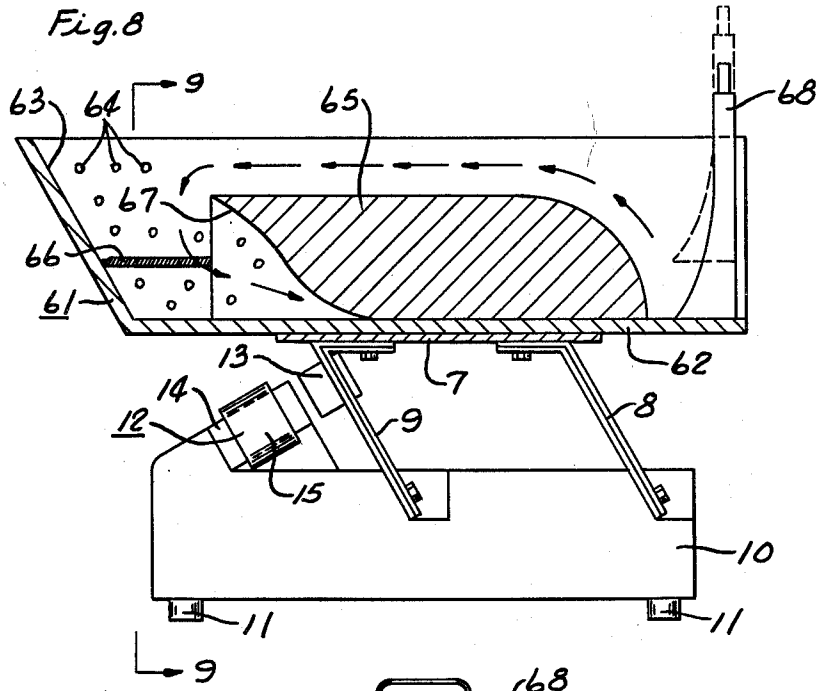
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Fig. 8



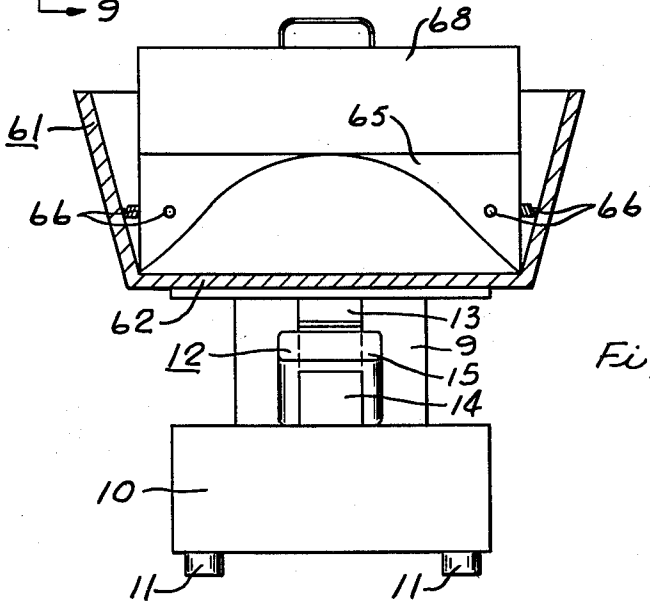


Fig. 9

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United States Patent Office 3,108,408 Patented Oct. 29, 1963

3,108,408

APPARATUS FOR ABRADING BY VIBRATORY FLOWING OF THE ABRADING MATERIAL

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6 Claims. (Cl. 51—163)

This invention relates generally to apparatus for abrading workpieces and more particularly to abrading workpieces by having them pass through abrading material acted upon by vibratory motion.

In the art of abrading workpieces having their whole surface area covered by loose abrading material, it is difficult to produce a definite cycle through which the material passes. It is also difficult to control the path of such a cycle and such an abrading action is sometimes too harsh and rough in tumbling the workpieces or articles which are frail and fragile.

The principal object of this invention is the provision of a controlled vibratory feeding motion applied to the abrading material for the purpose of carrying the article being abraded through and along with the material in a definite path and since the article or workpiece is ordinarily larger than the abrasive material it is caused to flow in a circuit similar to that taken by the abrading material but at a much slower rate which provides a definite advantage in abrading the article.

Another object is the provision of apparatus for controlling the flow of abrading material by vibratory movement and for also controlling the speed of the movement of the material which is effective in controlling the speed of movement of the articles being abraded to thereby control the rate of abrasion.

Another object is the provision of controlling not only the flow and the rate of speed of the flow of abrasion particles to control the rate of abrasion of the articles but also to control the direction of flow as well as the pattern of flow in abrading articles covered by and submerged with so as to travel along constantly moving abrading material.

Another object is the provision of apparatus of feeding the abrasion material together with the articles through a prescribed circulatory path and then subsequently conveying the articles and the abrading material over a screening means to separate the same and to clean the abrading particles from the surface of the articles.

Another object is the provision of apparatus for abrading articles by conveying the abrading material with the articles submerged therein through a predetermined cyclic path and simultaneously changing the path continuously through a predetermined period of time which results in the combination of rotating the container of the abrading particles through an arcuate period during a predetermined length of time until the container is oriented to such a position as to feed the abrading material and articles from the container to separate the same at the end of a predetermined period determined by the rotation of the container relative to the direction of the vibratory feeding action of the abrasive material and the articles immersed therein.

Other objects and advantages appear hereinafter in the following description and claims.

The accompanying drawings show for the purpose of exemplification without limiting this invention or the claims thereto, certain practical embodiments illustrating the principles of this invention wherein:

FIG. 1 is a view partly in section illustrating the simple form of vibratory container for the loose, abrading material and articles.

FIG. 2 is an enlarged view of a modified form of a container which is capable of being swung through 180° to feed the material out of the container upon the completion of the abrading operation.

FIG. 3 is an end view of the structure shown in FIG. 2.

FIG. 4 is a plan view of the abrading pan shown in FIG. 2.

FIG. 5 is an end elevation of the discharge end of the abrading container shown in FIG. 2.

FIG. 6 is a plan view of another modified form of abrading container.

FIG. 7 is a view in side elevation of the structure shown in FIG. 6 with parts in section and parts broken away.

FIG. 8 is a view in vertical section showing the powder mill.

FIG. 9 is taken on the line 9—9 of FIG. 8.

Referring to FIG. 1 of the drawings the abrading machine and method comprising this invention is illustrated as the container 1 having the sides 2 with an opening 3 in the top thereof. This container has flat sides 2 connected by a bottom 4 which is curved upwardly at both ends to form the arcuate end portions 5 and 6.

This container is secured to the frame 7 mounted on the spaced parallel vibratory members in the form of the two sets of springs 8 and 9 which are bolted or otherwise secured to the base or vibratory reaction member 10 which in turn is mounted on the elastomer feet 11 to prevent absorption or retransmission of the vibratory motion to the table or floor surface.

An electromagnetic vibratory motor 12 is provided with an armature member 13 secured relative to the frame 7 in spaced operative relation to the core member 14 of the electromagnetic motor 12. The core 14 is energized by the coil 15 which is preferably supplied with a pulsating current such as an alternating current or a rectified alternating current or any type of interrupted current that provides a pulsation which is of such frequency in reciprocating the frame 7 and the container 1 at a frequency close but not in resonance with the natural period of the vibratory system made up of the container 1, the frame 7 and the springs 8 and 9. The electromagnetic motor 12 ordinarily is provided with some form of control so that the amplitude or reciprocation of the container may be varied to any desired degree.

Other types of controls may be provided for motors of this character to change the frequency of vibration. In any event, the container is vibrated in a given path, the springs 8 and 9 traveling through a short arc thereby reciprocating the container in a direction between the turned up ends 5 and 6 of the container 1.

The abrasive material which ordinarily is in pellet, powdered or granular form, is supplied with the articles to be abraded through the opening 3 into the container and when the motor 12 is energized the material follows a path indicated by the arrows. The abrading material flows at a faster rate than the articles but the articles following first along the bottom of the conveyor from left to right as indicated by the arrow 16 and thence upwardly through a vortex indicated at 17 and downwardly to the front as indicated by the arrows 18 thence upwardly through the vortex 17 and downwardly along the path of the arrows indicated at 20 and thence repeating the cycle. This action is created by the wall in the general path of initial flow which is referred to as an abutment. This cycle is followed by the articles being abraded. However, sometimes they do not take the short loop indicated by the arrows 18 but take the long loop indicated by the arrows 16 and 20 or repeat either the short or the long loop in a haphazard manner. This is believed to be the path of movement although it may in certain cases follow a different pattern. After the articles have been

circulated in this manner for a relatively short time they are usually sufficiently abraded to be removed. The abrading material traveling over and faster than the articles and the articles are sometimes totally submersed and other times they will appear at the surface. However they are continuously washed by the abrading material as it circulates in the short and long cyclic paths. This abrading action can be very gentle and thus may be employed with very fragile articles. The movement of the abrading material may be slowed down materially by reducing the amplitude of vibration of the feeder type motor.

Referring to FIGS. 2 to 5 inclusive the container 21 is somewhat different in shape than the container 1 and it is mounted on the frame 7 which in this instance is provided with a central pivot screw 22 that extends upwardly into a container frame 23 that embraces a base member 24 and is provided with the upwardly extending side braces 25 and 26. The side brace 25 is at the front of the base 24 and spaced from the upwardly curved end 27 of the container 21.

The frame 7 in FIG. 2 is also provided with the clamping bolts 28 which extend through the frame 7 into the container frame member 23 for retaining the latter against rotation about the pivot bolt 22.

A gate valve 30 is provided on the feeder type conveyor 21 and the opening thereof may be adjusted by the lock screw 31. As the gate valve is raised the opening that it makes with the floor 32 of the container 21 limits the discharge of the material from the container 21 when the latter is swung 180° from that shown in FIG. 2 for the purpose of feeding the abrasive material from the container 21. To accomplish this, the locking bolts 28 are loosened and the container 21 is swung through 180° and the locking bolts are again tightened. The motor 12 is again energized and the gate 30 is opened to a sufficient degree to permit the discharge of the abrading material from the container 21 and if the articles being abraded are sufficiently large to prevent them from traveling through the gate opening, then all of the abrading material may be fed by a feeder action through the open gate thereby retaining only the abraded articles within the container 21 after which time the gate 30 may be open to a wider degree for the purpose of feeding the articles through the discharge 33 to a container other than the container that received the abrasive material.

If it is desirable to feed the material together with the articles through the open gate 30 at the same time then a screen 34 may be provided in the bottom of the discharge 33 to permit the abrading material to be sifted out and discharged laterally through the conveyor 35, whereas the articles being abraded are fed across the screen 34 to a second container.

If it is desired to re-use the abrading material it may be again inserted in the container 21 which is returned to the position as shown in FIG. 2 and a new batch of articles are then placed in the container 21 for abrading in the same manner as that previously described.

In the structures shown in FIGS. 6 and 7 the container 40 is circular in cross section and has an upwardly curved annular wall indicated at 41 extending from a circular base indicated at 42. The upwardly curved side 41 has two diametrically opposed discharge chutes 43 and 44. Each of these chutes are defined by the parallel plates 45.

The container 40 has an annular underframe structure 46 which surrounds and is journaled on the annular frame 47 supported by the parallel seats of flexible spring members 8 and 9 and is the same as the former frame 7. A central core member 48 extends downwardly from the frame 46 and has a spring 50 secured thereto by means of the bolt 51. The spring 50 rests upon the annular shoulder 52 and the underportion of the frame 47.

The frame 47 also has an external annular shoulder 53 on which is mounted the rubber rotary feeding members 54 by any suitable means such as cementing or vulcanizing the same thereto, such rubber supports as shown in U.S. Patent No. 2,746,599. The rubber members 54 have a series of upwardly extending flexible arms 55 which engage the undersurface 56 of the frame 46 and as the feeder motor 12 reciprocates the frame 47 it does so through an arcuate path in a single plane having a vertical and horizontal component, the vertical component of which is effective on the flexible arms to cause them to feed the container 40 about the vertical central axis of the center post 48. Thus the whole container slowly vibrates in a circular path about the vertical central axis 48 as the abrading material follows the same path as that illustrated in FIG. 1 at 18 and 20 when the arcuate sides 41 of the container are in line with the plane in which the springs 8 and 9 are vibrated. However, as the discharge chutes 43 and 44 are oriented to the position where they become aligned with the vibratory motion of the springs 8 and 9, the abrading material together with articles being abraded may be fed outwardly through the discharge throat 43 and screened or not in accordance with the teachings of FIGS. 2 and 4.

As the container 40 continues to rotate another batch is fed through the upwardly open container and since the discharge 43 is sufficiently remote of the plane of vibration as indicated at 60 the new load will not be discharged from the chute until the container is rotated through a half revolution of 180° at which time the discharge throat 44 is in the proper position to discharge the abrading material and the articles when it has aligned itself with the arrow of the vibratory plane 60.

Suitable gate valves 57 and 58 may be provided for each of the discharge chutes 43 and 44 respectively, however, the timing of the loading may be effected so as to eliminate the use of such gates.

In circulating workpieces through the ever moving mass of abrading material the rough edges as well as the surfaces are abraded. The workpiece surfaces are actually milled off by the abrading material. The degree of removal of the surface from the workpiece depends upon the time the workpiece is left in the constantly moving abrading material as well as the character of the material from which the workpiece is made. A workpiece made from a soft material such as chalk, talc, limestone, alabaster, asbestos or other softer material, even an aluminum lead, can be polished highly indicating removal of material.

The flow pattern of the abrasive material can be made to tumble the articles but they can be easily merely flown or conveyed at a slower rate than the abrading material. Thus the action is one of merely milling the surfaces of the articles. This action also acts on the edges of the articles. Thus by this feeding action the articles and the abrasive material is moved in a circulatory path which is not hard on the articles but accomplishes the milling of their faces and generally abrading the same.

In the structure shown in FIGS. 8 and 9 the feeder illustrated is the same straight feeder motor as illustrated in FIG. 1 and the frame 7 mounted on the cantilever springs 8 and 9 supports the feeder trough 61 which is provided with an extra heavy bottom as indicated at 62. This feeder trough has the sloping back 63 for receiving large granule material such as indicated at 64. Within the feeder trough 61 a weight 65 is mounted. This weight is loosely held on the bottom 62 and may be held in position as indicated by the spring members 66 on the sides and in the rear. Such springs merely retain the weight 65 from moving along the base but permits it to vibrate up and down independently of the trough 61.

The weight 65 is preferably provided with a throat such as indicated at 67 which is bell-shaped and enables the materials indicated at 64 to flow therein. As these materials flow down through the bell-shaped tapered opening they become caught or otherwise entrapped between the weight and the heavy bottom 62. Then the vibratory action of the springs 8 and 9 with the free weight 65 func-

tion to crush the particles 64 until they become powdered. However the granules will flow underneath the weight 65 towards the end of the trough and when the gate 68 is down as indicated in the full line position the materials will flow upwardly across the back of the weight 65 and will come to the feeding end of the conveyor and thereby reload itself in the throat 67. Thus by continuing a circulatory path in this manner the materials will be acted upon by the vibratory movement of the trough and the weight to powder the granules until they are extremely small.

The vibratory action of the conveyor on this loose or free weight which is merely retained from moving as the article is being fed has a tremendous effect in crushing or pulverizing the material. If the feeder is made in a materially larger size the material to be crushed or milled or ground is of course materially larger. The important thing is that the material will continue to mill in its own circulatory path as indicated by the arrows until it becomes quite fine, at which time the gate 68 may be lifted and allow the powdered material to flow to another container.

We claim:

1. A high frequency vibratory type abrading machine for abrading friable as well as non-friable materials in a granular mass of abrading material which consists of a frame having a front and back, a material container secured on said frame and having a chamber with smooth inner surfaces on the bottom and front and sides which retains the material therein during abrading operation, a reaction base mounted on isolators, tuned straight springs each having one end secured to said reaction base and their other end secured to said frame to support said container for reciprocation in a single plane, an electromagnet having its armature mounted on said frame and its electromagnetic field member mounted on said reaction base to hold the same in operative spaced relation with said armature and when energized to feed by vibratory reciprocation said material in one direction against said front of said chamber where it flows up and back over itself in an endless path, said frame and said material-loaded container and said reaction base and said tuned straight springs making up a tuned vibratory system the natural period of vibration of which is a selected frequency close but not in resonance with the frequency of the alternating current to energize said electromagnet and reciprocate said material-loaded container at a high frequency to produce a feeding action and feed the material in one direction against said front wall of said container where it flows up and back over itself in a continuous path within the smooth surfaced chamber of said container to permit the abrading material to abrade friable as well as non-friable material in the granular mass of abrading material.

2. The abrading machine of claim 1 which includes a discharge at the back of said container to discharge the material from said chamber, and a revolving support for rotatably mounting said container on a vertical axis on said frame to permit said container to be turned on said vertical axis and position said discharge at the front of said frame so that said high frequency feeding action in flowing the material in the one direction will flow the material from said chamber through said discharge.

3. The abrading machine of claim 2 which includes a screen supported from said frame and adjacent said discharge over which the material flows from said discharge to separate the friable and non-friable materials from said abrading material when the back of said container is revolved to the front of said frame and said high frequency feeding action flows the material in one direction through said discharge and over said screen.

4. The abrading machine of claim 2 which includes locking means to secure said container to said frame in selected front and back positions on said frame.

5. The abrading machine of claim 2 which includes a flexible means disposed between said frame and said container to continuously rotate said container about said vertical axis in increments due to the high frequency feeding reciprocation in one direction of said tuned vibratory system and thereby abrade the material in the chamber of said container until said discharge reaches the front of said frame and the material is fed through said discharge out of said chamber.

6. The abrading machine of claim 1 which includes means to vary the supply of alternating current to said electromagnet to vary the forces delivered by the high frequency feeding action and change the amplitude of reciprocation of said tuned system to vary the rate of flow of the material in said chamber and to vary the intensity of the abrading effect on the friable and non-friable materials.

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