March 3, 1959 C. W. CALKINS 2,875,959

TILTED AXIS MULLER

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Fig. 1

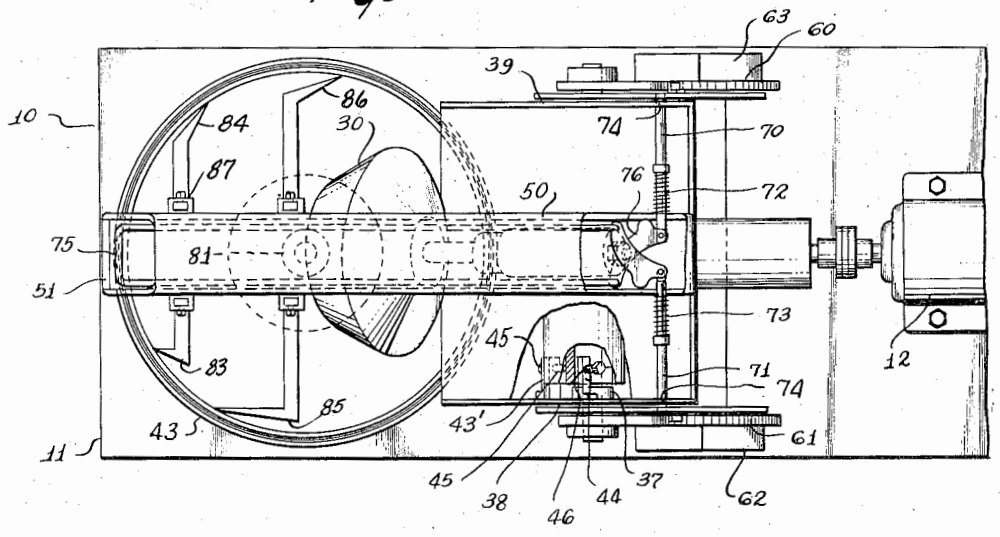
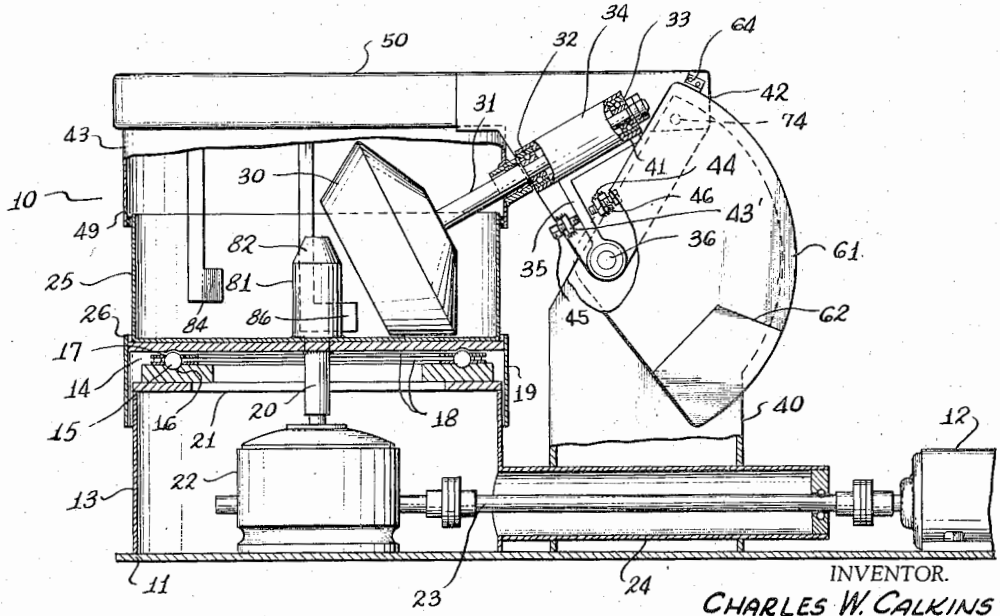


Fig. 2



INVENTOR.

CHARLES W. CALKINS

BY Edmond F. Shanahan

Attorney

United States Patent Office

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TILTED AXIS MULLER

Charles W. Calkins, Newhall, Calif., assignor to Bermite Powder Company, a corporation of California

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This invention relates generally to mullers of the horizontal turntable type, and more particularly to such a muller in which a muller wheel, together with its shaft and bearings, can be tilted out of operating position to permit removal of ground materials. Also, the axis of the muller wheel is obliquely disposed when the wheel is in operating position so that its bearings can be isolated from the muller pan and to one side of it.

In the manufacture of many explosives, it is necessary to reduce a granular material to some predetermined mesh fineness. Those familiar with the art of explosives manufacture know that the grinding of such materials is often accompanied by serious hazards of explosion. For example, certain explosive components can be ground safely as long as they are in pure form and are shielded from any sparks in the environment. The lightest trace of impurity, however, serves as a potential detonating agent which can be ignited fairly easily, and will serve as a primer for the entire batch contained within the muller. The total quantity of the impurity need not be large; on the contrary, it may be very minute indeed, since a batch which is almost entirely pure may be exploded by a relatively small, local primer explosion of the impure portion.

An obvious and common source of trouble in such mullers is the oil used to lubricate the moving parts thereof. A drop or two of oil, which is inadvertently permitted to flow down a shaft or the like into the material being subjected to grinding, may have disastrous consequences. On the other hand, it is dangerous to risk the heating of machine parts which may occur if they are allowed to run continuously without proper lubrication.

In addition to lubrication oil and grease, other stray impurities which may be present in the air, or may be dropped from the hands or clothing of an operator, may fall into the muller apparatus and produce a dangerous mixture with the explosive granular material. Most mullers are so constructed that it is very difficult to cover them while they are in motion, and to shield the muller pan from all contaminants.

Another requirement for any muller which is to operate satisfactorily for the purposes of explosives manufacture is that it be completely isolated from the electric motor providing the power for the muller drive. Sparks from the motor would produce an obvious explosion hazard.

An objectionable feature found not only in mullers for explosives, but in other mullers also, is the difficulty of removing a heavy batch of ground material. Many mullers are so constructed that the pan cannot be removed from the muller apparatus when it is full; instead, the material must be shoveled out by manual means. This type of handling is particularly unsuited for explosives.

Many of the foregoing objectional features can be overcome by using a muller wheel which is rotated about

a tilted axis, that is, an axis passing obliquely from the muller pan over its upper edge to bearings located at one side of the muller pan, i. e., not over it. Moreover, if such a muller wheel and its shaft and bearing are carried in the tiltable cradle, it is possible to lift the entire assembly clear of the pan when it is desired to remove the pan and a completed batch therein. However, any such muller construction presents certain difficulties. In the first place, the usual method of driving the muller wheel by means of power on the muller wheel shaft becomes extremely cumbersome and complex. Even if this problem is avoided by driving the pan or its supporting table, and causing the muller wheel to rotate by engagement with the bottom of the pan, there remain problems of lifting the muller wheel assembly clear of the pan for removal at the end of the grinding of a batch.

It is a major object of the present invention to provide a muller suitable for explosives. However, it will be understood that the utility of the muller disclosed herein is not restricted to the grinding of explosive materials. Wherever a muller, capable of grinding under exceptionally fine control of purity and cleanliness, is required, for example, in manufacture of certain foods, drugs, cosmetics, and chemicals, the present invention will have particular application. In addition, the muller construction shown is susceptible to modification even for crude work that will provide an exceedingly reliable muller in which the moving parts are well protected from the severe wearing conditions usually prevailing in the environment of a muller, because of the tendency of powdered materials to find their way into the bearings of the apparatus.

It is another major object to provide a muller in which the muller wheel bearings are located to one side and not over the pan in which grinding is taking place. It is an associated object to provide a muller in which oil drippings fall outside the pan, and in which a pan cover with a packed opening in the side thereof for the muller wheel shaft can be used to seal the muller bearing from the pan and its contents. Another important object of the present invention is to provide a muller construction well suited to isolation of the electric motor from the apparatus or the room in which it is operated.

It is still another object of the present invention to provide a muller pan which can be completely sealed by packing means during operation of the muller.

Still another object of the invention is to provide a reliable muller apparatus extremely resistant to excessive bearing wear from the powdered material in the muller.

Finally, an important object of the invention is to provide a muller in which the muller wheel and pan and cover assembly can be readily lifted completely clear of the pan in order to facilitate removal of the pan and the batch of ground material contained therein.

The foregoing and other objects are accomplished by means of a muller wheel, which is in turn rotatably mounted in a bearing-carrying cradle which can be tilted about a horizontal axis. Complexities of drive for the muller are avoided by driving the table upon which the muller pan is carried and causing the muller wheel to rotate by engagement of its grinding surface with the bottom of the muller pan. The general principles of the invention will best be understood from a detailed and specific description of one specific embodiment, which is illustrated in the accompanying drawings in which:

Figure 1 is a plan view of a muller apparatus built according to the invention, but with the pan cover removed in order to reveal in plan the interior of the muller pan and various apparatus therein; and

Figure 2 is a side elevational view, partly in section, of the apparatus of Figure 1.

The numeral 10 indicates the muller generally. The muller 10 may very suitably be mounted on a floor platform 11 and driven by a remotely located electric motor 12. Preferably, the motor 12 may actually be on the other side of a wall partition from the major parts of the muller apparatus 10.

A cylindrical turntable base 13, supported on the platform 11, provides a stationary support for a rotatable turntable 14, which is preferably carried on the turntable base 13 by means of ball bearings 15 which roll in a grooved circular track 16 and engage a similar circular groove 17 in the underside of the rotating table 14. The ball bearings 15 are retained in place by retainers 18. Also preferably, the space between the underside of the table 14 and the upper part of the turntable base 13 is shielded from the exterior by means of a cylindrical skirt 19 attached to the periphery of the table 14.

A vertical shaft 20 extends downwardly from the center of the underside of the table 14 through an opening 21 in the upper part of the turntable base 13, and into a right angle gear box 22.

The turntable 14 can be rotated on its bearings 15 on the table base 13 by the shaft 23 extending from the electric motor 12 to the gear box 22 through an enclosing and shielding passage 24.

The grinding of the granular material being processed by the muller is carried out in a cylindrical muller pan 25, which is supported without any necessary connection on the rotatable table 14, possibly being retained in position by the upwardly extending edge 26 of the table skirt 19.

A massive grindstone or muller wheel 30 is located inside the muller pan. It will be seen from the side view of Figure 2 that the muller wheel 30 is mounted on a muller wheel shaft 31 which, in operating position, as shown on both Figures 1 and 2, is tilted to an angle of about 30 degrees (for the particular embodiment shown) from the horizontal.

Preferably, the muller wheel 30 is mounted integrally on the shaft 31, the latter being rotatably supported in ball bearings 32 and 33 located in a tubular bearing support 34. The tubular bearing support 34 is carried at the end of an arm 35 which is rotatable in a vertical plane about the horizontal shaft 36, which is journaled at each end and the bearings 37 (one of which is visible in Figure 1) mounted in the right and left side panels 38 and 39, respectively, of the supporting structure indicated generally by the numeral 40, located at one side of the turntable 14 and the muller pan 25 thereon.

The assembly which includes the tubular bearing support 34 and the rocking arm 35 may conveniently be referred to as a bearing cradle 41, since it carries the bearings 32 and 33 for the muller wheel 30, and can be rocked through a vertical plane up and away from the muller pan 25.

The horizontal cradle shaft 36 carries a second cradle 42, which may be referred to as the cover cradle, since it carries an inverted cylindrical cover 43 which fits over and covers the muller pan 25. The cover cradle 42 is adjustably associated with the bearing cradle 41, as will be explained hereinafter.

Although the two cradles are mounted to rotate independently of each other about the axis of the shaft 36, an adjustable engagement means is provided in the form of a pair of ears 43 and 44 carried on the cover cradle 42 and provided with a pair of adjustment bolts 45 and 46 which can be spaced so as to leave the bearing cradle 41 free to rotate through a small arc independently of the cover cradle 42. However, if the cover cradle 42 is moved through any arc larger than the few degrees permitted by the adjustment bolts 45 and 46, the bearing cradle 42 together with the muller wheel 30 and the muller wheel shaft 31 are carried along as an integral assembly.

The cover cradle 42 has a long, channel shaped lever 50 extending toward the front (the left of the apparatus as viewed in Figures 1 and 2) to serve as a lifting handle at 51 as seen in the plan view of Figure 1. The cover 43 is attached to the underside of the channel-shaped lever 50 and has a sufficiently larger diameter than the muller pan 25 so that the slightly overlapping edge 49 of the cover 43 can swing upwardly and clear of the upper edge of the pan 25 when the operator rocks the cover cradle 42 upwardly by means of handle 51 in order to remove the muller pan 25 and a completed batch therein.

The muller cradle 42 and its associated parts, particularly the muller wheel 30, are rather massive and heavy, and two additional features are preferably incorporated in the apparatus. The first of these is a pair of segmentally shaped counterweight members 60 and 61 carrying heavy weights 62 and 63 at their circumference, and mounted to rotate on the same axis as shaft 36, but riveted or bolted at 64 to rotate integrally with the cover cradle 42. The counterweights 62 and 63 approximately match the muller wheel assembly on the opposite side of axis 36 and make it relatively easy to rotate the entire massive assembly about that axis.

A second desirable feature is the provision of a latch means readily operable from the operator's lifting handle 51. A specific embodiment of such latch means shown in Figure 1 is comprised of a pair of horizontally and laterally reciprocable latch bars 70 and 71, which are urged outwardly by their encircling helical springs 72 and 73 so that they tend to engage holes 74 in the stationary side panels 38 and 39 of the cradle supporting structure 40. The latch bars 70 and 71 are carried in the cover cradle 42 and may be manually retracted for release of the cradle 42, to permit its being rocked through a vertical plane around the axis of shaft 36, by retraction of a handle 75, which holds the ice-tong mechanism 76, so as to retract the latch bars 70 and 71 against their springs 72 and 73.

It will be observed that the operation of the muller is such that a conical grinding surface 80 is usually the most practical for the muller wheel 30. Preferably, the pan 25 is provided with a cylindrical centerpiece 81, having a conical upper part 82 which mates with the bottom of the muller wheel 30. The presence of the centerpiece 81 prevents the material being subjected to grinding from accumulating in a solidly packed and unground cone in the center of the pan 25 as it would otherwise tend to do.

The construction of the muller 10 makes it possible to scrape material from the walls of the cylindrical muller pan 25 into the path of the muller wheel 30 by means of scrapers 83, 84, 85 and 86. Preferably, these scrapers are disposed at different elevations (e. g. 84 and 86) to scrape different areas or at arcuately separated points (e. g. 83 and 84) to scrape the same area at successive intervals, as illustrated. It is also preferred that the scrapers be suspended from the cradle 41 as indicated at 87, so that the scrapers 83 through 86 are lifted clear of the pan 25 to permit its removal when the cradle 41 is swung upward.

It will be seen from the foregoing that the specific embodiment of the muller shown in the drawings, and described herein, includes many refinements which are not essential to the broadest and simplest form of the invention. It will, therefore, be appreciated that the description given is not intended to limit or restrict the scope of the invention, but that its limits are defined only in terms set forth in the following claims.

I claim:

1. A muller which includes: a flat-bottomed container in which to grind material; means for rotating said container about a vertical axis; a centerpiece carried in said container at the axis of rotation thereof and adapted to prevent material undergoing grinding from accumulating in the center of said container; a muller wheel with a

conical grinding surface and adapted to rotate against the flat floor of said container about an oblique axis passing through the axis of rotation of said container, said muller wheel being rotated adjacent said centerpiece by the rotation of said container; a shaft for said muller wheel; bearing means for rotatably carrying said shaft said bearing means being located over an area horizontally removed from the upper opening of said container; and a cradle means supporting said bearing means and adapted to rock about a horizontal axis to permit said muller wheel and shaft to be lifted clear of the bottom of said container.

2. A muller which includes: a flat-bottomed container in which to grind material; means for rotating said container about a vertical axis; a muller wheel with a conical grinding surface and adapted to rotate against the flat floor of said container about an oblique axis passing through the axis of rotation of said container and passing above the edge of the upper opening of said container, said muller wheel being rotated by the rotation of said container; a shaft for said muller wheel; bearing means for rotatably carrying said shaft, said bearing means being located over an area horizontally displaced from the upper opening of said container; a cradle means supporting said bearing means and adapted to rock about a horizontal axis to permit said muller wheel to be lifted clear of the bottom of said container; and counterweight means carried by said cradle means and counterbalancing the greater part of the weight of said muller wheel.

3. A muller which includes: a flat-bottomed container in which to grind material; means for rotating said container about a vertical axis; a muller wheel with a conical grinding surface and adapted to rotate against the flat floor of said container about an oblique axis passing through the axis of rotation of said container and passing above the edge of the upper opening of said container, said muller wheel being rotated by the rotation of said container; a shaft for said muller wheel; bearing means for rotatably carrying said shaft at one side of the upper opening of said container; a cradle means supporting said shaft and adapted to rock about a horizontal axis to permit said muller wheel to be lifted clear of the bottom of said container; and cover means supported by said cradle means over said container.

4. A muller which includes: a flat-bottomed container in which to grind material; means for rotating said container about a vertical axis; a muller wheel with a conical grinding surface and adapted to rotate against the flat floor of said container about an oblique axis passing through the axis of rotation of said container and passing above the edge of the upper opening of said container, said muller wheel being rotated by the rotation of said container; a shaft for said muller wheel; bearing means for rotatably carrying said shaft at one side of the upper opening of said container; a cradle means supporting said shaft and adapted to rock about a horizontal axis to permit said muller wheel to be lifted clear of the bottom of said container; and scraper means engaging the interior surfaces of said container and supported from said cradle means.

5. A muller which includes: a stationary base structure open at the top; a circular rolling bearing track supported on said base structure and encircling said top opening; a rotatable table and rolling bearings supported on said base structure by said track; a cylindrical skirt on said table for shielding the space between said base structure and said table; a flat-bottomed container open at the top and supported on said table; a vertical shaft within said base structure to rotate said table and said container thereon about a vertical axis; motor means remote from said base structure and said table; shielding means enclosing said power transmission means and said vertical shaft; a cradle support structure located at one side of said rotatable table and said container thereon; a horizontal cradle shaft means rotatably mounted in said cradle support structure; a bearing cradle rotatably mounted on said cradle shaft; a muller wheel adapted to rotate on the floor of said container around an oblique axis, and a shaft extending from said muller wheel over the upper edge of said container and rotatably received in said bearing cradle; a cover cradle rotating integrally with said cradle shaft; a cover covering said container and supported from said cover cradle; counterweights carried on said cradle shaft and cover cradle assembly and rotating therewith; adjustable engagement means between said bearing cradle and said cover cradle for permitting said bearing cradle to move freely through a small arc, but engaging said bearing cradle and carrying it and said muller wheel and said muller wheel shaft with said cover cradle when the latter is rocked upwards through a large angle; and latch means for locking said cover cradle to said cradle support structure to maintain it in a desired position relative thereto.

6. A muller which includes: a stationary base structure; a rotatable table supported on said base structure; a cylindrical skirt on said table for shielding the space between said base structure and said table; a flat-bottomed container open at the top and supported on said table; means for rotating said table on said base structure; a vertical shaft within said base structure to rotate said table and said container thereon about a vertical axis; a cradle support structure located at one side of said rotatable table and said container thereon; a horizontal cradle shaft means rotatably mounted in said cradle support structure; a bearing cradle rotatably mounted on said cradle shaft; a muller wheel adapted to rotate on the floor of said container around an oblique axis, and a shaft extending from said muller wheel over the upper edge of said container and rotatably received in said bearing cradle; a cover cradle rotating integrally with said cradle shaft; a cover covering said container and supported from said cover cradle; counterweights carried on said cradle shaft and cover cradle assembly and rotating therewith; adjustable engagement means between said bearing cradle and said cover cradle for permitting said bearing cradle to move freely through a small arc, but engaging said bearing cradle and carrying it and said muller wheel and said muller wheel shaft with said cover cradle when the latter is rocked upwards through a large angle; packing means between said rotating container and said cover, and between said rotating muller shaft and said cover; and latch means for locking said cover cradle to said cradle support structure to maintain it in a desired position relative thereto.

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