April 20, 1965 J. W. SHERWEN 3,179,343

GRINDING MILLS, PELLETISING MILLS AND LIKE APPARATUS

Filed Oct. 2, 1962 2 Sheets-Sheet 1

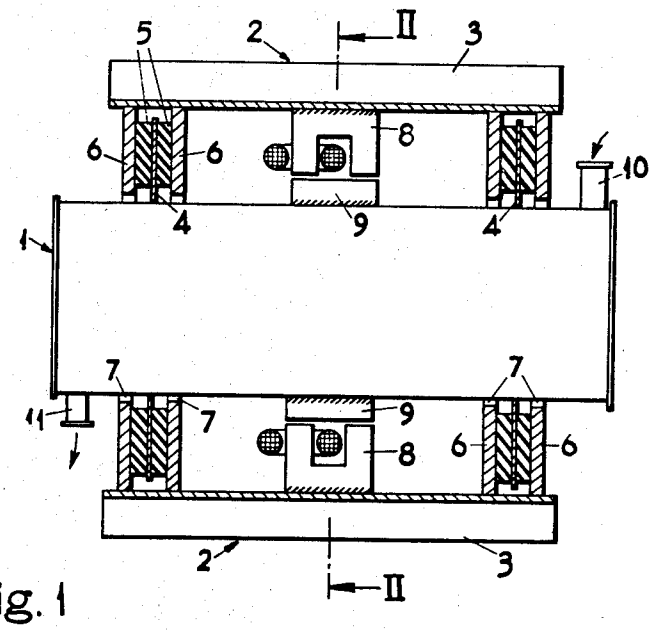


Fig. 1

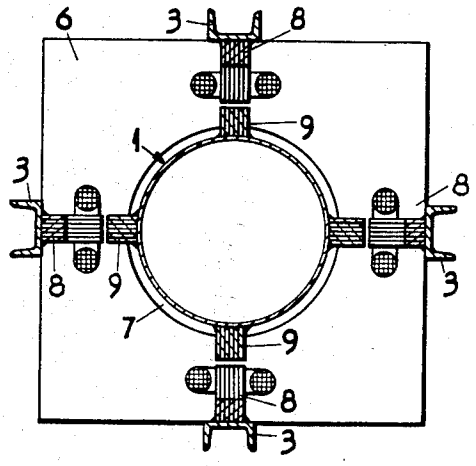


Fig. 2

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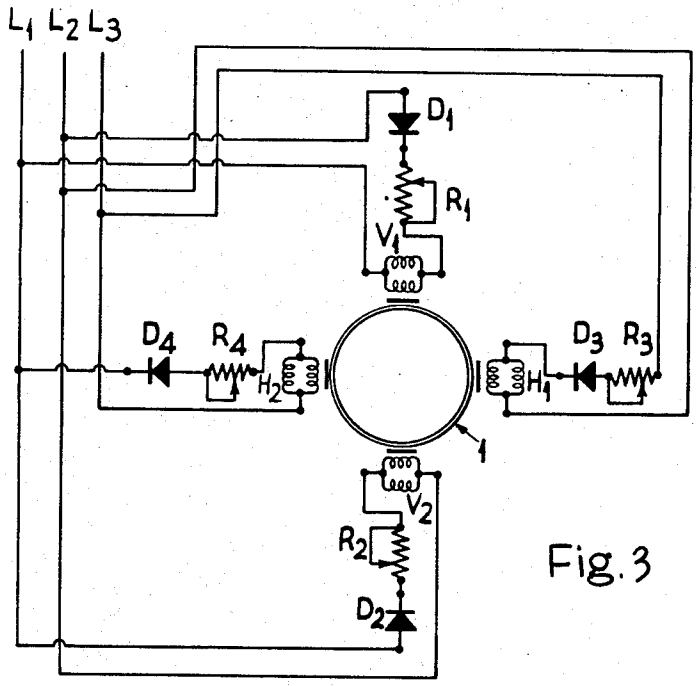


Fig. 3

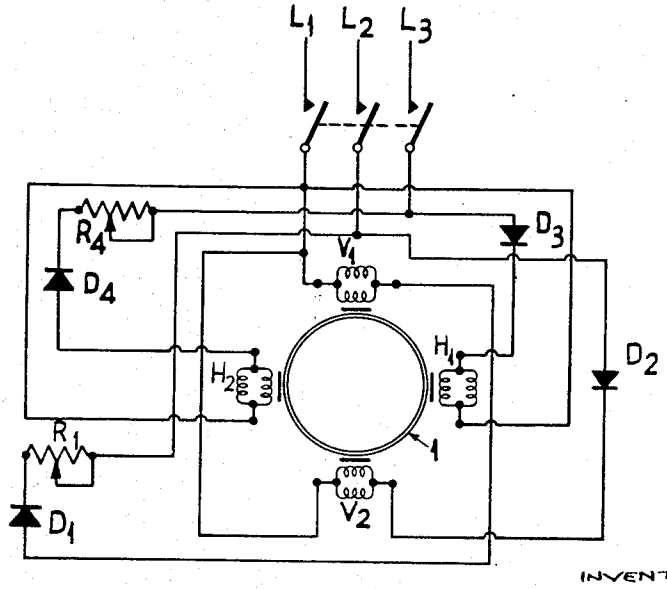


Fig. 4

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GRINDING MILLS, PELLETISING MILLS AND LIKE APPARATUS

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4 Claims. (Cl. 241—175)

The present invention relates to grinding mills, pelletising mills and like apparatus, that is to say, apparatus of the kind comprising a drum or container and a support therefor, and drive means for imparting motion to the drum or container for tumbling the contents thereof. Such apparatus is hereinafter referred to as "apparatus of the kind specified."

The invention is particularly applicable to ball grinding mills.

In apparatus of the kind specified the drum or container, hereinafter called a drum is usually mounted on bearings and is so carried by the support as to permit rotation of the drum about its own axis. It is an object of this invention to provide an improved apparatus of the kind specified which dispenses with such bearing.

According to this invention, in apparatus of the kind specified, the drum is resiliently mounted on the support whereby to permit movement of the drum in any direction perpendicular to its axis, and the drive means comprise a plurality of electro-magnets distributed around the axis of the drum, the armatures of the electro-magnets being coupled to the drum, and the electro-magnets being arranged to be energised in sequence so as to displace the drum whereby the axis of the drum is caused to describe a closed path about a fixed axis.

The drum may be mounted on the support by one or more resilient pads of rubber or like material which are arranged to act in shear when the axis of the drum is caused to describe its closed path about the fixed axis.

Preferably the closed path described by the axis of the drum about the fixed axis is a substantially circular path.

In order that the invention may be more readily understood and further features made apparent, one embodiment of the invention as applied to a ball mill will now be described, by way of example, with reference to the accompanying drawings, in which—

FIGURE 1 is a part sectional elevation of the ball mill,

FIGURE 2 is a section on line II—II of FIGURE 1, and

FIGURES 3 and 4 are schematic wiring diagrams of two electro-magnetic driving systems for a ball mill.

Referring to FIGURES 1 and 2, the ball mill comprises a drum **1** which is resiliently mounted on a stationary support **2**, the support comprising essentially four channel section members **3** disposed around the axis of the drum **1** and spaced 90° apart, a suitable structure (not shown) being provided to hold the channel members **3** in their respective positions relatively to one another.

Two rectangular plates **4** are provided, one near each end of the drum **1** in planes perpendicular to the axis of the latter. Each plate **4** is resiliently connected to the support **2** on each of its four sides, the arrangement being such that each side of each plate is sandwiched between a pair of resilient pads **5** of rubber or like material which, in turn, are compressed between a pair of parallel, spaced apart rectangular support plates **6**, connected to the channel members **3**, each plate having a central aperture through which the drum **1** projects with a clearance **7** as shown in FIGURES 1 and 2 of the drawings.

Four electro-magnets **8** are carried by the support **2**, the electro-magnets being rigidly connected, one to each longitudinal member **3**, more or less centrally thereof, and extending inwardly therefrom towards the drum **1**. The armatures **9** of the electromagnets **8** are suitably positioned on, and carried by the drum **1**.

The drum **1** is provided with inlet and outlet ports, **10** and **11** respectively, for the throughflow of raw material which is to be ground and the drum contains a plurality of small steel balls to effect such grinding.

In operation, the electro-magnets **8** are arranged to be energised in sequence so as to displace the drum **1**, whereby the axis of the latter describes a closed path about a fixed axis, the rubber pads **5** acting in shear during such drum displacement.

In practice, it has been found that the ball mill is most efficient when the axis of the drum **1** is caused to describe a substantially circular path about the fixed axis.

Referring now to FIGURE 3, driving means for imparting rotary movement to the drum **1** comprise four electro-magnets disposed around the drum and spaced 90° apart. One pair of diametrically opposed electromagnets have energising coils V_1 and V_2 respectively, while the other pair have energising coils H_1 and H_2 respectively, and these coils are energised from a three phase alternating current supply L_1, L_2, L_3, each coil having its own respective energising circuit comprising a rectifier D_1, D_2, D_3, or D_4 and an adjustable resistance R_1, R_2, R_3, or R_4 connected in series. The energising circuits of the coils V_1 and V_2 and connected in parallel between two phases L_1 and L_2 of the supply and the rectifiers D_1 and D_2 are so arranged that the electro-magnets are energised alternately. The energising circuits of the coils H_1 and H_2 are connected between the phases L_2 and L_3 and L_1 and L_3 respectively. The arrangement is such that the electro-magnets are energised in sequence to displace the drum **1** from its central position so that the axis of the drum follows an elliptical path about a central fixed axis. By appropriate adjustment of the resistances R_1–R_4 the energisation of the electro-magnets can be controlled to produce a true circular movement about said fixed axis.

Referring now to FIGURE 4, which shows an alternative arrangement for producing circular movement of the drum about the fixed central axis, the energising circuits of the coils V_1 and V_2 are connected in parallel between two phases L_1 and L_2 of the supply, and the energising circuits of the coils H_1 and H_2 are connected in parallel between two phases L_1 and L_3 of the supply.

In this case only one of each pair of energising circuits includes an adjustable resistance R_1 or R_4 for controlling the energisation of a respective electro-magnet whereby to modify the elliptical movement of the drum and so produce a true rotary movement.

I claim:

1. Apparatus comprising a container, a support, pads of rubbery material resiliently mounting the container to the support whereby to permit bodily movement of the container, and so constrained between the container and the support that relative movement between the container and the support stresses the pads in shear, drive means comprising a plurality of electro-magnets distributed around the container, the armatures of the electromagnets being coupled to the container and the cores of the electro-magnets being fixed on the support, and energizing means for the electro-magnets whereby the electromagnets are energized in a sequence to cause the container to describe a closed path.

2. Apparatus comprising a container, at least one plate on the outside of the container, a support having a pair of spaced plates disposed one on either side of the first

mentioned plate and substantially parallel thereto, a pair of pads of rubbery material each compressed between a respective one of said pair of spaced plates and said first mentioned plate whereby to mount the container resiliently to the support in a manner permitting bodily movement of the container and causing simultaneous stressing of the pads in shear, drive means comprising a plurality of electro-magnets distributed around the container, the armatures of the electro-magnets being coupled to the container and the cores of the electro-magnets being fixed on the support, and energizing means for the electro-magnets whereby the electro-magnets are energized in a sequence to cause the container to describe a closed path.

3. Apparatus comprising a container, a plurality of plates on the container, said plates being disposed parallel to each other and distributed along an axis passing through said container with their planes perpendicular to said axis, a support having a plurality of pairs of spaced plates, which are parallel to the first mentioned plates, the plates of each pair having a respective one of the first mentioned plates disposed between them, a pad of rubbery material compressed between each plate of said pairs of plates and the one of said first mentioned plates disposed therebetween, whereby to mount the container resiliently to the support in a manner permitting bodily

movement of the container and causing simultaneous stressing of the pads in shear, and drive means comprising a plurality of electro-magnets distributed around the container, the armatures of the electro-magnets being coupled to the container and the cores of the electro-magnets being fixed on the support, and energizing means for the electro-magnets whereby the electro-magnets are energized in a sequence to cause the container to describe a closed path.

4. Apparatus as claimed in claim 3, wherein there are two of said first mentioned plates spaced from each other along said axis, and the electro-magnets are disposed intermediate said two plates with their armatures substantially co-planar.

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