

PATENT SPECIFICATION (11)

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(54) BALL MILL LINING

- (71) We, GEBR BOHLER & Co., Aktiengesellschaft, an Austrian Company of Elisabeth Strasse 12, Vienna 1, Austria, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- The present invention relates to a lining of or for a ball mill, which lining comprises grinding plates having grinding surfaces formed with grooves which have in cross-section the shape of a segment of a circle having substantially the same radius as the largest grinding balls used in the mill.
- Such grinding plates are known and have been described, e.g., in Austrian Patent Specification No. 283,092. Compared with the conventional grinding plates, they have a number of advantages: the lining is lighter in weight, the energy consumption for a given throughput is reduced, the grinding drum can be rotated at a lower speed so that further energy is saved, and they require less repair so that they are more reliable in operation.
- The use of grooved plates obviously results in a basic change in the comminution process, compared with ungrooved grinding plates, in that the impact of the balls on the plates is greatly weakened and a much larger part of the energy which is available is used for comminution.
- The grinding plates and the grinding balls are usually made from iron-chromium-carbon alloys. Special care must be taken to keep their residual austenite content, at the time when they are installed, as low as possible, for instance below 5%. As a result of the impact stresses, any residual austenite will be transformed into martensite so that there is a danger of embrittlement and distortion, which may result in a destruction by spalling. For these reasons, the residual austenite content should be minimized.
- With the grooved plates with which the present invention is concerned, this danger is basically present too, but apparently to a much lower degree, so that the wear due to frictional abrasion is of greater significance for the life of the grinding plates.
- Whereas it has been recognized that a high content of residual austenite is basically detrimental, tests have shown that under comparable stresses the life of the grooved plates may be increased by at least 20% if they are cast from a conventional iron-chromium-carbon alloy with an admixture of nitrogen. If the alloy is melted in the usual manner, the amount in which nitrogen may be added will depend on the content of nitride-forming substances, particularly on the contents of chromium, manganese, and molybdenum, and on any contents of aluminium, zirconium, and titanium, and may be between about 0.05 and 0.5%. (% refers to % by weight through this specification). Nitrogen contents between 0.1% and 0.3% are preferred. It has not yet been found out whether the improvements of the wear characteristics resulting from the presence of nitrogen is unexpectedly due to an increased residual austenite content or to a formation of nitrides or to both effects combined. It is interesting to note, however, that the nitrogen which is admixed in accordance

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with the invention gives particularly desirable results in the most highly stressed portions in the mill, where the coarse grinding is effected.

5 The invention thus relates to a lining of or for a ball mill, which lining comprises grinding plates having grinding surfaces formed with grooves which have in cross-section the shape of a segment of a circle having substantially the same radius as the largest grinding balls used in the mill, these grinding plates being shaped castings of an iron-chromium-carbon alloy which contains 0.05 to 0.5%, preferably 0.1 to 0.3% nitrogen.

15 The iron-chromium-carbon alloys which may be used within the scope of the invention may consist of 0.5 to 3% carbon, 5 to 30% chromium, 0.5 to 2% silicon, 0.5 to 5% (preferably 0.7 to 1.2%) manganese, 0 to 5% (preferably 0.5 to 1.5%) molybdenum, 0.05 to 0.5% (preferably 0.1 to 0.3%) nitrogen, and, if desired, aluminium, zirconium, and titanium, individually or combined, in amounts of to 0.5% each, balance iron and inevitable impurities.

25 The grinding balls which are desirably used in ball mills provided with such a lining have a chromium content which is higher than that of the grinding plates and should be not less than 12%, and are of an iron-chromium-carbon alloy.

30 The grooved plates may be used in a slowly cooled cementitic state or in the hardened and tempered state which is conventional for ungrooved plates. The grinding balls are hardened in most cases to a Rockwell C hardness about 60 if they contain 12% or more chromium.

40 So far, an admixture of nitrogen to the alloys for the grinding balls has not resulted in detectable improvements. On the other hand, if the grinding balls are made of an alloy which contains aluminium, zirconium, 45 or titanium in a small amount up to about

0.5%, an admixture of up to about 0.5% nitrogen will slightly improve the wear characteristics.

WHAT WE CLAIM IS:—

1. A lining of or for a ball mill, which lining comprises grinding plates having grinding surfaces formed with grooves which have in cross-section the shape of a segment of a circle having substantially the same radius as the largest grinding balls used in the mill, these grinding plates being castings of an iron-chromium-carbon alloy which contains 0.05 to 0.5% nitrogen.

2. A lining as claimed in claim 1, in which the alloy contains 0.1 to 0.3% nitrogen.

3. A lining as claimed in claim 1, in which the grinding plates are of an iron-chromium-carbon alloy consisting of 0.5 to 3% carbon; 5 to 30% chromium, 0.5 to 2% silicon; 0.5 to 5% (preferably 0.7 to 1.2%) manganese; 0 to 5% (preferably 0.5 to 1.5%) molybdenum; 0.05 to 0.5% (preferably 0.1 to 0.3%) nitrogen; and, if desired, up to 0.5% aluminium and/or up to 0.5% zirconium and/or up to 0.5% titanium; the balance being iron and inevitable impurities.

4. A lining as claimed in any of claims 1 to 3, in which the alloy contains 0.7 to 1.2% manganese and 0.5 to 1.5% molybdenum.

5. A lining as claimed in claim 1, substantially as described hereinbefore.

6. A ball mill having a lining as claimed in any of claims 1 to 5.

7. A ball mill as claimed in claim 6, having grinding balls of an iron-chromium-carbon alloy whose chromium content is higher than that of the plates.

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