Jan. 7, 1958 J. C. AGARWAL 2,818,601

DISC-TYPE BALLING DEVICE

Filed Oct. 27, 1955

FIG. 1.

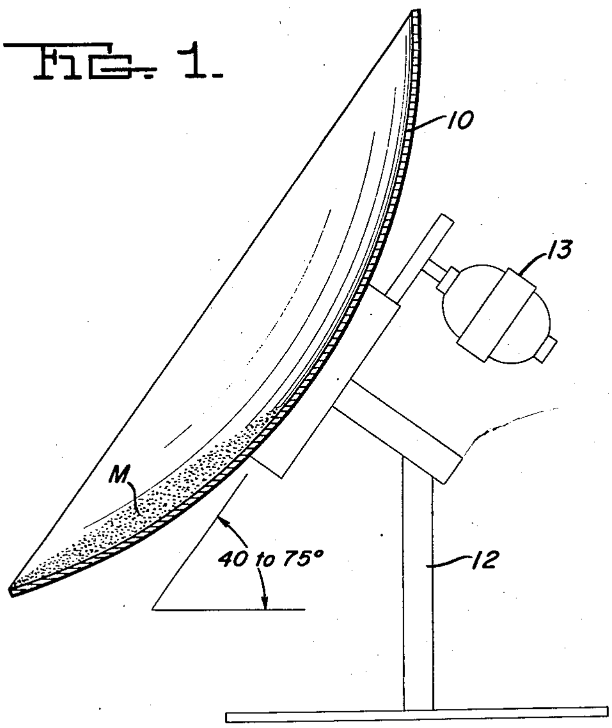
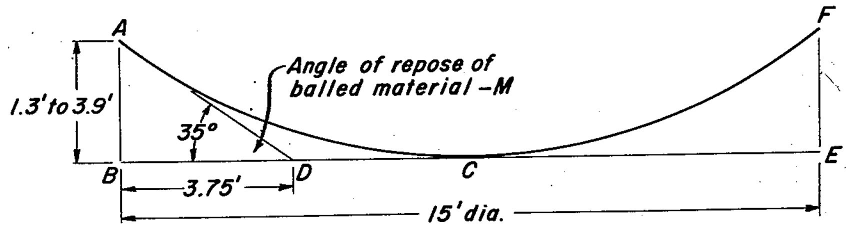


FIG. 2.



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DISC-TYPE BALLING DEVICE

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2 Claims. (Cl. 18—1)

This invention relates to an improved disc-type balling device for agglomerating moist fines.

Although my invention is not limited to use with any specific material, it is especially suited for balling fine iron ore or iron mineral concentrates recovered from beneficiating low grade ores, such as taconite. Often low grade ores must be ground to exceedingly fine sizes (for example 90 percent minus 270 mesh) to liberate the iron minerals from the gangue. A concentrate of this fineness must be agglomerated before it can be utilized for many purposes, such as in a blast furnace, and the agglomerates must possess both substantial mechanical strength and porosity. One currently known procedure for agglomerating these fine materials involves accreting the moist fines into balls of about 1/8 to 1 inch in diameter, and indurating these balls, commonly on a traveling grate sintering machine or in a shaft furnace. The balling device can be either of the disc-type or the drum-type, the present invention being concerned with the former. For a discussion of the theories involved in balling, reference can be made to Firth Patent No. 2,411,873, dated December 3, 1946. However, as recognized subsequent to this patent, a disc-type balling device produces balls of more uniform size than a drum-type and does so without a circulating load.

Previous disc-type balling devices with which I am familiar have included a flat circular base plate, an upstanding circumferential rim or weir fixed to this plate, and a power drive for rotating the plate about its central axis. The plate is supported with its plane inclined to the horizontal at perhaps 55°. This arrangement has several disadvantages. The pocket adjacent the bottom juncture of the base plate and rim constitutes a dead space, and the relatively large dead load unduly increases power required to drive the disc. Partially formed balls or their nuclei within the dead space are subjected to the load of the material thereabove. The balls are easily crushed; hence the size and capacity of the device is limited by the depth of material whose weight can be sustained by balls at the bottom of the dead space. Also, only a small portion of the disc surface is utilized effectively for ball formation.

Objects of the present invention are to provide an improved disc-type balling device which eliminates any dead space, permits a greater portion of the disc surface to be utilized for ball formation, increases the capacity, and reduces power requirements.

A more specific object is to provide an improved disc-type balling device in which the disc is a smoothly curved dish whose curvature is mathematically related to the angle of repose of the material balled therein.

In accomplishing these and other objects of the invention, I have provided improved details of structure, a preferred form of which is shown in the accompanying drawing, in which:

Figure 1 is a somewhat diagrammatic vertical sectional view of a balling device constructed in accordance with my invention; and

Figure 2 is a diagrammatic view illustrating the preferred relation between the dish curvature in my balling device and the angle of repose of the material.

My balling device comprises a smoothly and uniformly curved dish **10** of circular outline. The dish is journaled

to a suitable support **12** to rotate on its central axis and is power driven by a motor **13**. Since the support and drive can be of conventional construction, they are shown only diagrammatically. A plane tangent to the dish at its central axis slopes at about 40° to 75° to the horizontal, being illustrated as sloping at about 55°. The dish receives moist pulverulent material M to be accreted into balls, which discharge from the bottom edge. The dish has a continuously rising curvature from this bottom edge, which is its lowermost point. Consequently there is no dead space below the point of discharge. Balls form as their nuclei pick up material while rolling over a moving surface. Nearly half the surface of the dish is utilized effectively for this purpose.

Figure 2 shows the preferred relation between the curvature of the dish **10** and the angle of repose of the material M. Distance BE represents the largest diameter, which is governed by the capacity desired. For example for a capacity of 50 to 100 tons per hour this diameter can be about 15 feet. Distance AB represents the depth, which is determined by multiplying the tangent of the angle of repose of the balled material (about 35° for iron ore balls) by one fourth to three fourths the largest radius, or preferably two fifths to three fifths this radius. In the example where the angle of repose is about 35° (tan 35°=0.700) and the diameter 15 feet, the depth would be in the following range:

Minimum: $0.700 \times 1/4 \times 15/2 = 1.3$ feet
Maximum: $0.700 \times 3/4 \times 15/2 = 3.9$ feet

Next the midpoint C of line BE is located, and the depth FE diametrically opposite the depth AB is plotted. Finally a circular arc ACF is plotted connecting the points A, C and F, and represents the desired curvature.

While I have shown and described only a single embodiment of my invention, it is apparent that modifications may arise. Therefore, I do not wish to be limited to the disclosure set forth, but only by the scope of the appended claims.

I claim:

1. A disc-type balling device adapted to roll moist pulverulent solids into balls each about 1/8 to 1 inch in diameter comprising a smoothly and uniformly curved dish of circular outline, means supporting said dish for rotation about its central axis and with a plane tangent to the dish at its central axis sloping at about 40 to 75° to the horizontal, the lowest point on said dish being located on its outer circumference, the depth of the dish equalling one-fourth to three-fourths the maximum radius multiplied by the tangent of the angle of repose of the balls, and power means for rotating said dish at a rate which retains pulverulent solids on the dish until they accrete into balls and which discharges balls from the bottom portion of the dish.

2. A device as defined in claim 1 having a capacity to roll about 50 to 100 tons of pulverulent iron ore per hour into balls, said dish having a diameter of about 15 feet and a depth of about 1.3 to 3.9 feet, the curvature of the dish being represented by a circular arc that connects the center with diametrically opposed points on the circumference.

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