June 29, 1926. 1,590,655

H. N. SPICER

LINING FOR GRINDING APPARATUS AND THE LIKE

Filed Dec. 17, 1925

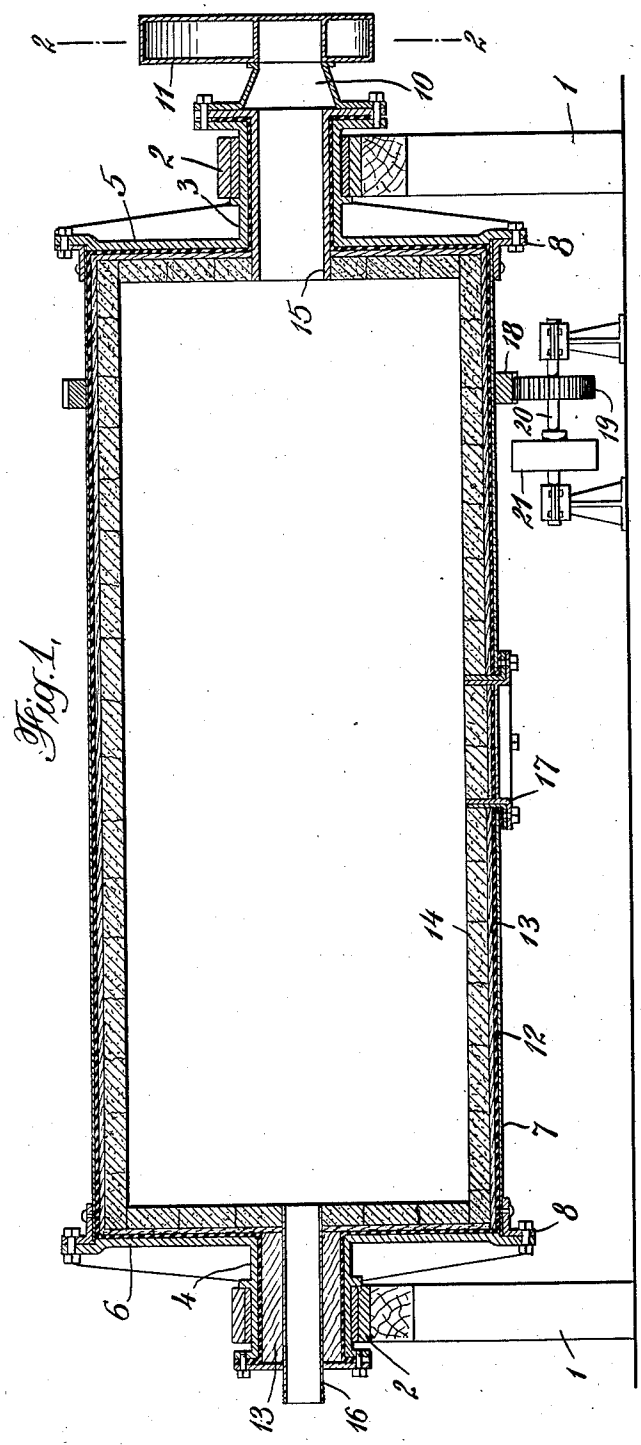


Fig. 1.

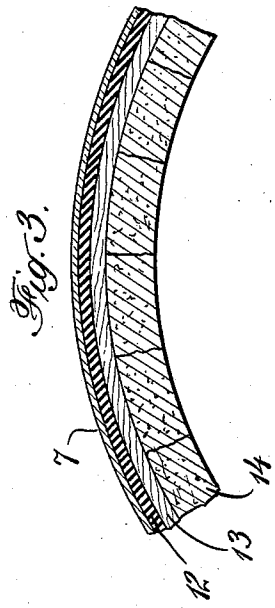


Fig. 3.

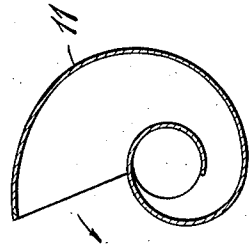


Fig. 2.

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Patented June 29, 1926. 1,590,655

UNITED STATES PATENT OFFICE.

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LINING FOR GRINDING APPARATUS AND THE LIKE.

Application filed December 17, 1925. Serial No. 75,984.

This invention relates to linings for grinding apparatus, and the like, and has for its object the provision of an improved lining for such apparatus and more particularly an improved acid-resistant lining for apparatus used in grinding (such, for example, as ball mills) dissolving, precipitating, and other operations.

Various expedients have heretofore been employed for providing ball mills and similar apparatus with acid-resistant or acid-proof lining. Metallic lead is substantially resistant to the action of many acid liquors, and on this account, lead has been most generally employed heretofore as the acid-resistant lining of ball mills and similar apparatus. In attaching a coating or lining of lead (generally in sheet form) to a metal surface (such as iron or steel), the metal is usually first heated to the melting point of lead. In some cases, the sheet of lead is burnt onto the metal shell at various points by means of a blow torch. The first method is so expensive as to be impracticable with ball mills more than about three feet in diameter, while the second method gives a coating which is not rigid and which is very likely to become dislodged from the metal shell.

Since lead is a relatively soft material, it does not satisfactorily withstand the abrading action which takes place in a ball mill. On this account, the lead lining has been sometimes protected by a layer of silica brick. I have found that these bricks exercise a hammering action upon the lead lining, as a result of which the union between the lead lining and the metal shell is ruptured with consequent danger of displacement of the lead lining and also puncturing or fracturing of the lead lining may take place.

The present invention contemplates certain improvements for protecting a lead or other relatively soft acid-resistant coating or lining from the hammering action of a co-operating abrasion-resistant protective layer or lining. Thus, the invention involves the provision of an intermediate layer of wood, or equivalent material, between the acid-resistant lining and the co-operating abrasion-resistant protective layer or lining. In its preferred aspect, the invention involves an acid-resistant rubber lining appropriately secured to the metal shell of the apparatus over which is placed a layer of wood, or the like, the latter being covered with a protective layer of silica brick, or the like, laid in acid-proof cement.

I prefer rubber as the acid-resistant material in the improved lining of my present invention, but it will of course be understood that lead and equivalent acid-resistant materials may be employed if desired. An acid-resistant rubber or rubber compound should of course be employed in apparatus requiring an acid-proof or acid-resistant lining. To this end the crude rubber should be compounded and/or vulcanized with agents which will produce a rubber compound satisfactorily resistant to the particular acid characteristics of the material to be treated in the apparatus. It is not necessary that the rubber lining be particularly resistant to abrasion since it is protected in the first instance by the outer layer or lining of silica brick as well as by the intermediate layer of wood or similar material. Accordingly, it is possible in accordance with the present invention to employ a rubber lining possessing optimum properties with respect to attack by acid liquors, and thereby obtaining the best possible acid-proof or acid-resistant lining for the particular apparatus in hand.

In the accompanying drawing I have illustrated a ball mill embodying the novel features of the present invention in what I now consider the preferred form thereof. In the drawing:—

Fig. 1 is a sectional elevation of the apparatus;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged detail view of the metal shell and my improved lining.

The ball mill illustrated in the drawing comprises a cylindrical metal shell 7 to the ends of which are bolted headers or end plates 5 and 6 provided with trunnions 3 and 4. These elements are easily made of an easily workable metal, such as steel or iron. The trunnions are appropriately mounted on the foundations 1. The shell 7 is provided with a manhole normally closed by a cover 17 appropriately bolted to the shell.

A circular rack 18 is secured to the shell 7 and operatively engages a gear 19 secured to a rotatably mounted shaft 20. A pulley

21 is secured to the shaft 20, and when driven from an appropriate source of power serves to rotate the mill at the desired speed.

In accordance with my present invention the interior surface of the shell 7 is covered with a lining 12 of acid-resistant rubber or equivalent material. Similarly the interior surfaces of the headers 5 and 6 and the trunnions 3 and 4 are lined with the acid-resistant material. Preferably, this acid-resistant lining is a monolithic coating or layer over the entire inner surface of the various exposed parts of the mill. In the case of rubber, I find a layer of about one-fourth of an inch in thickness satisfactory for ordinary purposes. The rubber lining may be applied to the shell in any appropriate manner as, for example, by vulcanization in situ.

The acid-resistant lining 12, preferably of rubber is covered with a layer or shell 13 of wood, or equivalent material. For this purpose boards from one-half inch to about one inch in thickness by three inches wide and of appropriate length may be used. These boards are preferably held in place by wedging, thus avoiding the use of bolts, rivets, and similar metallic fastening means. This wooden construction covers the acid-resistant lining on the shell 7, the headers 5 and 6, and the trunnion 4, and if desired, may also cover the acid-resistant lining on the trunnion 3, thus protecting all exposed portions of the lining from the layer of bricks subsequently applied.

An abrasive layer or lining 14 of silica brick is laid on the wooden shell 13. The silica bricks are laid in a suitable acid-proof cement and cover such parts of the apparatus as in operation are exposed to abrasive action, such as the interior of the shell 7 and headers 5 and 6. The manhole 17 is also lined with the three layers of acid-resistant material, protective material, and abrasive material.

The manhole frame and manhole cover 17, as well as other relatively small and easily replaced parts of the apparatus, such as the feed or inlet pipe 15 and the discharge or outlet pipe 16, are made of bronzalum or other suitable acid-proof material.

The operation of the mill is as follows. A charge of balls, rocks, or other material to be used as a grinding medium is first placed in the mill through the manhole or through the feed pipe. The mill is then rotated at the desired speed. The solids to be ground with the acid or other liquor are fed into the mill continuously by means of a feed scoop 11 secured to the trunnion 3 by means of a suitable casting 10. The feed scoop 11 thus rotates with the mill and dips into a feed trough (not shown). When the level of the material in the mill has risen to the lower lip of discharge pipe 16, the discharge of material from the mill may be controlled by the amount of material fed thereto. The grinding in the mill results from the rumble action of the balls on the solids in the mill as well as from the natural attrition of the solids on each other. The greatest amount of abrasive action occurs in the cylindrical portion of the mill, and considerable abrasive action occurs in the ends of the mill; hence these parts of the mill are protected by the abrasion-resistant layer or lining 14.

It is to be understood that the present invention is not restricted to grinding apparatus, but may be advantageously applied to apparatus of various types. For example, in the precipitation of copper from solution by iron in an acid leaching process, one method commonly used is to fill an apparatus of the type herein particularly described with small pieces or chunks of iron and cause the copper-bearing solution to flow in at one end and out at the other end. The copper is precipitated on the iron and the abrading action of the chunks of iron on each other knocks the precipitated copper loose so that it is discharged by the liquid flow and subsequently recovered by settling. An apparatus employed for this purpose may very advantageously be provided with the improved lining of my present invention.

From the foregoing description it will be seen that, in accordance with my present invention, the acid-resistant lining, preferably of rubber, is protected from abrasion by the inner abrasion-resistant lining or layer of silica brick. In addition to satisfactorily resisting abrasion this inner lining must be effectively resistant to the action of the acid liquor in the mill. Silex blocks set in Duro cement may, for most purposes, be satisfactorily used as the inner abrasion-resistant lining. It will of course be understood that the abrasion-resistant lining need not be constructed of bricks or blocks, but may be, in whole or in part, a continuous or monolithic layer of appropriate thickness. In addition, my present invention involves the interposition of the layer or shell of wood, or equivalent material, between the acid-resistant lining and the abrasion-resistant lining. The wooden lining or shell distributes the pounding or hammering effect of the abrasion-resistant lining over substantially the entire surface of the acid-resistant lining, and thereby effectively prevents dislocation, excessive wear, puncture, and other injuries to the relatively soft acid-resistant lining. By means of this construction a very satisfactory acid-resistant or acid-proof lining is provided, and at the same time the inner or contacting surface of the mill is set hard and resistant to abrasion for practical purposes.

I claim:—

1. In an apparatus of the character described, a lining comprising a layer of acid-resistant material, protected by a layer of abrasion-resistant material, and a layer of fibrous material interposed between said acid-resistant layer and said abrasion-resistant layer.

2. In an apparatus of the character described, a lining comprising a layer of relatively soft acid-resistant material, protected by a layer of abrasion-resistant material, and means positioned intermediate said two layers for distributing the action of the abrasion-resistant layer substantially uniformly over the acid-resistant layer.

3. In an apparatus of the character described, a lining comprising a layer of acid-resistant material, a layer of abrasion resistant material superposed thereon, and means whereby the wear action of the abrasion-resistant layer upon the acid-resistant layer is distributed substantially uniformly over the surface of the acid-resistant layer.

4. In an apparatus of the character described, a lining comprising a layer of acid-resistant rubber protected by a superposed layer of abrasion-resistant material.

5. In an apparatus of the character described, a lining comprising a layer of rubber, a layer of abrasion-resistant material superposed on said layer of rubber, and means intermediate said two layers for uniformly distributing the wear of said abrasion-resistant material on said rubber layer substantially uniformly over the surface of the layer of rubber.

6. In an apparatus of the character described, a lining comprising a layer of relatively soft material, protected by a superposed layer of abrasion-resistant material, and means interposed between said layers for distributing the wear of the abrasion-resistant material upon said other material substantially uniformly over the surface of said other material.

7. In an apparatus of the character described, a lining comprising a layer of rubber, a layer of abrasion-resistant material superposed thereon, and a layer of fibrous material interposed between said layer of rubber and said layer of abrasion-resistant material.

8. In an apparatus of the character described, a lining comprising a layer of relatively soft material, protected by a superposed layer of abrasion-resistant material in the form of bricks, and means interposed, between said layers for distributing the wear of the abrasion-resistant layer on said other layer substantially uniformly over the surface of said other layer.

9. In an apparatus of the character described, a lining comprising a layer of relatively soft material, protected by a superposed layer of abrasion-resistant material in the form of bricks, and a layer of fibrous material interposed between the relatively soft layer and the abrasion-resistant layer.

10. In an apparatus of the character described, a lining comprising a layer of acid-resistant rubber, protected by a superposed layer of abrasion-resistant material in the form of bricks, and a layer of fibrous material interposed between said layer of rubber and said layer of abrasion-resistant material.

11. In an apparatus of the character described, a lining comprising a layer of acid-resistant rubber, a layer of silica bricks superposed on said layer of rubber, and a layer of fibrous material interposed between said layer of rubber and said layer of silica bricks.

In testimony whereof I affix my signature.

HAROLD NORMAN SPICER.