

May 18, 1948.

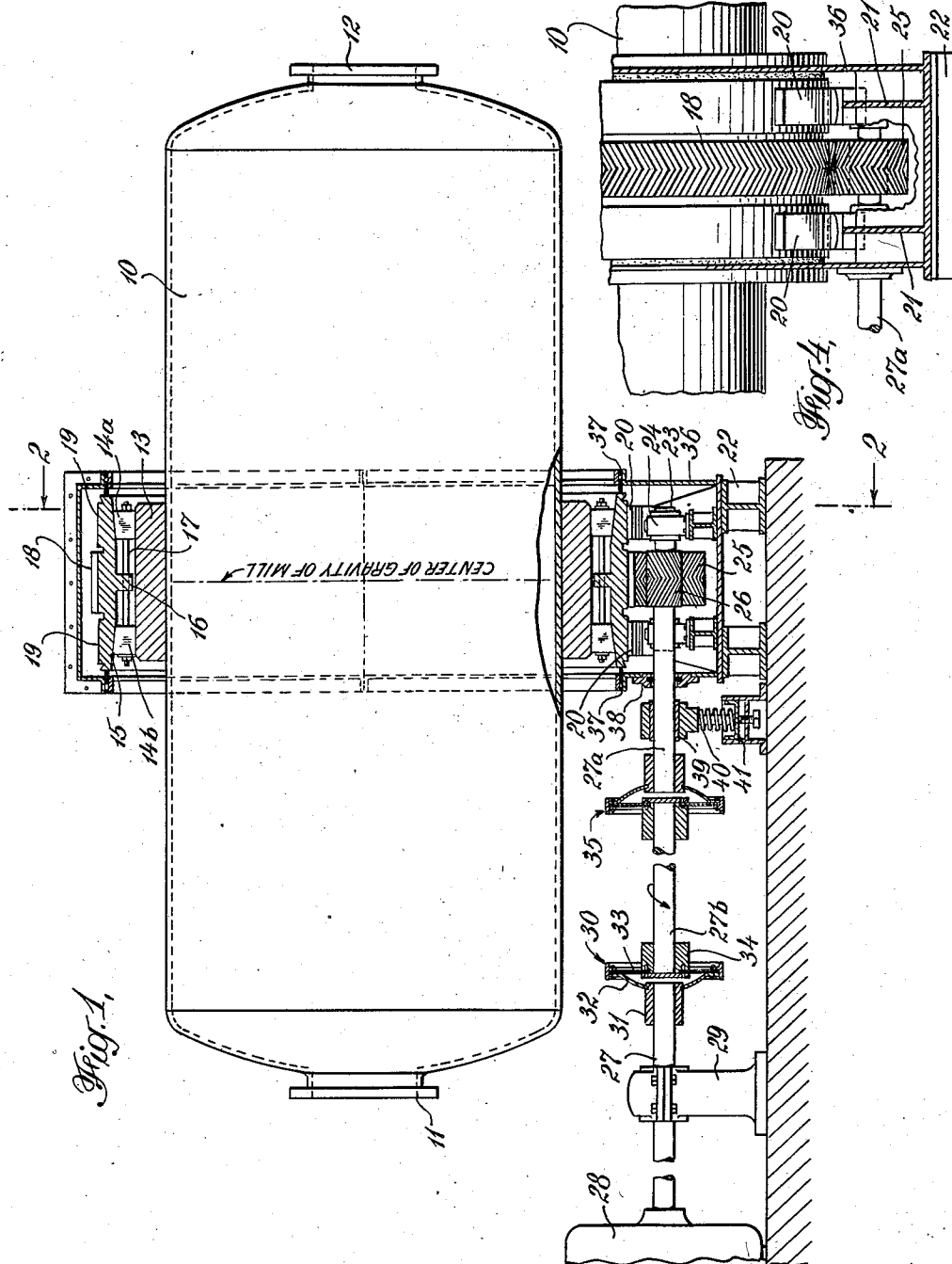
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2,441,901

MILL

Filed Feb. 9, 1946

2 Sheets-Sheet 1



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Fig. 2,

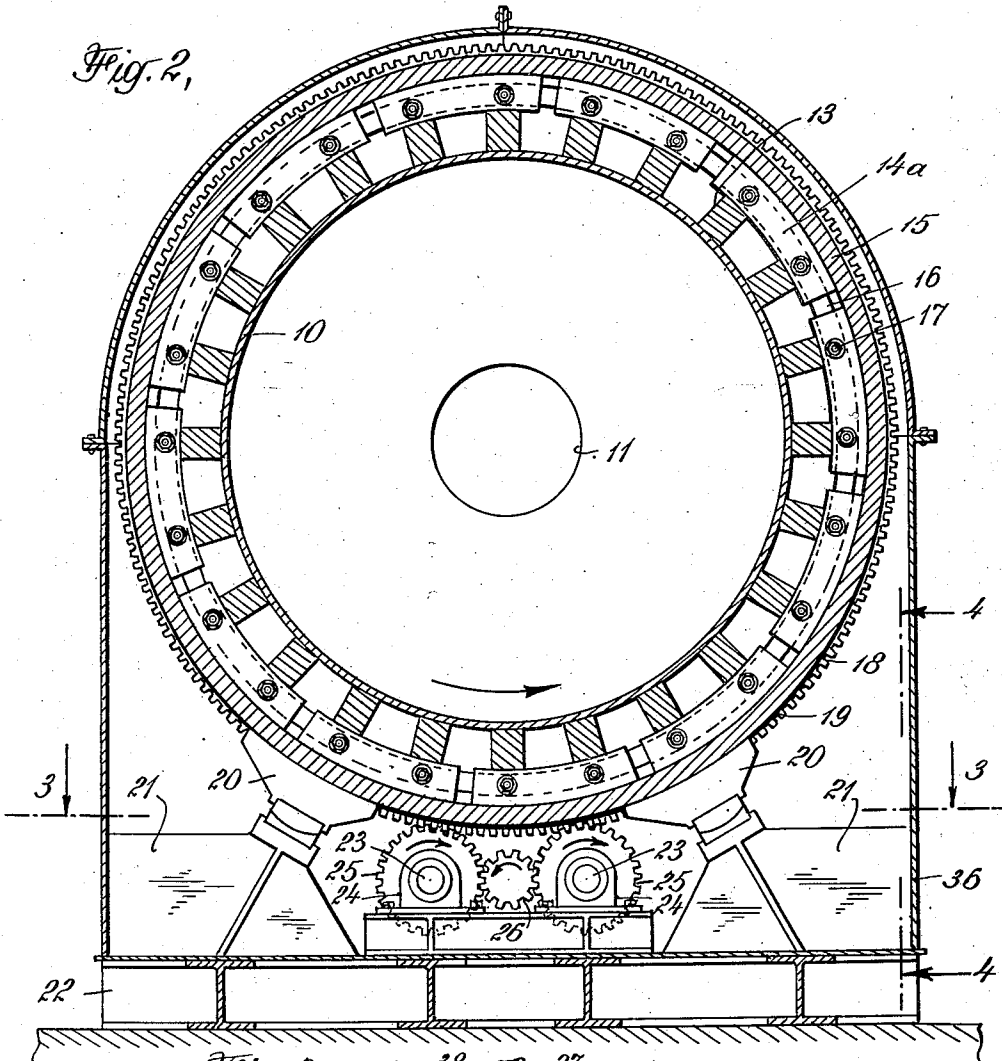
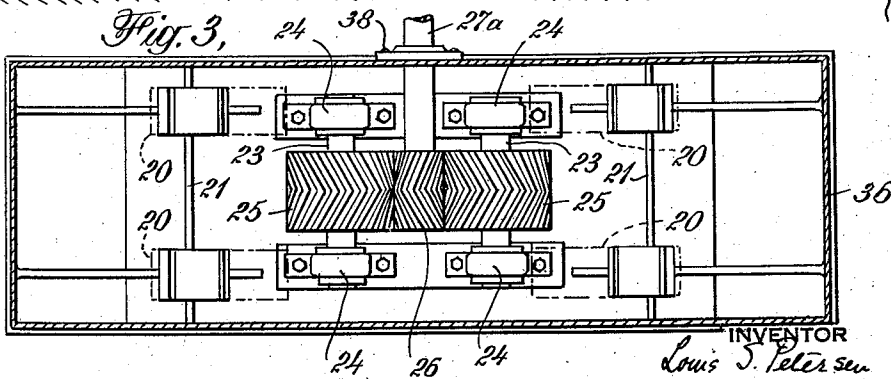


Fig. 3,



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2 Claims. (Cl. 74-421)

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This invention relates to apparatus of the type that includes a generally cylindrical shell mounted for rotation on its longitudinal axis, examples of such apparatus being ball mills, rotary kilns, certain forms of dryer, etc. More particularly, the invention is concerned with a novel apparatus of the kind mentioned which is superior to prior equipment with respect to the means by which the shell is supported and rotated. While the new apparatus may take various forms, as indicated above, the invention may be embodied to especial advantage in ball mills and its application to that field will, accordingly, be illustrated and described in detail for purposes of explanation.

Ball mills consist essentially of a generally cylindrical shell or drum mounted with its longitudinal axis horizontal and supported for rotation on that axis. The shell is closed at its ends and is provided with an inlet at one end through which material to be ground may be introduced by appropriate means, such as a rotary scoop within a casing, and with an outlet at the other end through which the ground material is discharged.

In my co-pending application, Serial No. 505,729, filed October 11, 1943, now Patent No. 2,396,057, I have disclosed an apparatus, such as a ball mill, which includes a cylindrical shell mounted for rotation with its axis horizontal and encircled by a ring lying about midway between its ends. In the construction, which is preferred when the mill is of great weight, the ring is formed with a pair of peripheral gear sections and a smooth surfaced peripheral section lying between the gear sections and serving as a tire. The mill is supported by means, such as slide shoes, which engage the tire, and it is kept from tilting in any suitable manner, as by means of a shaft secured to the mill at the inlet end and mounted for rotation in a bearing. The mill is rotated by a drive shaft which has pinions engaging the respective gear sections and the shaft is supported for rotation in fixed bearings, although the bearings may be of the self-aligning type.

The mill shown in the co-pending application offers advantages over prior mills rotated by a single master gear driven by a drive pinion, for the following reasons. When a single master gear and pinion are used, they must be very strong, because of the large amount of power transmitted through their teeth, and the cost of such a gear is high and its manufacture is difficult. In the mill of the co-pending application, in which the ring encircling the shell is provided

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with two gear sections driven by separate pinions, only half the power required for driving the mill is transmitted through the teeth of each pinion and its gear section and the cost of such gear sections is substantially less than that of a single master gear. However, my prior mill requires the use of an anti-tilting bearing, and also that section of the drive shaft carrying the drive pinions must be supported by a bearing, so that the shaft can not adjust itself to the extent desirable to insure proper tooth pressure on both drive pinions and their gear sections at all times.

The present invention is directed to the provision of an apparatus, such as a ball mill, which includes a cylindrical shell provided with means which support the shell between its ends in such fashion that no anti-tilting bearing is required. In addition, the shell of the new apparatus is driven by means of a single master gear, but power is transmitted to the gear by a pair of idler pinions, so that the gear need be only half as strong as would be necessary, if a single drive pinion were used.

For a better understanding of the invention, reference may be made to the accompanying drawings, in which:

Fig. 1 is a view of the new apparatus in side elevation, with the mounting means shown in vertical section;

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

Figs. 3 and 4 are sectional views on the lines 3-3 and 4-4, respectively, of Fig. 2.

The new apparatus is illustrated in the form of a ball mill, which comprises a cylindrical shell 10 having an inlet opening 11 at one end and an outlet opening 12 at the other. The shell is of conventional construction and, midway between its ends, a series of blocks 13 are secured to its outer surface by welding and extending both radially and axially of the shell. Arcuate wedge members 14a, 14b are mounted in pairs against the outer surfaces of a plurality of adjacent blocks near their ends, and, in the construction shown, each wedge member bears against a pair of blocks. The wedge members of each pair have inwardly convergent top surfaces and a ring 15 having inwardly convergent inner surfaces rests on top of the pairs of wedge members 14a, 14b. The ring has an inner peripheral flange 16 formed with openings therethrough and the wedge members of each pair are secured together by bolts 17, which pass through the wedge members and through the flange 16 of the ring. When the bolts are

drawn up, the wedge members act against the blocks 13 and the convergent surfaces on the underside of the ring to hold the latter securely in position on the shell.

The ring is formed with a central gear section 18 which may consist of gear teeth of herring-bone form. On either side of the gear section, the outer surface of the ring is smooth and the smooth sections 19 serve as tires.

Pairs of slide shoes 20 mounted on supports 24 on a foundation 22 engage the respective tire sections 19 and the shoes constitute the sole support for the shell. A pair of shafts 23 are mounted in self-aligning bearings 24 supported on the foundation and an idler pinion 25 mounted on each shaft meshes with the gear section 18 on ring 15.

The idler pinions are driven by a drive pinion 26 on the end section 27a of a drive shaft 27 driven by a motor 28. Adjacent the motor, the shaft 27 is mounted in a fixed bearing 29 and, beyond the bearing toward its free end, the shaft is provided with a membrane coupling generally designated 30, which connects it to an intermediate section 27b. The coupling comprises a hub 31 on the main part of shaft 27, and a dished circular plate 32 attached to the hub. The outer edge of the plate is secured to a plurality of thin flexible plates 33 which are bolted to a hub 34 mounted on one end on the intermediate shaft section 27b. The other end of the intermediate shaft section is attached by a second membrane coupling 35 to one end of the end section 27a of the shaft. With such a mounting, the shaft section 27a is free to float, that is, to move in all directions without inclination of its axis and this insures that the drive pinion 26 will find its correct meshing position with the idler pinions 25 in response to pressures exerted between the teeth of the respective pinions.

The ring 15 and its mounting on the shell 10 are enclosed within a casing 36 which is supported on the foundation 22 and has openings in its opposite walls through which the shell extends. Sealing means 37 mounted at the edges of the openings engage the end surfaces of the ring and prevent the access of dust to the gear teeth. The casing has an opening through which the shaft section 27a extends, and a resilient seal 38 is mounted on the casing wall to encircle the shaft section 27a at the opening. The seal is so constructed that it does not interfere with the floating movement of the shaft section. In order to balance the dead weight of section 27a and pinion 26, a bearing 39 for the shaft section is provided, and the bearing is supported on a spring 40 resting on a suitable support 41.

With the construction described, the slide shoes 20, bearing on the tire sections 19 of ring 15, provide the sole support for the mill and it is not necessary to make use of an anti-tilting bearing at either end thereof. Even though the distance between the centers of the tires is relatively small, the weight that must be applied to one end of the mill to cause the latter to begin to tilt, is much greater than any unbalanced load that is likely to occur in normal operation. Thus, with the slide shoe bearings separated by a distance equal to one-eighth of the length of a shell which is fifteen feet long and seven feet

in diameter and weighs one hundred forty thousand pounds, a load of twenty thousand pounds must be applied at one end of the shell before tilting starts.

Since the mill is driven from the drive shaft through the two idler pinions, those pinions and the teeth of gear section 18 need be only half as strong as would be necessary, if the drive pinion acted directly on the gear section. Also, since the drive pinion is mounted between the idler pinions and the shaft section carrying the drive pinion is free to float, the action of the two idler pinions on the drive pinion keeps the latter in position to insure proper tooth pressure at all times.

Since the new mill does not require any anti-tilting bearing, the construction is simplified and the cost reduced. A further reduction in cost results from the use of a master gear section, which is driven through two idler pinions instead of directly from a single pinion on the drive shaft.

I claim:

1. Apparatus of the type described, which comprises a generally cylindrical shell, a member encircling and secured to the shell, the member having a pair of smooth surfaced tire sections and a gear section between the tire sections, a foundation, sets of slide shoes mounted on the foundation and engaging the respective tire sections, the shoes forming the sole support for the shell in its rotation, a pair of shafts beneath the shell, an idler pinion on each shaft, the teeth of the pinions meshing with those of the gear section, a drive shaft having an end section supported for floating movement, and a pinion on said end section lying between and driving the idler pinions and their shafts.

2. Apparatus of the type described, which comprises a generally cylindrical shell, a member encircling and secured to the shell, the member having a pair of smooth surfaced tire sections and a gear section between the tire sections, a foundation, sets of slide shoes mounted on the foundation and engaging the respective tire sections, the shoes forming the sole support for the shell in its rotation, a pair of shafts beneath the shell, an idler pinion on each shaft, the teeth of the pinions meshing with those of the gear section, a drive shaft having an end section supported for floating movement, resilient means tending to raise said end section, and a pinion on said end section driving the idler pinions and their shafts.

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