United States Patent

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[33] **Germany**
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[54] **METHODS AND APPARATUS FOR TREATMENT OF A RAW MATERIAL**
4 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **241/19,** 241/16, 241/42, 241/46.15, 241/153
[51] **Int. Cl.** **B02c 17/10**
[50] **Field of Search** 241/18, 20, 15, 16, 19, 24, 29, 30, 42, 41, 43, 68, 46.15, 153, 72, 171, 175

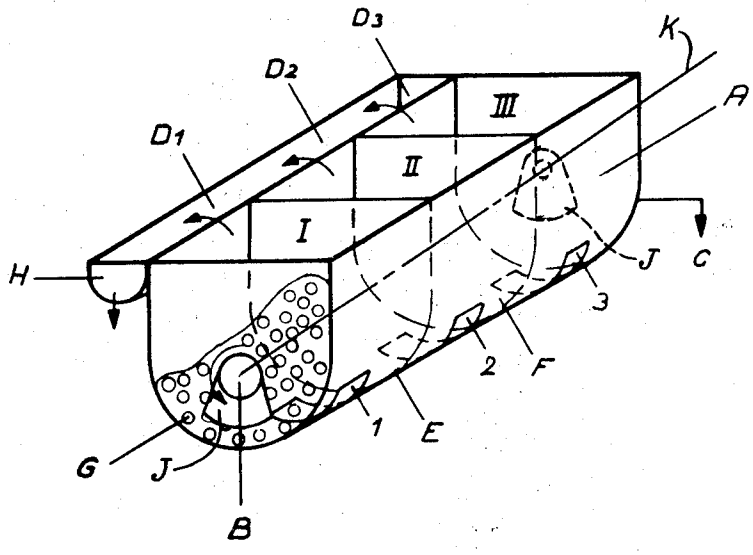
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ABSTRACT: A method and apparatus for treatment of a raw material whereby the material is passed through a vibrating mill while being subjected to a flotation separation.



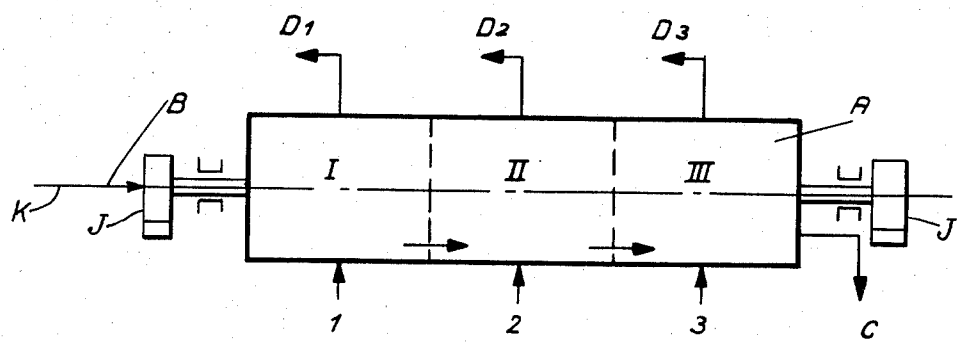


FIG. 1

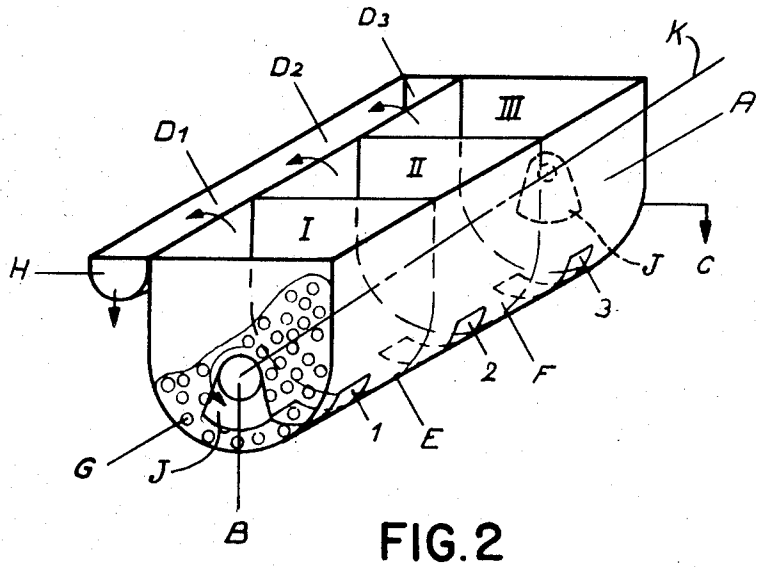


FIG. 2

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METHODS AND APPARATUS FOR TREATMENT OF A RAW MATERIAL

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the treatment of materials by flotation, and, more particularly, to such a treatment utilizing a vibration mill.

2. Description of the Prior Art

Flotation methods and apparatus for the carrying out of this type of treatment, particularly by foaming and floating, are generally known. Similarly, mechanically driven, rapidly rotating mills utilizing grinding bodies vibrating and striking against each other are also taught in various forms. However, these arrangements require the use of costly associated equipment such as automatic regulators for regulating the degree of grinding, etc., and are relatively inefficient in production.

SUMMARY OF THE INVENTION

A method and apparatus for treatment of a raw material wherein the material is passed through a vibrating mill and ground in plural stages while frothing air is introduced into the mill in a direction transverse to the direction of flow of the material.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference is now made to the accompanying drawings for a better understanding of the nature and objects of the present invention, which drawings illustrate the best mode presently contemplated for carrying out the objects of the invention and its principles, and are not to be construed as restrictions or limitations on its scope. In the drawings:

FIG. 1 is a diagrammatic view of the vibration mill container of the present invention; and

FIG. 2 is a perspective view of the vibration mill container of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring specifically to FIG. 1, A refers to an elongated, horizontally extending vibration mill which is preferably tubular or trough shaped, and which has three chambers I, II and III formed therein which communicate with each other.

A vertical stream of air 1, 2, 3 is introduced transversely through openings or screens in the bottom of each chamber, and a flotation agent can be added with the streams of air, or by free admission, in concentrations and compositions adapted to the advance of the grinding and to the flotation.

In operation, the prebroken raw material enters at B into chamber I, and after flowing through the chambers, the liquid charged with the tailings leaves the container at C. The separated floated material is discharged as froth from each chamber in the directions indicated by the arrows D1, D2 and D3.

The details of the present invention are better shown in FIG. 2. Specifically, mill A has an open top and may be suspended elastically in any known manner. Partition walls E and F divide the container into the three chambers, each of which contains a plurality of grinding bodies G, the size of which may vary from chamber to chamber. The shape and direction of rotation of grinding bodies G are indicated for chamber I in FIG. 2, and the lower portions of walls E and F are preferably interrupted to permit the flotation pulp to pass through, while preventing movement or mixing of grinding bodies G.

Mill A is rapidly vibrated in any known manner such as by use of eccentric weights J located on shaft K, mainly to substantially eliminate phixotropic effects in the region of the grinding body fillings, to prevent agglomeration, and to easily separate the laden froth and facilitate the advance of the comminution.

The streams of air 1, 2 and 3 pass through bottom perforations from below into the chambers and are distributed in fine form by the vibrating grinding bodies G, the intensity of these streams being adjusted to correspond to the advance of the flotation. The charging of the raw material into chamber I is effected through an elastically connected channel B, while the emergence of the tailings takes place at C from the chamber III.

The froth discharges at D1, D2 and D3 from the chambers and may collect in a trough H or the like, which may also vibrate and which is located along the mill A as shown.

The products of the first grinding flotation stage can, if they are not already of final quality, either be worked in further grinding flotation stages or in pure flotation stages.

The apparatus and their technological process developments can be applied to ores, minerals, rocks and earth, etc., for instance for breaking, ash removal and desulphurization of coal.

The present invention thus combines known flotation methods with wet vibration mills in a continuous flow operation. It is a particular advantage that in this way it is possible to grind up the intergrowth limitations in the charge material continuously and gently, to wet the freshly produced fraction surfaces immediately in an easily adjustable manner, and to discharge the output through a cross-passage stream in steps automatically, without having to install automatic regulators. The grinding bodies utilized in the present invention prevent undesired mixing processes upon vigorous movement, and can easily be adapted as a whole or by chambers by specific gravity and size to the properties of the material.

In order to make the flotation process more productive, *i.e.* to increase the yield of useful mineral and at the same time to simplify the carrying out of the method and to make it more economical, a known flotation agitator, and possibly also a pneumatic cell may be provided in front of the vibration mill. In this manner, all the mineral particles which already lie free are floated out. The flotation pulp then flows into the vibration mill which need then only grind the finer intergrowths and float them.

However, the fine intergrowths can also be floated out by the preliminary agitator or pneumatic cells as so-called intermediate material, in which case only the latter will be ground further in the vibrating mill and floated.

In the case of fine intergrowths, the comminution should not, if possible, extend beyond the breaking up necessary for the exposure of the individual minerals. Upon the further developing of the invention, it was found that it was not always advisable fully to utilize the very strong comminuting power of the vibration mill. By doing so one will obtain an excessively fine material which it is difficult to filter or which settles out poorly. In certain cases of use it will therefore be advisable to use a flattened vessel rather than the relatively deep trough shape prescribed.

Also, one or more such troughs can be arranged parallel to the shaft of the vibration drive and in such a manner with respect to each other that the flotation pulp, which is divided up in accordance with the requirements into streams flowing in the same direction, is conducted through the flotation vessels in parallel paths. Also, in the case of a difficult mineral, all the vessels may be passed through one behind the other.

Of course, other variations of the specific construction and arrangement of the method and apparatus herein disclosed can be made by those skilled in the art without departing from the invention as defined in the appended claims.

I claim:

1. A flotation process comprising the steps of passing raw material through a mill, vibrating said mill, grinding said material in different stages in said mill and introducing frothing air into said mill transverse to the direction of flow of said material.

2. An apparatus for effecting a flotation treatment of a raw material comprising a mill, means to charge said raw material through said mill, means to vibrate said mill, grinding means to grind said material in said mill, and means to introduce frothing air into said mill transverse to the direction of flow of said material.

3. The apparatus according to claim 2, further comprising at least one partition in said mill for separating said container into at least two chambers, said grinding means being adapted to grind said material in different stages in said chambers.

4. The apparatus according to claim 3, wherein said grinding means comprises a plurality of grinding bodies disposed in each of said chambers, the size of the grinding bodies in each chamber being different from the size of the grinding bodies in the other chambers.