United States Patent

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[54] **RESILIENT PADDLE IMPACT MILL**
14 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **241/38,** 241/38, 241/54, 241/73, 241/101, 241/102, 241/124, 241/126, 241/228

[51] **Int. Cl.** **B02c 17/02**

[50] **Field of Search** 241/38, 54, 58, 73, 124, 126, 228, 102, 101

[56] **References Cited**

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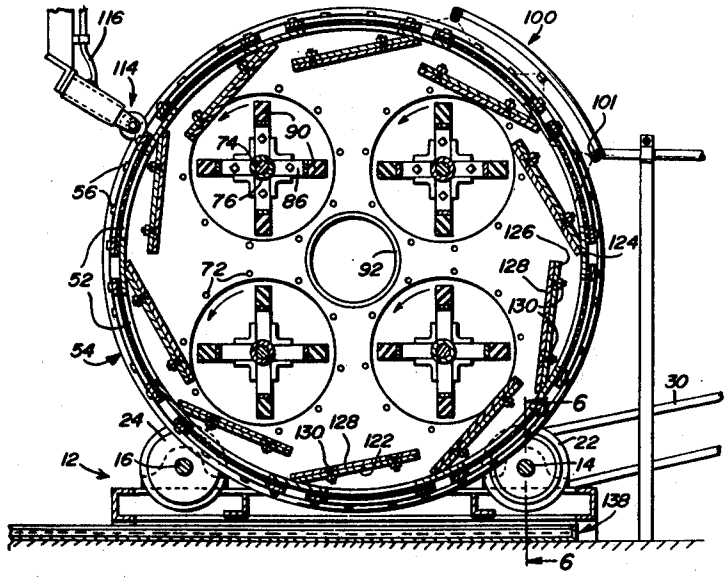
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ABSTRACT: A horizontally disposed rotary drum provided with opposite end wall portions and delivery means for delivering material generally axially into one end of the drum and means for withdrawing pulverized material from the drum. The drum is designed 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 portion of the drum includes 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 peripheral wall of the drum disposed in planes lying generally along cords of the drum with the plates including base edge portions supporting from the peripheral wall portions of the drum and free end portions spaced slightly inwardly from the base edge portions of the adjacent plates, the plates overlying the screened outlet opening of the drum.



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Fig. 1

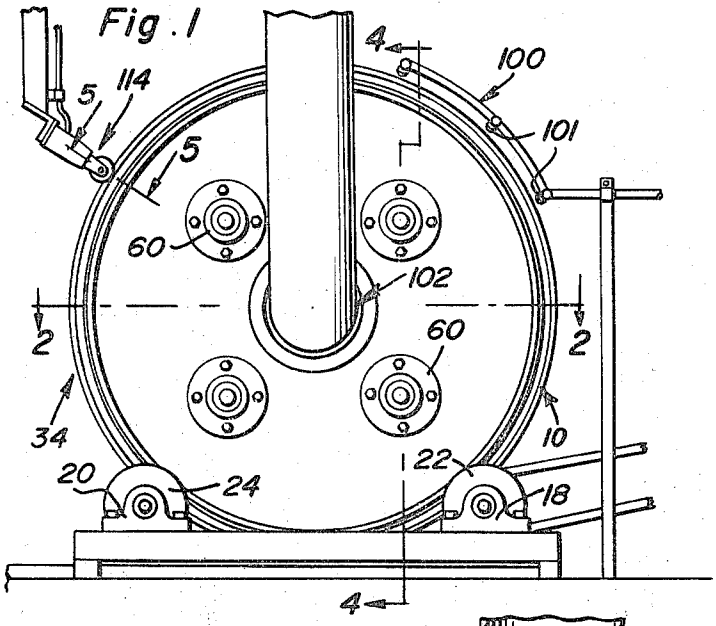


Fig. 5

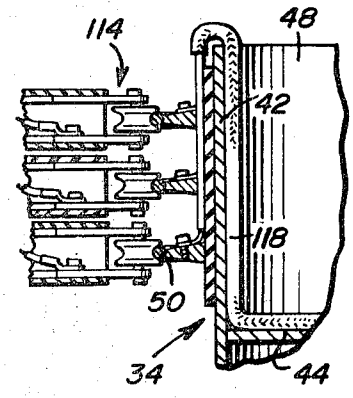


Fig. 2

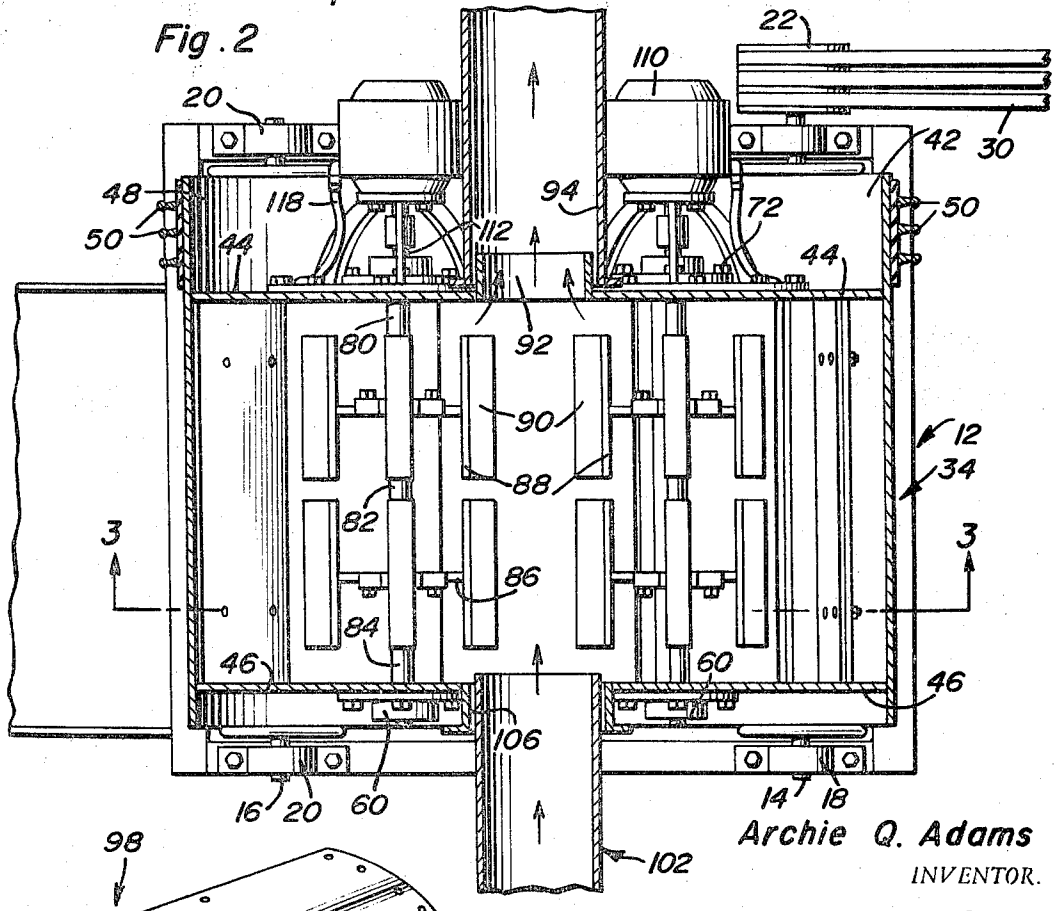
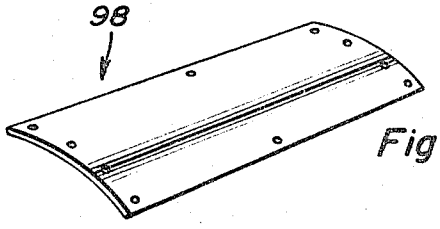


Fig. 7



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Fig. 3

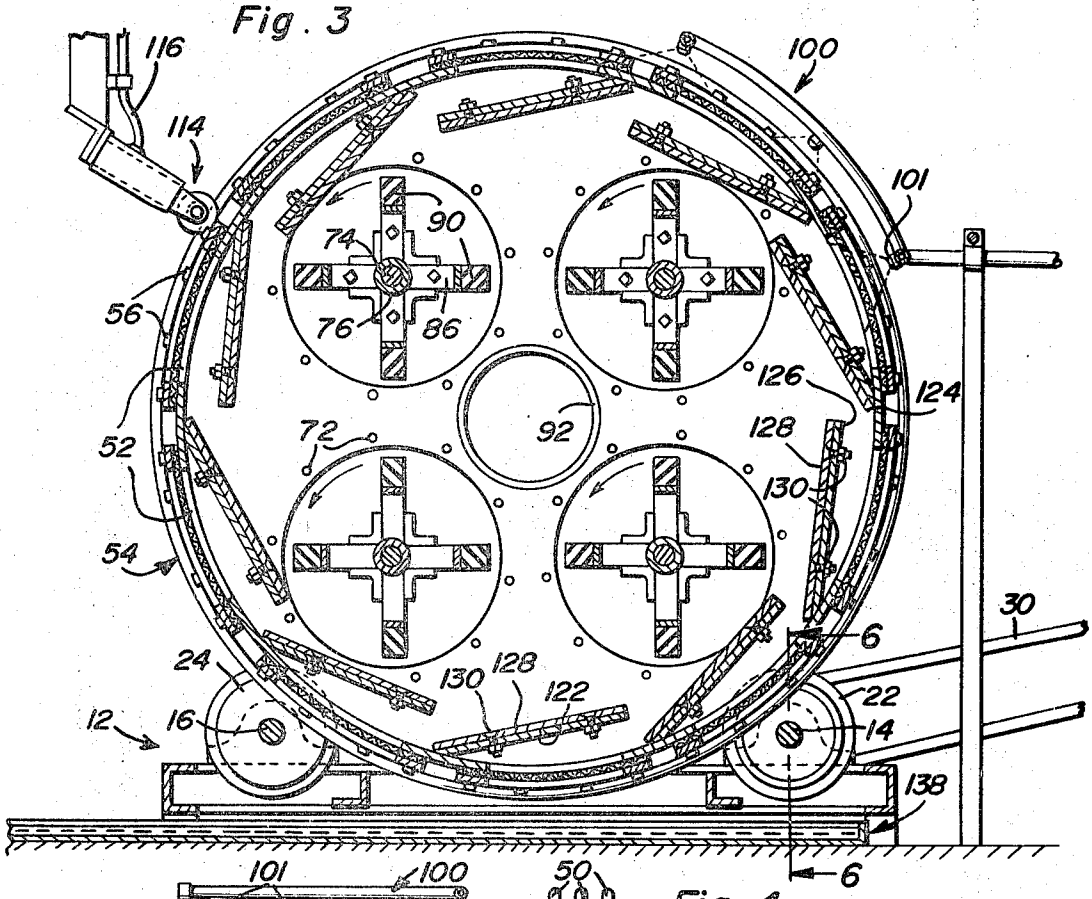


Fig. 4

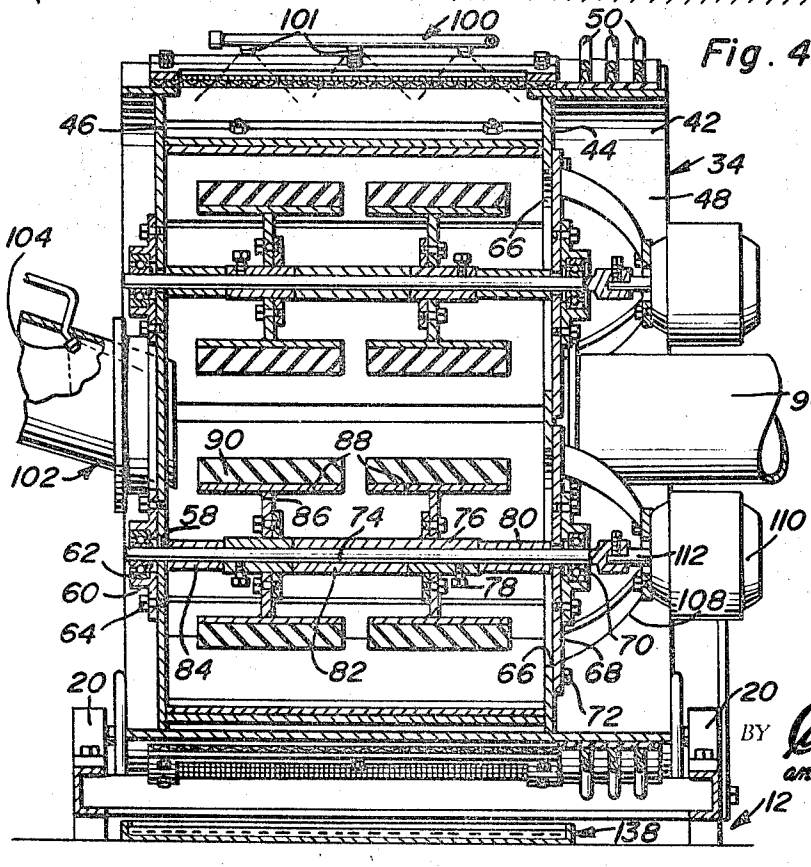


Fig. 6

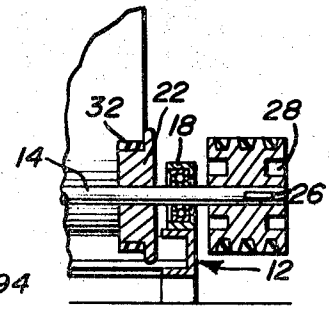


Fig. 8



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RESILIENT PADDLE IMPACT MILL

This invention relates to an impact mill of the rotating horizontal drum type constructed in an a manner whereby it may be alternately used to process materials to be pulverized by a wet process and a dry process. Very little modification of the mill is necessary to convert it from a dry process mill to a wet process mill and the mill is further constructed in a manner whereby it is expected to perform its pulverizing function for extended periods of time before requiring maintenance or repair.

The impact mill of the instant invention is capable of operating to produce a high recovery of nonmetallic ores such as asbestos and also metallic ores. When metallic ores are being recovered, the wet process is used and when nonmetallic ores are being recovered the dry recovery process is used. Further, when metallic ores, especially gold, cinnabar, tungsten and copper are being recovered, the percentage of ore recovered has been found to be rewardingly high and in addition the metallic ores appear to be released intact in the sulphate or in nugget form without being so finely pulverized as to become lost in the milling and concentrating process.

A distinct feature of the mill is that the rotary impact members thereof include resilient portions 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 tending to recover the desired ore without overpulverizing the ore being recovered. They also tend to reduce the shearing of fibrous ores such as asbestos ore. Still further, the resilient rotary impact members, by yielding somewhat under impact with the ores being recovered, do not chip away as readily as metal impact members and thus the rotary impact members remain balanced for high speed rotation without excessive vibration for a longer period of time. Also, the resilient portions of the rotary impact members greatly reduce the operating noise of the mill.

The mill of the instant invention is also constructed in a manner whereby the rotary impact members may be readily replaced or repaired with maintenance or replacement becomes necessary and the resilient operative portions of the rotary impact member have been found to increase not only the quality of the ore being recovered but also the rate at which the ore may be recovered and thus the capacity of the mill.

In addition to the above advantages of using a rotary impact member with resilient portions, the resilient impact portions of the rotary impact members of the instant invention enable not only the drum but also the rotary impact members of the mill to be of lighter construction. Therefore, a mill constructed in accordance with the present invention may be more readily made transportable from one location to another.

The main object of this invention is to provide a rotary impact mill which will be extremely durable so as to be capable of extended periods of operation before requiring maintenance or repairs.

Still another important object of this invention is to provide a rotary impact mill which will reclaim a larger percentage of the ore being handled.

A further object of this invention is to provide an impact mill which will be capable of efficiently recovering metallic as well as nonmetallic ores without overpulverizing ores and shearing fibrous nonmetallic ores such as asbestos.

It is an important object of this invention to provide a rotary impact mill which may be readily converted from a dry process mill to a wet process mill with little alterations in the mill being required.

Another object of this invention is to provide a rotary impact mill of high capacity for its size and which may be constructed so as to be reasonably easily transported from one location to another.

A final object of this invention to be specifically enumerated herein is to provide a rotary impact mill in accordance with the preceding objects which will conform to conventional forms of manufacture, be of simple construction and be easy to use so as to provide a device that will be economically feasible, long lasting and relatively trouble free in operation.

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 an end elevational view of the mill with parts of the air and ore outlet conduit being broken away;

FIG. 2 is an enlarged horizontal sectional view taken substantially upon the plane indicated by section line 2–2 of FIG. 1;

FIG. 3 is a vertical sectional view taken substantially upon a plane indicated by the section line 3–3 of FIG. 2;

FIG. 4 is a an enlarged fragmentary vertical sectional view taken substantially upon a plane indicated by section line 4–4 of FIG. 1;

FIG. 5 is a fragmentary enlarged sectional view taken substantially upon the plane indicated by section line 5–5 of FIG. 1;

FIG. 6 is a fragmentary vertical sectional view taken substantially upon a plane indicated by section line 6–6 of FIG. 3;

FIG. 7 is a perspective view of one of the cover plates for the circumferentially spaced outlet openings formed in the peripheral wall portion of the drum; and

FIG. 8 is a perspective view of a cap which may be selectively telescoped over the outlet neck of the drum in lieu of the air and pulverized material outlet pipe when the mill is to be used with water during a wet process operation.

Referring now more specifically to the drawings the numeral 10 generally designates the mill which includes a suitably anchored base referred to in general by the reference numeral 12 from which a pair of support shafts 14 and 16 are journalled by means of journal blocks 18 and 20, respectively. The shafts 14 and 16 have opposite end-flanged rollers 22 and 24 mounted thereon for rotation therewith and the shaft 14 includes an extended end portion 26 upon which a pulley wheel 28 is mounted. The pulley wheel 28 has a plurality of endless flexible belts 30 entrained thereabout which are also entrained over any suitable drive pulley (not shown) for driving the flanged rollers 22, the latter including resilient friction drive bands 32 disposed thereabout.

A drum assembly referred to in general by the reference numeral 34 is provided and includes a cylindrical wall portion 42 and removable end wall portions 44 and 46, the removable end wall portion 44 and 46 being supported from the cylindrical wall portion 42 in any convenient manner for ready removal therefrom. The cylindrical wall portion 42 includes an extension 48 at one end upon which a plurality of collector rings 50 are insulatively mounted, for a purpose to be hereinafter more fully set forth and the central portion of the cylindrical wall portion 42 disposed between the end wall portions 44 and 46 includes a plurality of circumferentially spaced openings 52 over which screen assemblies referred to in general by the reference numeral 54 are secured by means of suitable fasteners 56.

The removable end wall 46 has a plurality of small diameter openings 58 formed therethrough at points spaced circumferentially thereabout and a journal plate 60 including a bearing 62 is secured over each opening 58 by means of suitable fasteners 64. In addition, the removable end wall portion 44 includes a plurality of larger diameter openings 66 formed therethrough at points spaced thereabout and a plurality of larger journal plates 68 including bearings 70 are secured over the openings 66 by means of suitable fasteners 72. A plurality of rotatable shaft members 74 are journaled between corresponding pairs of bearings 62 and 70 and each has a pair of support sleeves 76 secured thereon by means of a setscrew 78. A protective wear sleeve 80 is disposed about each shaft

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member 74 intermediate the corresponding journal plate 68 and the adjacent sleeve 70, a protective wear sleeve 82 is disposed on each shaft member 74 between the corresponding pair of mounting sleeves 76 and a protective sleeve 84 is disposed on each shaft member 74 between the removable end wall portion 46 and the adjacent mounting sleeve 76.

Each of the mounting sleeves 76 includes a plurality of generally radially outwardly projecting support arms 86 upon whose free ends a plurality of crossheads 88 generally paralleling the axis of rotation of the drum assembly 34 are mounted. Each of the crossheads 88 includes a resilient ball-like member 90 adapted to engage the material introduced into the drum assembly 34 for pulverizing.

The removable end wall portion 44 includes a centrally disposed outlet neck 92 over which the inlet end of an air and pulverized material outlet conduit 94 is telescoped. The outlet end of the conduit 94 is adapted to be communicated with any suitable source of vacuum and the conduit 94 is stationarily positioned whereby the drum assembly 34 rotates relative to the outlet conduit 94. The end of the outlet conduit 94 remote from the drum assembly 34 may be supported in any convenient manner for ready disengagement of the conduit 94 in order that the removable cap referred to in general by the reference numeral 96 in FIG. 8 may be secured over the outlet 92 in lieu of the conduit 94 so as to prevent the discharge of pulverized material through the outlet neck 92.

The openings 52 comprise outlet openings for material pulverized in the drum assembly 34 by the wet process when the cap 96 is secured over the outlet 92 in lieu of the conduit 94. However, when the material to be pulverized is to be dry processed the screen assemblies 54 are removed and replaced by cover plates generally referred to by reference numeral 98 such as the cover plate illustrated in FIG. 6. In this manner, the outlet openings 52 may be closed by the cover plates 98 and the cap 96 may be removed and replaced by the inlet end of the conduit 94 whereby materials handled under the dry process may be discharged from the drum assembly 34 through the conduit 94 with the air that is being drawn through the conduit 94.

On the other hand, when the screen assemblies 54 are in position as illustrated in FIGS. 3 and 4 of the drawings and the cap 96 is secured over the outlet neck 92 in lieu of the inlet end of the conduit 94, the mill 10 is conditioned to process ore under the wet process. When the wet process is used, water under pressure may be sprayed from the water manifold referred to in general by the reference numeral 100 including water jet nozzles 101 positioned to spray water in through the screen assemblies 54 at points adjacent the upper periphery of the drum assembly 34. Also, the inlet conduit referred to in general by the reference numeral 102 includes a water inlet nozzle 104 for spraying the ore or other material introduced into the drum assembly 34 through the inlet conduit 102. The inlet conduit 102 is also stationarily supported and the outlet end thereof extends into an inlet neck 106 opening outwardly through the removable end wall portion 46. Thus, material to be pulverized is introduced into the drum assembly 34 through the inlet conduit 102 and is withdrawn from the drum assembly 34 through the conduit 94 when the dry process is being used and discharged from the drum assembly 34 through the lower screen assembly 54 when the wet process is being used.

The journal plates 68 include a plurality of supports 108 from which electric motors 110 are supported and each electric motor 110 includes an output shaft 112 drivingly coupled to the adjacent end of the corresponding shaft member 74. In addition, the electric motors 110 are electrically connected to the collector rings 50 and a multipulley trolley assembly referred to in general by the reference numeral 114 is provided and includes a plurality of trolley wheels rollingly engaged with the collector rings 50 and electrically connected to any suitabie source of electrical potential (not shown) through conductors 116. The electric motors 110 are electrically connected to the collector rings 50 by means of conductors 118 and the collector rings 50 may be suitably shielded and substantially fully enclosed by any suitable insulative ring stationarily supported for rotation of the drum assembly 34 relative thereto and through which the trolley assembly 114 may extend for engagement with the collector rings 50. Inasmuch as any suitable stationary insulative guard may be utilized, a specific type of guard for the collector rings 50 is not illustrated.

The drum assembly 34 includes a plurality of circumferentially spaced baffle plates 122 extending between the end walls portions 46 and 48 and which extend along over lapping cords of the cylindrical wall portion 42 and include base end portions 124 secured to the cylindrical wall portion 42 and free end portions 126 which overlie and are spaced inwardly of the base end portion of the next baffle plate 122 in the dire direction of rotation of the drum assembly 34. The inner surfaces of the baffle plates 122 are covered by wear plates 128 removably secured to the baffle plates 122 by means of suitable fasteners 130 an thus it may be seen that the baffle plates 122 are protected from irreparable damage.

The shaft member 74 rotates in the same direction in which the drum assembly 34 rotates and therefore the wear plates 128 and baffle plates 122, which overlie the openings 52, fully protect the screen assemblies 54 and the cover plates 98 from direct impact by the material being pulverized within the mill 10. In operation, if it is

In operation, if it is desired to pulverize material using the web process, the cover plates 98 are removed and replaced by the screen assemblies 54. In addition, the cap 96 is secured over the outlet neck 92 in lieu of the inlet end of the conduit 94. Then, the material to be pulverized is introduced into the interior of the drum assembly 34 through the inlet conduit 102 while water is sprayed into the outlet end of the inlet conduit 102 from the nozzles 104 and also while water is being sprayed into the drum assembly 34 through the screen assemblies 54 from the nozzles 101 supported from the manifold 100. Of course, the nozzles 101 and 104 may be communicated with any suitable source of water under pressure and it is to be understood that the amount of water introduced into the drum assembly 34 in proportion to the amount of material to be pulverized introduced into the drum assembly will determine, together with the speed of rotation of the shaft member 74, the amount the material being processed in pulverized. As the ore is introduced into the drum assembly 34 through the inlet conduit 102, the drum 34 is rotated slowly in a counterclockwise direction as viewed in FIG. 3 of the drawings by the shaft 14 and the rollers 22 mounted thereon. The baffle plates 122 pick up the material introduced into the drum assembly 34 and elevate the material introduced into the drum assembly 34 and elevate the material to the upper peripheral portion of the drum assembly 34 at which point the material falls by gravity from the baffle plates 122 and is struck by the resilient members 90 rotated by the shaft members 74 and rotating at high speed. The material is pulverized upon impact and tends to fall to the lower peripheral portion of the drum assembly 34 where the smaller particles are carried through the screen assemblies 54 through which the water introduced into the drum assembly 34 also flows. The smaller particles and water passing through the screen assemblies 54 fall into a water trough disposed beneath the drum assembly 34 and referred to in general by the reference numeral 138. The water then carries the smaller particles along the trough or tray 138 to a further processing point.

On the other hand, if it is desired to pulverize material introduced into the drum assembly 34 by the dry process, the screen assemblies 52 are replaced by the cover panels 98 and the cap 96 is removed and the inlet end of the conduit 94 is telescoped over the outlet neck 92. The internal surfaces of the drum assembly 34 may be dried by causing a rapid flow of air through the conduit 102, the drum assembly 34 and the conduit 94 and thereafter material to be pulverized by the dry process is introduced into the drum assembly 34 through the conduit 102. The drum assembly 34 acts upon the dry material

in a similar manner with the resilient members **90** impacting with the elevated material as it falls to the bottom of the drum assembly **34**. As the material becomes pulverized, the smaller particles thereof are carried out through the conduit **94** with the the air flow therethrough to a remote point for further processing. Of course, during the dry process operation of the mill **10** the water nozzles **101** and **104** are inactive.

Inasmuch as the journal plates **68** carried by the end wall **44** may by readily removed and the shaft member **74** as well as the resilient members **90** supported therefrom may be removed through the openings **66**, it may be seen that maintenance and repair on the mill **10** may be readily performed. Further, it will also be appreciated that ready access to the baffle plates **122** and wear plates **128** may be readily gained through the opening **66**.

The forgoing 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 drum provided with opposite end wall portions, means for delivering material into and 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 on to 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 the peripheral wall portions of said drum and free edge portions spaced slightly inwardly from the base edge portions of the adjacent plates, said free edge portions of said plates projecting in the direction of rotation in which said rum is driven.

2. The combination of claim **1** wherein said drum includes screened circumferentially spaced liquid and pulverized outlet openings formed in the peripheral wall portions thereof, defining said means for withdrawing pulverized material, said plates overlying said screened outlet openings.

3. The combination of claim **1** wherein said rotary impact means includes a plurality of rotary members journaled for rotation in said drum.

4. An impact mill comprising a horizontally disposed slow speed-driven 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 on to said rotary impact means, said rotary impact means including a plurality of shafts journaled in said drum at points spaced about the axis of rotation of said drum and inwardly of the peripheral wall portions of said drum, each of said shafts including a plurality of radially outwardly projecting arms including impact blade portions on their free ends.

5. The combination of claim **4** wherein the end wall portion at one end of said drum includes an opening through which said material delivery means is operative to discharge material into said drum.

6. The combination of claim **4** wherein said means for withdrawing pulverized material from said drum includes circumferentially spaced water and pulverized material outlet openings formed in the peripheral wall portions of said drum, a centrally disposed air and pulverized 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 panel assemblies and imperforate closure panels for said water and pulverized material outlet openings.

7. The combination of claim **4** wherein said impact blade portions are elongated and extend generally longitudinally of said drum.

8. The combination of claim **7** wherein the sides of said blade portions facing in the direction of their movement are covered with a tough resilient covering.

9. The combination of claim **4** wherein said drum includes screened circumferentially spaced liquid and pulverized outlet openings formed in the peripheral wall portions thereof, defining said means for withdrawing pulverized material, 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.

10. The combination of claim **9** wherein said free edge portions of said plates project in the direction of rotation in which said drum is driven.

11. The combination of claim **10** wherein said rotary impact means is driven in the direction of rotation of said drum.

12. The combination of claim **11** wherein said plates are inclined approximately 30° relative to tangential planes containing the base edge portions of said plates.

13. The combination of claim **4** 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.

14. An impact mill comprising a horizontally disposed slow speed-driven 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 on to said rotary impact means, said rotary impact means including a plurality of rotary members journaled for rotation in said drum, said plurality of rotary impact means including a plurality of shafts journaled in said drum at points spaced about the axis of rotation of said drum and inwardly of the peripheral wall portions of said drum, each of said shaft including a plurality of radially outwardly projecting arms including impact blade portions on their free ends, said rotary member each being driven by an electric motor mounted on said drum for rotation therewith, said drum including collector ring means insulatively mounted thereon for rotation therewith and electrically connected to said electric motors, and stationary contact means engaged with said collector ring means and adapted to be connected to a suitable source of electrical potential.

Resilient paddle impact mill (US Patent 3,545,685, 1970)
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