United States Patent

[11] 3,540,664

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[21] Appl. No. **729,628**
[22] Filed **May 16, 1968**
[45] Patented **Nov. 17, 1970**

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[54] **RESILIENT WHEEL IMPACT MILL**
13 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **241/38,** 241/54, 241/73, 241/101, 241/102, 241/228
[51] **Int. Cl.** **B02c 7/11**
[50] **Field of Search** 241/38, 54, 58, 73, 124, 126, 228; 102, 101

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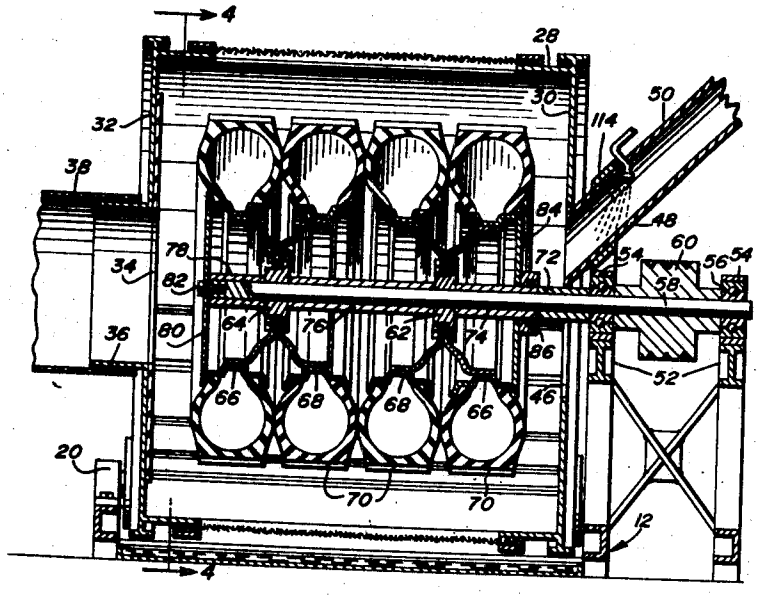
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Primary Examiner—James M. Meister
Attorney—Clarence A. O'Brien & Harvey B. Jacobson

ABSTRACT: A horizontally disposed rotary drum provided with opposite end wall portions and delivery means for delivering material generally axially into one end of the drum and means for withdrawing pulverized material from the drum. The drum is designed to rotate at low speed and includes internal high speed rotary impact means journaled for rotation about axes generally paralleling the axis of rotation of the drum. The peripheral wall portions of the drum include circumferentially spaced screened outlet openings defining the means for withdrawing pulverized material from the drum and the drum further includes baffle plates spaced about the inner surface portions of the drum disposed in planes lying generally along chords of the drum with the plates including base edge portions supported from the peripheral wall portion of the drum and free edge portions spaced slightly inwardly from the base edge portions of the adjacent plates, the plates overlying the screened outlet openings of the drum.



Sheet 1 of 2

Fig. 1

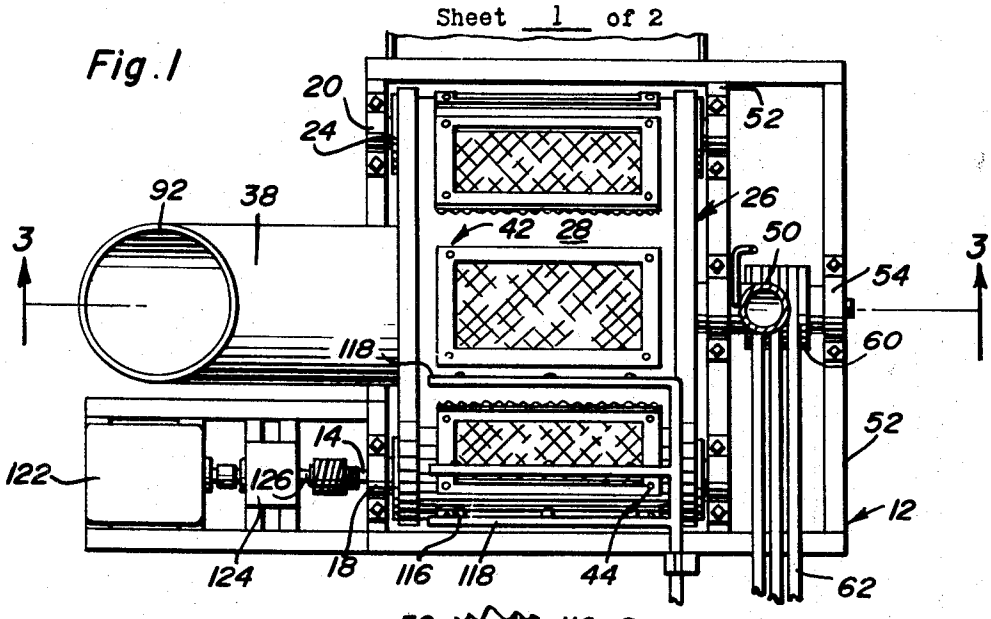


Fig. 4

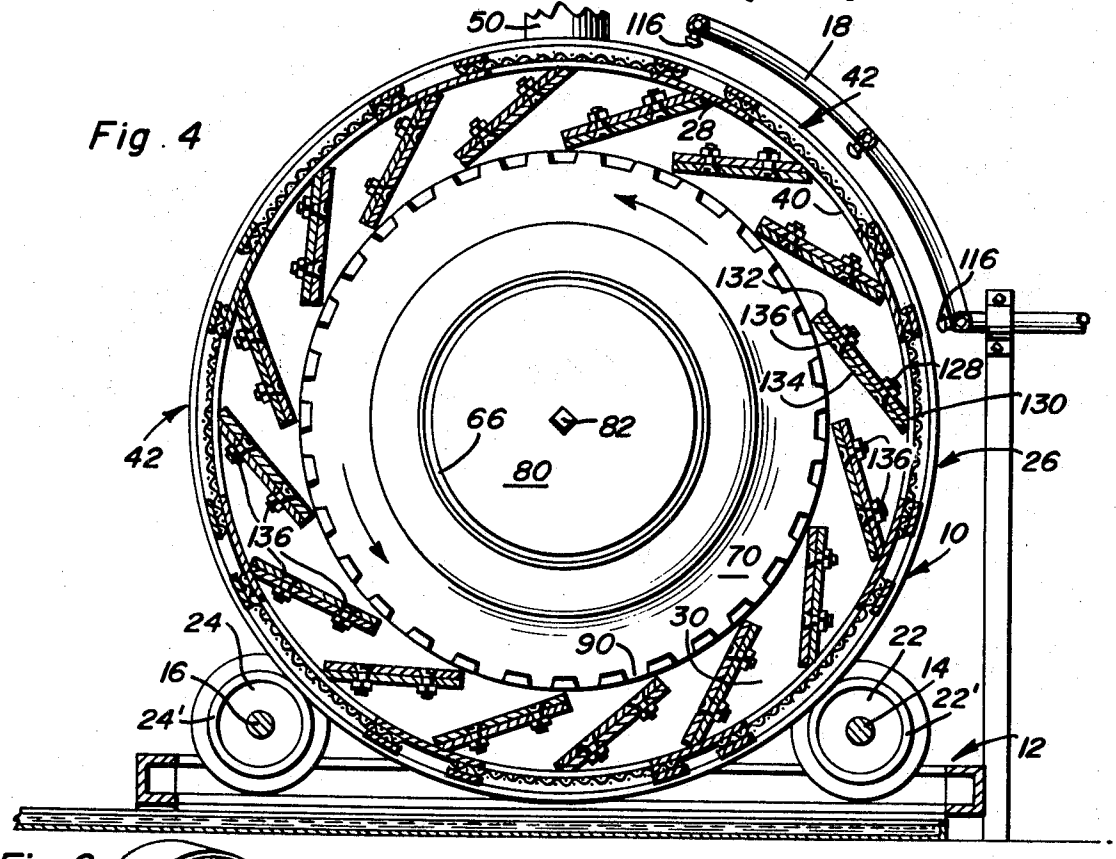


Fig. 6

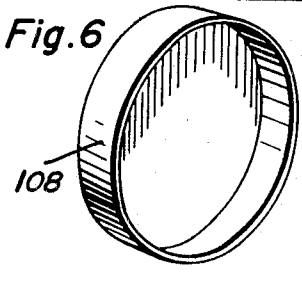
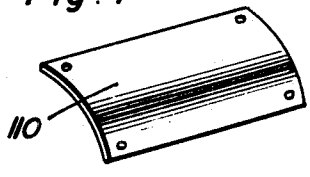


Fig. 7



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Fig. 3

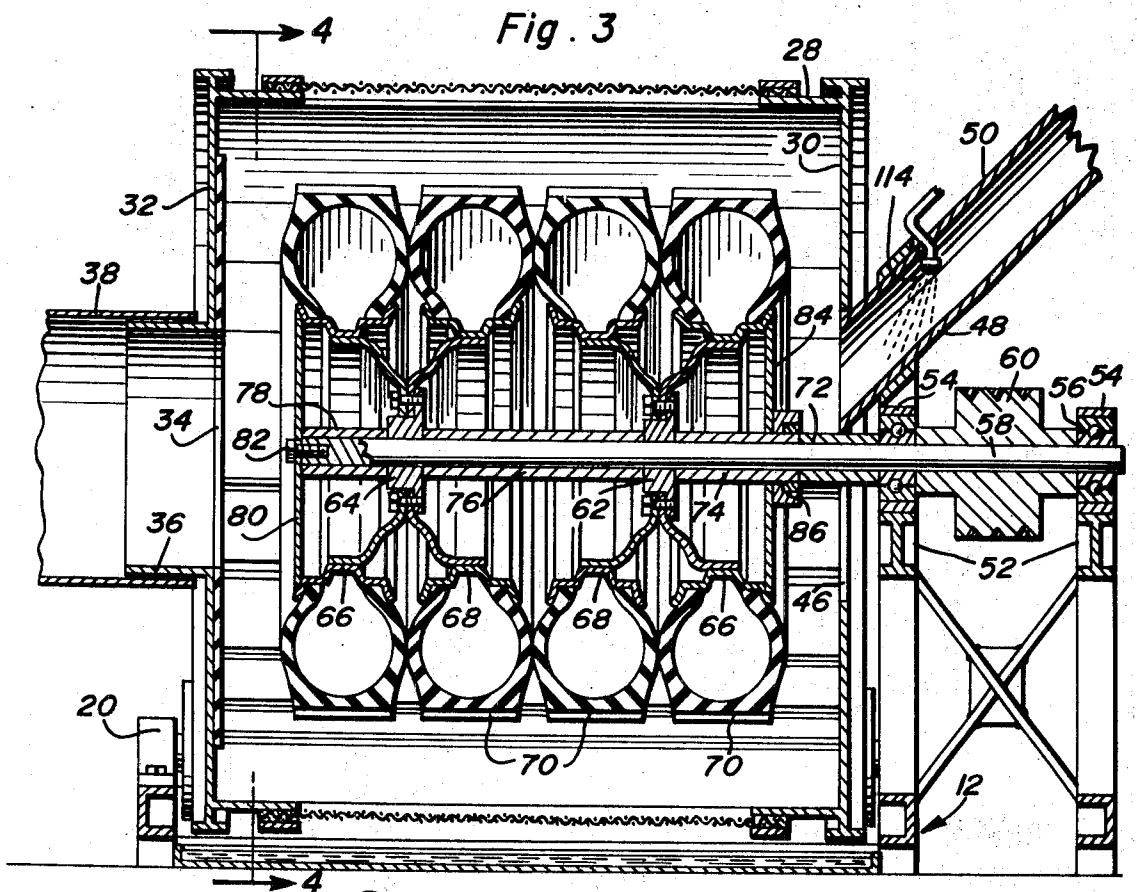


Fig. 2

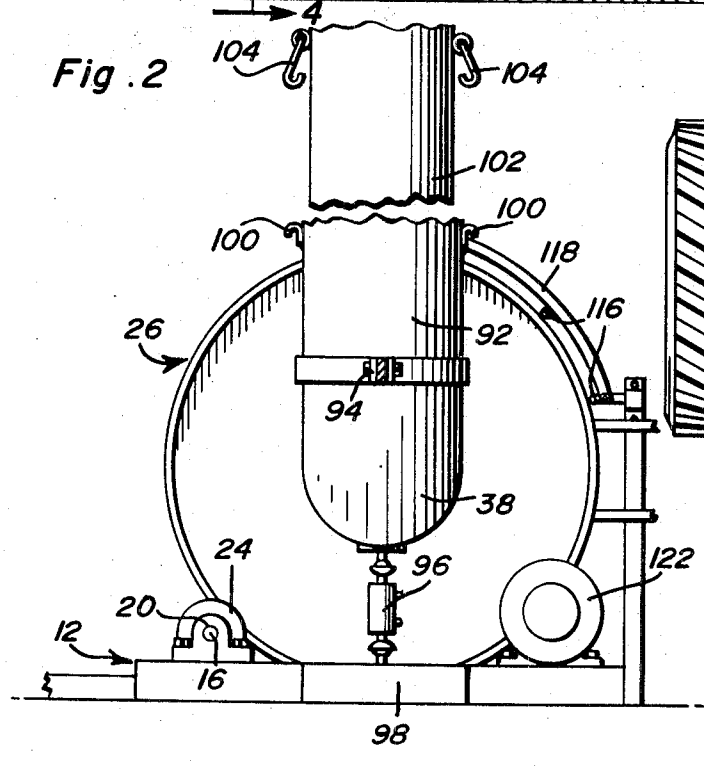
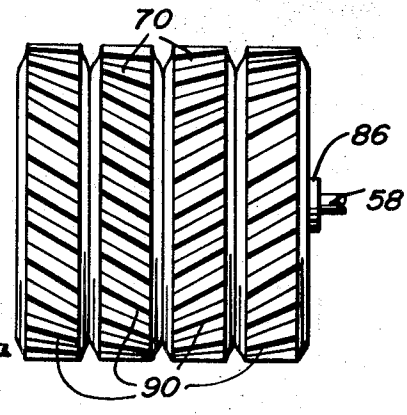


Fig. 5



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RESILIENT WHEEL IMPACT MILL

This invention relates to an impact mill of the rotating horizontal drum type constructed in a manner whereby it may be alternately used to pulverize materials either by a wet process or a dry process. Very little modifications of the mill are necessary to convert the drum from a dry process drum to a wet process drum and the drum or mill is further constructed in a manner whereby it is expected to have extended periods of operation before requiring maintenance or repair.

The impact mill is capable of operating in a manner such that high recovery and increased capacity is realized over the recovery capacity of conventional mills.

When metallic ores are being recovered, the wet process is used and when nonmetallic ores are being recovered the dry process is used.

The percentage of metallic ores recovered without overpulverizing such metallic ores is increased by using the mill of the instant invention and loss of metallic ores recovered due to overpulverization is reduced.

An important feature of the mill is that the internal rotary impact portions thereof are constructed of resilient material resulting in the expected life of the rotary impact members being as much as ten times as long as the life expectancy of metallic rotary impact members. In addition to these resilient rotary impact members functioning to recover metallic ores without overpulverizing, they also tend to reduce the shearing of fibrous ores such as asbestos. Further, the resilient rotary impact members, by yielding under impact, do not chip away and thus remain balanced over greatly extended periods of operation before requiring maintenance or replacement. Finally, the resilient portions of the impact members tend to greatly reduce the operating noise o f the impact mill.

The impact mill is constructed in a manner whereby it is subject to less shock and therefore it does not need to be as heavily constructed and can be more readily transported from one location to another. Further, the resilient portions of the rotary impact members of the mill increase not only the quality of the material being covered but also the capacity of the mill itself.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a top plan view of the resilient wheel impact mill;

FIG. 2 is an end elevational view of the mill as seen from the left side of FIG. 1;

FIG. 3 is an enlarged fragmentary vertical sectional view taken substantially upon a plane indicated by section line 3–3 of FIG. 1;

FIG. 4 is a vertical sectional view taken substantially upon a plane indicated by section line 4–4 of FIG. 3;

FIG. 5 is a side elevational view of the resilient wheel rotary impact member of the mill;

FIG. 6 is a perspective view of a selectively usable removable cap; and

FIG. 7 is a perspective view of a selectively usable removable closure plate.

Referring now more specifically to the drawings the numeral 10 generally designates the mill which includes a base referred to in general by reference numeral 12 from which a pair of support shafts 14 and 16 are journaled by means of journal blocks 18 and 20. The shafts 14 and 16 have flanged rollers 22 and 24 journaled thereon and which rotatably support a drum assembly generally referred to by reference numeral 26.

The drum assembly 26 includes a peripheral cylindrical wall portion 28 and a pair of opposite end walls portions 30 and 32 which may be removably secured in the corresponding ends of the cylindrical wall portion in any convenient manner. The end wall portion 32 is centrally apertured as at 34 and includes an outwardly projecting outlet neck 36. The outlet end of an

outlet conduit 38 is telescoped over the outlet neck 36 and the inlet end of the conduit 38 is adapted to be communicated with any suitable source of vacuum.

The cylindrical wall portion 28 includes a plurality of circumferentially spaced outlet openings 40 which have screen assemblies generally referred to by the reference numeral 42 secured thereover by means of suitable fasteners 44 and the end wall portion 30 is centrally apertured as at 46 while the outlet end 48 of an inlet chute or conduit 50 is registered with the opening or aperture 46 so that material to be pulverized may be introduced into the drum assembly 26 from the conduit 50.

The base 12 includes elevated portions thereof outwardly of the end wall portion 30 from which a pair of journal blocks 54 are supported. The journal blocks 54 include bearings 56 and rotatably journal longitudinally spaced portions of a shaft 58 having one extended end portion which projects through the opening or aperture 46 and into the drum assembly 26. A pulley wheel 60 is mounted on the shaft 58 for rotation therewith and a plurality of endless flexible belts 62 are trained about the pulley 60 and also any suitable remote rotary drive member (not shown).

The shaft 58 has a pair of hubs 62 and 64 mounted thereon at points spaced longitudinally therealong and keyed thereto for rotation therewith. The hubs 62 and 64 have pairs of dual wheels 66 and 68 mounted thereon. The wheels 66 and 68 have pneumatic tires 70 mounted thereon and a plurality of spacer and wear sleeves 72, 74, 76 and 78 are disposed on the shaft 58 so as to completely cover the entire extended end portion of the shaft which projects into the drum assembly 26. An end plate 80 is secured over the end of the shaft 58 remote from the pulley wheel 60 and the corresponding end of the adjacent wheel 66 by means of any suitable fastener 82 and an annular end plate 84 is disposed over the sleeve 74 and between the wheel 66 adjacent the pulley wheel 60 and a collar 86 disposed about the sleeve 74 adjacent the sleeve 72.

The pneumatic tires 70 may be of conventional design except that their outer tread portions include inclined transversely extending lugs 90 with the lugs 90 with one pair of tires 70 being inclined in one direction and the lugs 90 on the other pair of tires 70 being inclined in the opposite direction. However, it is not necessary that pneumatic tires be used and the tires 70 could be replaced by solid tirelike members. However, it is important that the outer peripheral portions of whatever rotary impact members are used be constructed of resilient material such as rubber.

The outlet conduit 38 is readily removably engageable over the outlet neck 36 and includes an upwardly directed portion 92 supported by means of a horizontally shiftable support member 94 and an extendible support member 96. The extendible support member 96 is supported from its own base member 96 and the support or support member 94 may be suitably supported from any suitable stationary member in a manner such that the conduit 38 may be shifted both slightly horizontally outwardly of the end wall portion 32 and vertically, the upper end of the upstanding portion 92 of the conduit 38 including diametrically opposite hooks 100 and being telescoped over and shiftable upwardly relative to an upper extension 102 of the upstanding portion 92 provided with pivoted hook members 104 for engagement with the hooks 100.

With attention now invited more specifically to FIG. 6 of the drawings there may be seen a cap 108 which may be removably and snugly telescoped over the outlet neck 36 in lieu of the outlet conduit 38. In FIG. 7 of the drawings there may be seen a cover plate 110 which may be secured over each of the openings 40 in lieu of the screen assembly 42. Further, the base 12 includes a shallow pan or trough underlying the lower periphery of the drum assembly 26 for a purpose to be hereinafter more fully set forth.

In operation, if the drum assembly 26 is to pulverize material by the wet process, the screen assemblies 42 are retained and the cap 108 may be removably secured over the outlet

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neck **36** in lieu of the outlet conduit **38**. Then, as material is discharged into the drum assembly **26** from the inlet conduit or chute **50**, the material is wetted by water from the nozzle **114** disposed within the chute **50** and also by water being sprayed inwardly through the screen assemblies **42** from the nozzles **116** of the manifold which is positioned outwardly of but adjacent the upper peripheral portions of the drum assembly **26**. The nozzles **114** and **116** are of course communicated with any suitable source of water under pressure.

The rollers **22** and **24** have resilient friction drive rings **22'** and **24'** disposed thereabout and the shaft **14** upon which the rollers **22** are mounted is driven by means of an electric motor **122** through a gear reduction drive assembly **124** including an output shaft **126** drivingly coupled to the shaft **14**. The motor **122** is supported from the base **12** and drives the drum assembly in a counterclockwise direction as viewed in FIG. **4** of the drawings. The shaft **58** is driven in a counterclockwise direction at a speed much higher than the slow rotating speed of the drum assembly **26** and the drum assembly **26** includes a plurality of baffle plates **128** extending between the end wall portions **30** and **32** and spaced circumferentially about the drum assembly **26**. The baffle plates **128** include spaced edge portions **130** secured to the peripheral wall portion **28** and free edge portions **132** which overlie the base edge portions **130** of the adjacent baffle plate in the direction of movement of the drum assembly **26**. The baffle plates **128** extend along chords of the drum assembly **26** and are disposed so as to overlie and mask the openings **40** whereby the screen assemblies **42** as well as the cover plates **110** will be protected from direct contact with materials contacting the tires **70** and being thrown outwardly toward the peripheral wall portions **28** of the drum assembly **26**. The baffle plates **128** have wear plates **134** secured over their inner surfaces in any convenient manner such as by fasteners and thus, the baffle plates **128** are also protected against irreparable damage.

In operation, material to be pulverized is introduced into the drum assembly **26** through the chute or conduit **50**. If the wet process is to be used, the screen assemblies **40** are used in lieu of the cover plates **110** and the outlet conduit **38** is used in lieu of the cap **108**. Then, as the drum assembly **26** is rotated in a counterclockwise direction, the material within the lower peripheral portion of the drum assembly **26** is engaged by the baffle plate **128** and elevated to the upper peripheral portion of the drum assembly **26** at which point the material falls from the baffle plate **128** down onto the adjacent peripheral portions of the tires **70** which are rotating at high speed. The lugs **90** on the tire **70** contact the material breaking the latter up into smaller particles and directing it outwardly for contact with the wear plates **134**. The material then falls downwardly toward the lower portion of the drum assembly **26** for engagement again by the baffle plates **126** and elevation to the upper peripheral portion of the drum assembly **26**. As the material is pulverized, the smaller particles thereof and the water being discharged from the nozzles **114** and **116** pass outwardly through the screen assemblies **42** in the lower peripheral portions of the drum assembly **26** and fall into the tray or trough disposed beneath the drum assembly **26** for conveying to a further point of processing.

If it is desired to pulverize material by the dry process, the screen assemblies **42** are replaced by the cover plates **110** and the cap **108** is removed and the outlet conduit **38** is positioned so as to have its inlet end telescoped over the outlet neck **36**. Then, the outlet end of the outlet conduit **38** is communicated with a suitable source of vacuum and the material to be pulverized may be introduced into the drum **26** in the chute **50**. The material is of course elevated in the same manner by the baffle plates **28** and the lugs **90** of the tires **70** engage and break up the material. As soon as the material has been broken up into sufficiently small particles, the airflow passing through the drum assembly **26** carries the smaller particles of material outwardly through the outlet **36** and the conduit **38** with the air for further processing at a remote location. Of course, the quantity of water discharged from the nozzles **116** and the amount of air flow through the drum assembly **26** together with the speed of rotation of the shaft **58** determine the rate at which material will be pulverized by the mill **10**.

The mill **10** may of course by be constructed of any suitable size but it is to be noted that its utilization of resilient rotary impact members and inclined baffle plates **128** with the protective wear plates **134** enables the mill **10** to be constructed of sufficiently light material whereby the mill **10** may be transported from one location to another with relative ease. In addition, the utilization of a resilient rotary impact member appreciably reduces maintenance requirements of the mill **10** and extends the periods of time that the mill **10** may operate without maintenance being performed thereon.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to falling within the scope of the invention as claimed.

I claim:

1. An impact mill comprising a horizontally disposed, slow speed driven rotary drum provided with opposite end wall portions, material delivery means for delivering material generally axially into one end of said drum and means for withdrawing pulverized material from said drum, high speed driven rotary impact means journaled in said drum for rotation about axes generally paralleling the axis of rotation of said drum, the inner periphery of said drum including material lifting means spaced about the inner periphery of said drum outwardly of said impact means and operative to engage and lift material falling thereon in the lower periphery of said drum and to elevate said material to the upper periphery of said drum and then drop the lifted material for falling by gravity onto said rotary impact means, the end wall portion at one end of said drum including an opening through which said material delivery means is operative to discharge material into said drum, said means for withdrawing pulverized material from said drum including circumferentially spaced water and pulverized material outlet openings formed in the peripheral wall portions of said drum, a centrally disposed air and pulverized material outlet opening formed in the other end wall portion of said drum, a selectively usable closure for said air and pulverized material outlet opening, and selectively usable screen and assemblies and imperforate closure panels for said water and pulverized material outlet openings.

2. The combination of claim 1 wherein said drum includes screened circumferentially spaced liquid and pulverized outlet openings formed in the peripheral wall portion thereof, said material lifting means including baffle plates spaced about the inner peripheral wall portions of said drum disposed in planes lying generally along chords of said drum, said plates including base edge portions supported from the peripheral wall portions of said drum and free edge portions spaced slightly inwardly from the base edge portions of the adjacent plates, said plates overlying said screened outlet openings.

3. The combination of claim **2** wherein said plates are inclined approximately 30° relative to tangential planes containing the base edge portions of said plates.

4. The combination of claim 1 wherein said rotary impact means includes a plurality of rotary members journaled for rotation in said drum, said rotary members being spaced along a common axis of rotation.

5. An impact mill comprising a horizontally disposed slow speed driven rotary drum provided with opposite end wall portions, material delivery means for delivering material generally axially into one end of said drum and means for withdrawing pulverized material from said drum, high speed driven rotary impact means journaled in said drum for rotation about axes generally paralleling the axis of rotation of said drum, the inner periphery of said drum including material lifting means spaced about the inner periphery of said drum outwardly of said impact means and operative to engage and lift

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material falling thereon in the lower periphery of said drum and to elevate said material to the upper periphery of said drum and then drop the lifted material for falling by gravity onto said rotary impact means, said rotary impact means including a plurality of rotary members journaled for rotation in said drum, said rotary members being spaced along a common axis of rotation, said common axis of rotation generally coinciding with the axis of rotation of said drum and said rotary members comprising generally circular members each including an outer peripheral portion defined by a tough resilient material.

6. The combination of claim 5 wherein the outer peripheral surface portions of said rotary members include radially outwardly projecting circumferentially spaced projections constructed of tough resilient material.

7. The combination of claim 6 wherein said projections include riblike projections extending generally paralleling said common axis.

8. The combination of claim 7 wherein said riblike projections are slightly inclined relative to said common axis.

9. The combination of claim 8 wherein the riblike projections on some of said rotary members are oppositely inclined relative to the riblike projections on some of the other of said rotary members.

10. An impact mill comprising a horizontally disposed slow speed driven rotary drum provided with opposite end wall portions, material delivery means for delivering material generally axially into one end of said drum and means for withdrawing pulverized material from said drum, high speed driven rotary impact means journaled in said drum for rotation about axes generally paralleling the axis of rotation of said drum, the inner periphery of said drum including material lifting means spaced about the inner periphery of said drum outwardly of said impact means and operative to engage and lift material falling thereon in the lower periphery of said drum and to elevate said material to the upper periphery of said drum and then drop the lifted material for falling by gravity onto said rotary impact means, said drum including screened circumferentially spaced liquid and pulverized outlet openings formed in the peripheral wall portion thereof, said material lifting means including baffle plates spaced about the inner peripheral wall portions of said drum disposed in planes lying generally along chords of said drum, said plates including base edge portions supported from the peripheral wall portions of said drum and free edge portions spaced slightly inwardly from the base edge portions of the adjacent plates, said plates overlying said screened outlet openings, said delivery means including means for adding liquid to the material being delivered into said drum.

11. The combination of claim 1 wherein said means for withdrawing pulverized material from said drum includes a centrally disposed air and pulverized material outlet opening formed in the other end wall portion of said drum, said outlet opening being adapted for communication with a remotely disposed source of vacuum.

12. An impact mill comprising a horizontally disposed slow speed driven rotary drum provided with opposite end wall portions, material delivery means for delivering material generally axially into one end of said drum and means for withdrawing pulverized material from said drum, high speed driven rotary impact means journaled in said drum for rotation about axes generally paralleling the axis of rotation of said drum, the inner periphery of said drum including material lifting means spaced about the inner periphery of said drum outwardly of said impact means and operative to engage and lift material falling thereon in the lower periphery of said drum and to elevate said material to the upper periphery of said drum and then drop the lifted material for falling by gravity onto said rotary impact means, said rotary impact means including a plurality of rotary members journaled for rotation in said drum, said rotary members being spaced along a common axis of rotation, and comprising wheellike members including at least outer peripheral portions constructed of resilient material.

13. An impact mill comprising a horizontally disposed slow speed driven rotary drum provided with opposite end wall portions, means for delivering material into and withdrawing pulverized material from said drum, high speed driven rotary impact means journaled in said drum for rotation about an axis generally paralleling the axis of rotation of the drum, the inner periphery of said drum including peripherally spaced lifting means disposed outwardly of said impact means and operative to engage and lift material falling thereon in the lower periphery of said drum and to elevate said material to the upper periphery of said drum and then drop the lifted material for falling by gravity onto said rotary impact means, said material lifting means including baffle plates spaced about the inner peripheral wall portions of said drum disposed in planes lying generally along chords of said drum, said plates including base edge portions supported from peripheral wall portions of said drum and free edge portions spaced slightly inwardly from the base edge portions of the adjacent plates, at least the inner surfaces of said plates being hard and defining impact surfaces, said rotary impact means comprising generally circular wheel means including outer peripheral portions defined by a tough resilient material.

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