July 5, 1938. P. O. ABBÉ 2,122,399

BALL AND PEBBLE MILL

Filed Jan. 11, 1934

FIG. 1

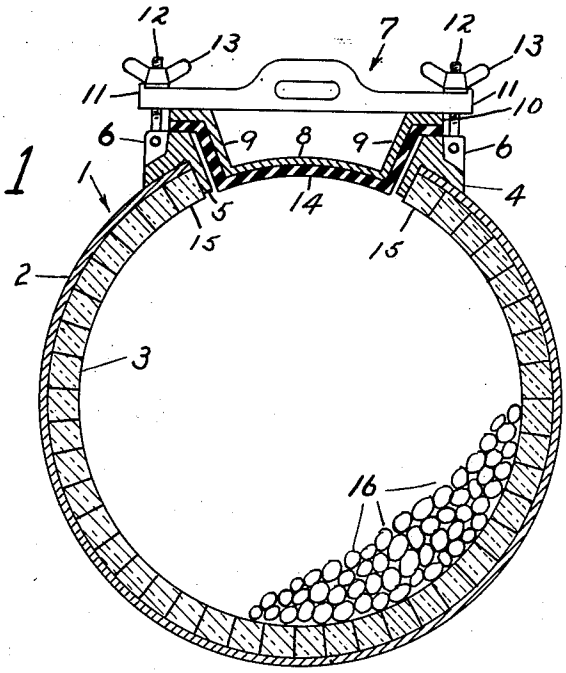


FIG. 2

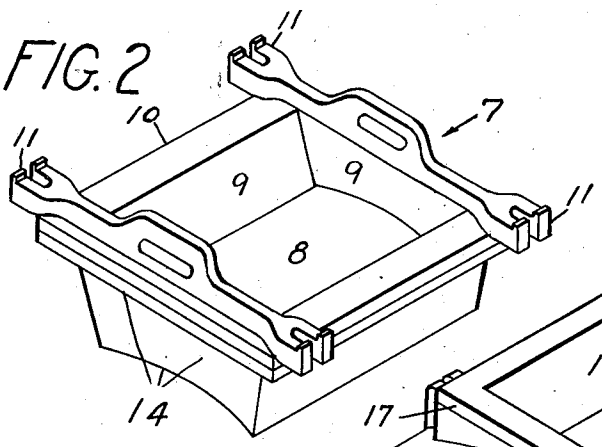


FIG. 3

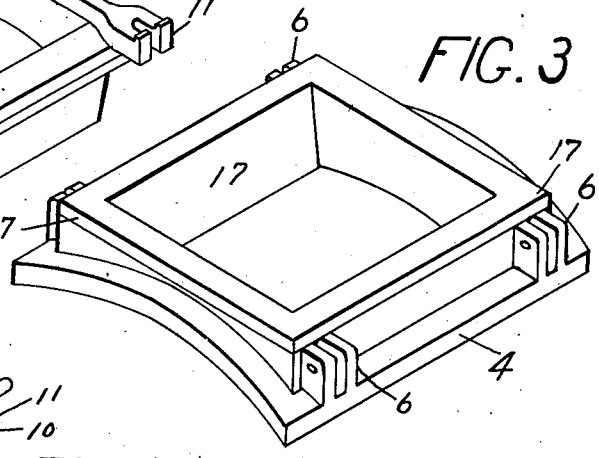
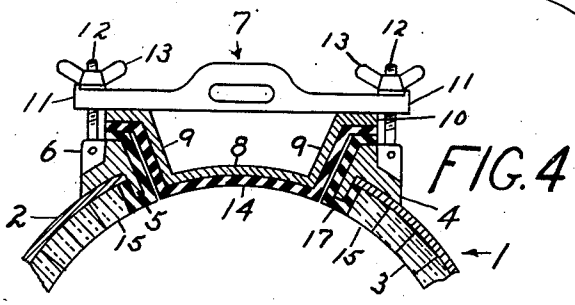


FIG. 4



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UNITED STATES PATENT OFFICE

2,122,399

BALL AND PEBBLE MILL

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2 Claims. (Cl. 83—9)

This invention relates to ball and pebble mills for grinding and pulverizing various materials, and particularly refers to means rendering the linings and the inner surfaces of the mill drums and their covers more durable and far less likely to contaminate a charge of materials therein by grains or portions of the linings, etc., which often may otherwise be worn, broken or loosened and thus dropped into the charge.

Hence, the main object of my invention is to so alter and improve the construction of a ball or pebble mill, that there is no possibility of any of the lining being knocked off the edges of the cover opening, inasmuch as modern mill drums often have such openings in the arcuate walls thereof through which to introduce charges of material to be ground and to withdraw the same when finished, a cover being fitted to the opening during the grinding operation to retain the materials.

It is also an object to prevent damage to the material being ground from the unavoidable wear of the refractory material of which the lining is usually composed, or more especially from small amounts of metal worn or eaten off from the frame around the opening or from the cover of said opening.

Another object is to provide a mill drum with protective lining material about the inner edges of the opening for the charging cover as well as upon the inner surfaces of the cover, which is more or less flexible and continuous and free from cracks or joints, and which can be applied in sheet form, if so desired.

A further object is to provide the inner surface of the cover for the charge opening, and perhaps also the exposed edges of the frame about the opening with a relatively softer and different covering material in strong contrast with the hard characteristics of the rest of the drum lining.

Other objects will appear more fully in detail hereinafter.

In the accompanying drawing which forms part hereof:

Fig. 1 is a transverse section of a mill drum for the purpose of disclosing the same in operative condition with a cover in position and the whole equipped with the features of the present invention.

Fig. 2 is a perspective view of the cover of the drum of Fig. 1.

Fig. 3 is a perspective view of the frame alone for the charging opening in the drum adapted to receive the cover.

Fig. 4 is a fragmentary section similar to the upper portion of Fig. 1, showing a modification.

Throughout the views, the same reference numerals indicate the same or like parts.

In the drums of ball and pebble mills, the pounding action of porcelain balls or flint pebbles causes unavoidable wear of the surfaces of the lining, and especially around the edges of the openings for the charging and discharging covers is there likelihood of grains and fragments being worn or actually broken off to subsequently contaminate the grinding charge. This damaging effect is quite certain to appear when it is considered that such materials are ground in this type of mills, as vitrified porcelain enamels, glass, plastics, ceramic colors, chemicals and other materials, and the usual metal frame about the opening in such a drum, as well as the metal edges of the cover itself also tend to be worn and sometimes even corroded by the contents, to the great detriment of said contents. Some products are utterly ruined by the slightest trace of iron, for example, and thus such contamination becomes a matter of considerable concern.

On the other hand, the linings in such drums are usually composed of blocks of porcelain, burr stone or a special grade of glass of requisite strength and thickness to resist ordinary wear by the blows from the grinding bodies, but the usual moderate wear of such siliceous materials matters little. It is when larger particles are broken loose, and especially if metallic surfaces are directly exposed to wear and rusting within the drum that damage is more certain.

As is now commonly known, modern ball and pebble mills have at least one charge opening provided with a removable manhole cover, and the same is removable for charging the drum or discharging the finished contents therefrom, and said opening is fitted with a reinforcing metal lining or frame, as already intimated. This construction corresponds with one form of the invention as illustrated in the drawing, wherein Fig. 1 shows a cross section of a mill at 1, comprising an outer metallic or other kind of shell 2 which is lined with an interior refractory lining 3 which may be built up of blocks closely fitted together by cementing or in any other known manner. A metal frame 4 is mounted upon the drum and has an inwardly extending flange 5 forming a continuous lining within the manhole opening of the drum, and is particularly designed to reinforce the end blocks 15—15 of the refractory lining 3, the latter being preferably of porcelain, stone of any suitable kind, glass, corundum, etc.

Exteriorly, the frame 4 has a plurality of associated pairs of lugs 6—6 in which are fitted swing bolts 12, 12. A cover, generally indicated at 7 is fitted removably into the frame 4 and has a plurality of bifurcated projections 11—11 into which the swing bolts may be swung, and then wing nuts such as 13—13 may be screwed down on the lugs in order to secure the cover in position. Obviously, upon unscrewing these wings somewhat, the swing bolts may be swung off the

cover lugs 11—11 in order to release the cover for removal, at will. Other well known devices for closing and securing the cover may be used, although I prefer the means for this purpose now shown in the drawing and described herein as being practical.

Ordinarily, a manhole cover has the same kind or a similar lining to that of the rest of the interior of the drum, being formed of one or more blocks of refractory material such as porcelain, etc., the cover having inwardly projecting edges surrounding the lining to hold the same in place. In contrast therewith, the cover 7 has a flange 10 normally resting upon frame 4 and the sides 9—9 which are connected at the bottom by a continuous and perhaps integral plate 8. The bottom surface 8 of the cover does not extend to the general surface level of the lining within the drum at 3 or end blocks 15—15, but if directly exposed to the action of grinding bodies such as indicated at 16, would nevertheless be soon worn and cause very serious contamination of the contents of the mill. However, upon the entire surface of bottom 8 of the cover, as well as upon the sides and the underside of flange 10, a coating or sheet 14 of flexible or resilient material such as rubber is applied in the form, for example, of gum rubber secured directly to the cover in any suitable manner. Synthetic rubbers and gums as well as leather might also be used, but gum rubber is preferred, as a comparatively thin coat thereof will outlast the thick refractory lining in the mill proper, and most of the materials ground in the same are not affected by rubber. While the cover is thus protected from abrasion, yet the flange 5 of the frame or manhole lining 4 does not reach even the working face of bottom 8 of the cover, and comes very short of extending to the surface level of the refractory lining 3 of the drum, and for this reason, the exposed edges of the end blocks 15—15 tend to wear far more rapidly than the general surface of the rest of the lining, and pieces may even chip or break off, this soon tending to actually expose the edge of flange 5 to direct contact with the grinding bodies. In this respect, the effect is somewhat similar as found in drums already in use, although here the cover is protected.

Hence, my invention also provides protection for the flange of the manhole frame or lining 4 with a coat or sheet of rubber similarly to the lower surfaces of the cover indicated at 17 in Figs. 3 and 4, the rubber upon both the flange and the cover corresponding substantially with the general level of the working surface of the refractory lining in the drum. In this manner, all metallic surfaces and flanges are protected from direct contact with the grinding action of the mill, and in the same manner the contents are protected from damage by any fragments of lining or traces of metal, while in addition, the lining within the refractory lining within the drum and particularly the rubber lining of the cover and frame are exceedingly durable in combination because they present a substantially uniform surface level to the grinding bodies and have no weak spots.

Manifestly, variations of my invention are possible, and some features and parts may be used without others or altered to suit conditions, while other materials than rubber may be used to protect metallic frames, castings, stampings, covers and the like for ball and pebble mills. Hence, my invention has been shown in the drawing and described herein by way of example only, and not in a manner intended to be limitative to the exact forms and features disclosed.

Having now fully described my invention and indicated a practical form thereof, I claim:

1. In a rotatable ball or pebble mill of the type having an interior refractory lining and a charging opening in the arcuate wall thereof provided with a rigidly secured metal frame which has a flange extending inwardly into the drum toward the working surface of said interior refractory lining so as to reinforce the edges of said opening, and also a completely removable charging cover normally disposed in said frame and provided with a protective coating of rubber upon the inwardly directed surface thereof exposed to the interior of the drum, means for preventing abrasion of the edges of said cover and the inwardly extending flange of the frame occupying the charging opening in the drum wall and also preventing crude raw material intended to be ground from lodging between the side edges of said cover and said flange, comprising a continuous extension of live rubber connected directly with said rubber coating on said cover, which envelopes the sides of the cover, and a continuous coating of live rubber covering the inner exposed edges and the inside of the frame so as to wholly insulate the same from the cover and the contents of the drum, said extension of live rubber upon the cover and coating of live rubber together filling the space between the flange and the sides of said cover and being in mutual resilient contact in said space, and said cover forming the direct and preferably sole closure for said drum.

2. In a rotatable ball or pebble mill of the type having an interior refractory lining and a charging opening in the arcuate wall thereof provided with a rigidly secured metal frame which has a flange extending inwardly into the drum toward the working surface of said interior refractory lining so as to reinforce the edges of said opening, and also a charging cover normally disposed in said frame and provided with a protective coating of live rubber upon the inwardly directed surface thereof exposed to the interior of the drum, said cover being capable of being opened to expose the opening for charging and discharging the drum, means for preventing abrasion of the edges of said cover and the inwardly extending flange of the frame occupying the charging opening in the drum wall and also preventing crude raw material intended to be ground from lodging between the side edges of said cover and said flange, comprising a continuous extension of live rubber connected directly with said rubber coating on said cover so as to envelop the sides of the cover, and a continuous coating of live rubber covering the inner exposed edges and the inside of the frame so as to wholly insulate the same from the cover and the contents of the drum, said extension of live rubber upon the cover and coating of live rubber upon the inside of the frame together serving to occupy the space between the flange and the sides of said cover and being capable of being brought into mutual resilient contact in said space when placing said cover in position in said charging opening in order to close said opening.

PAUL O. ABBÉ.