The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to us of any royalty thereon.

The invention relates to ball mills in which material is finely divided in a rotating container partially filled with solid balls, preferably polished steel balls, and the material to be pulverized. Such ball mills are used extensively in many industrial and laboratory operations. The process of reducing materials to finely divided desired particle sizes usually consumes considerable time and therefore limits production and increases the cost of the ultimate product.

In ball mills of the usual type, the drum containing the balls and the material which is being worked is usually rotated at some desired constant velocity. This method does not employ the balls in the most efficient manner since the tumbling motion is rotary and does not provide as great an impact or as many impacts per given time as might be obtained with greater random motion of the balls.

One object of this invention is to increase the grinding efficiency to provide for better dispersion of material and to produce a greater grinding action by providing means for compound motion of the ball mill.

The foregoing and other objects of the invention will be more clearly understood from the following description, reference being made to the accompanying drawings, wherein:

Fig. 1 is a side view of the mechanism in one stage of rotation;

Fig. 2 is a partial side view of the mechanism in a second stage of operation; and

Fig. 3 is an end view through section A—A of Fig. 1.

Referring first to Fig. 1, 1 is a motor driving plate 2 to which are affixed by suitable screws four springs 3, 3', 4, and 4'. Springs 3 and 3' being firmer than springs 4 and 4', and also located 180° apart. To springs 3, 3', 4 and 4' is attached by suitable screws to a mounting plate 5 against which container 6 is held by clamp plate 7 and bolts 8.

In operation, the material to be pulverized is placed with polished solid balls in container 6. The container 6 is clamped between the mounting or supporting plate 5 and the cover plate 7 by clamping bolts 8. As shown most clearly in Figs. 1 and 2, the bolts 8 pass through passages formed in axially extending ribs 10 formed on the outer surface of the container 6 thus leaving the interior of the container 6 smooth and free from projections of any sort. The mounting plate 5 and the cover plate 7 are provided with co-acting lugs 12, 14 and between which the bolts 8 clamp the container 6 in position. Rotation of the motor 1 will cause the container 6 to rotate. With the mechanism in position as shown in Fig. 1, the weight of container 6 causes a tendency for the said container 6 to be displaced laterally of the driving axis or angularly from the horizontal plane. However, with stiff springs 3 and 3' in the same vertical plane as the center of gravity of container 6, the tensile force of the upper spring 3 or 3' and the compressive force of the lower spring 3' or 3 resists the tendency of container 6 to fall to be displaced laterally. After 90° of rotation, lighter springs 4 and 4' assume positions in the vertical plane with the center of gravity of container 6 as shown in Figs. 2 and 3. In this case, the tensile force of the upper spring 4 or 4' is much less than that of spring 3 or 3' and the compressive force of lower spring 4' or 4' is much less than that of springs 3' or 3, thus allowing container 6 to be displaced from its original position, as in Fig. 2. After another 90° increment, the stiff springs 3' and 3 return to the vertical plane thus tending to restore the container 6 to its original position as in Fig. 1. It will be seen that the combined rotation of container 6 will, therefore, be accompanied by a rocking or vibrating motion which will give a greater random motion to the balls within said container 6.

It will be understood that although we have described a preferred embodiment of the invention, that the invention is not limited thereto.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In a ball mill, a container, means including a driving plate for rotating said container, one set of stiff springs and one set of lighter springs for supporting said container and connected to said driving plate for flexibly driving said container for eccentric motion about the axis of rotation of said driving means to produce a tumbling action.

2. In a ball mill, a container, driving means for rotating said container, one set of stiff springs and one set of lighter springs for supporting said container and for connecting said container to said driving means for flexibly driving said container eccentrically about the axis of rotation of said driving means, said stiff springs being placed in a plane passing through said axis of rotation and said lighter springs being placed substantially in a second angularly related plane passing through said axis of rotation.

3. In a ball mill comprising a container and means for vibrating said container including a support to which said container is secured, a driving motor having a rotating shaft, a plate fixed to said shaft, two pairs of springs each fixed at one end to said driving plate and at the other end to said container support to provide a flexible driving connection between said motor and said container, said springs being arranged in pairs, each pair of springs having different resistance to displacement laterally of the driving axis of said motor, thereby providing varying lateral displacement of said container as it rotates.

References Cited in the file of this patent

UNITED STATES PATENTS
36,517 Heath Sept. 23, 1862
2,469,484 Thiman May 10, 1949
2,727,697 Stone Dec. 20, 1955
FOREIGN PATENTS
630,831 France Dec. 9, 1927