July 21, 1953 C. A. AREND, JR., ET AL 2,645,861

BALL HAMMER FOR ROTARY DRIERS

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Fig. 1

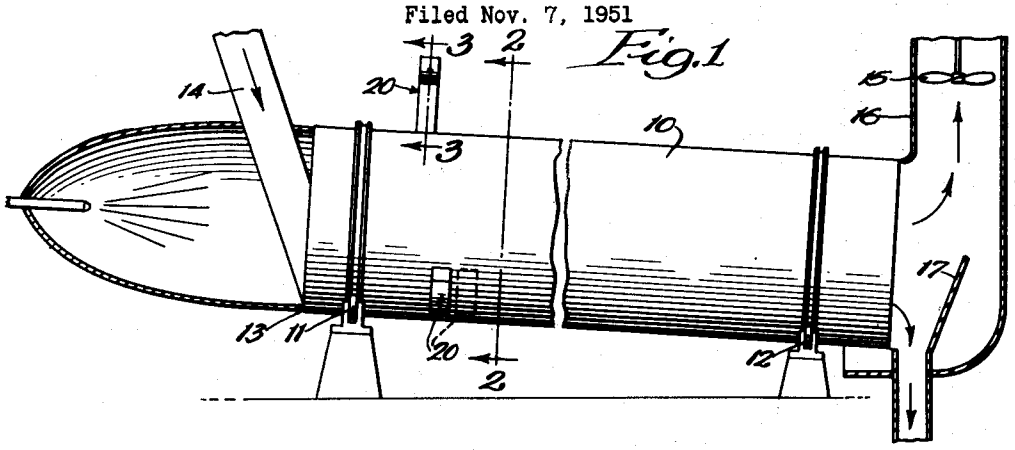


Fig. 3

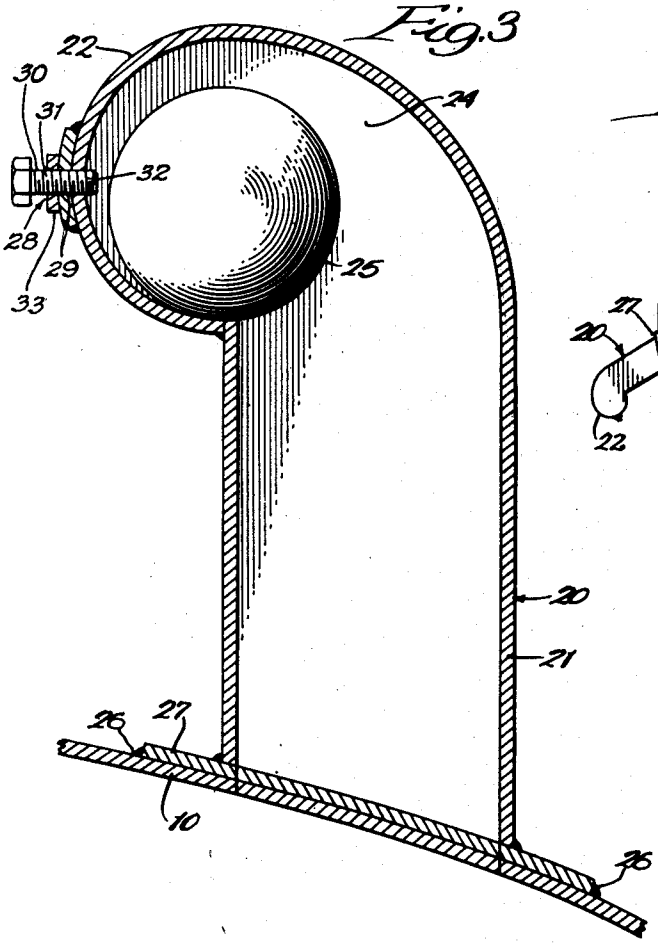
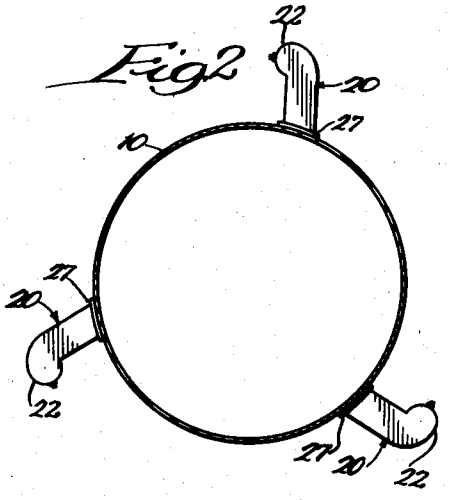


Fig. 2



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BALL HAMMER FOR ROTARY DRIERS

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5 Claims. (Cl. 34—85)

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This invention relates to improvements in mechanical drying apparatus. More particularly, it relates to an apparatus for drying moist granular materials. Still more partiuclarly, it relates to apparatus for disengaging material from the sides of rotary dryers.

In the past it has been the practice to insert heavy chains inside rotary dryers. Such chains slide about during rotation and scrape the interior of a rotary drum clean.

Another means to accomplish the same result is to attach balls to a chain secured to the interior of a rotary drum. These balls swing in pendulum style as the drum rotates, thus beating against the drum at a position approaching 90° from the top.

Still another means for keeping rotary dryers clean are the externally positioned hammers. These have been of two types, those secured to the dryer and actuated by cams in contact with the rotary dryer and those pivotably secured to the rotating drums. The cam-actuated hammers are usually positioned to strike the drum intermediate and usually half way between the highest and lowest vertical point of the drum. The pivotably mounted hammers swing when the point at which the hammer is pivotably secured moved at least into the vicinity of and usually past the top point of rotation of the drum. As a consequence, the hammer strikes the shell at a point in the right first quadrant when the drum is rotating in clockwise direction.

All of the above systems have the disadvantage that they do not strike the drum or shell at the most effective point for dislodging material adhering to the interior thereof, namely at the top or highest point reached in the rotation of the rotary kiln.

Another disadvantage of these systems is that the material, when dislodged, usually is in such a position in the downward rotation of the shell that the material does not fall freely through the drying gas stream, but merely slides down the side with only its upper surface in contact with the drying gases.

It is an object of the instant invention to overcome the disadvantages and shortcomings of apparatus heretofore in use.

It is a further object of this invention to provide apparatus to impart the maximum impact to a rotary shell at the point of greatest effectiveness, namely the highest point reached in the rotation of the rotary kiln.

It is a still further object to provide simple and closed apparatus which will be free from the

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effects of dust and chemicals associated with the operation of rotary kilns.

It is still another object of this invention to provide an apparatus in which the time of impact is adjustable to compensate for changes in speed of rotation of rotary kilns.

It is still another object to provide apparatus wherein the impact is derived from the substantially free fall of a heavy ball.

It is still another object of this apparatus to provide for breaking loose of material from the shell at a point providing for the longest possible path for material contact with drying gases.

These and other objects and advantages of the invention will be apparent from the following description when read in connection with the accompanying drawings in which:

Figure 1 is a side elevational view of a dryer equipped with ball hammers of the instant invention. Figure 2 is a cross-sectional view along the line 2—2 of Figure 1 and Figure 3 is a cross-sectional view of the boot as seen along the line 3—3 of Figure 1.

Briefly stated, the apparatus of the instant invention comprises a heavy ball enclosed in a housing consisting of a hollow head portion and a straight tubular portion with the axis of the tubular portion disposed transverse to the longitudinal axis of the drum and angled from the radial line in a direction opposite to that of the drum rotation.

This housing is secured to the exterior of a rotary material-conveying drum. The housing is provided with the hollow head angled transverse to the tubular portion of the housing and is adapted to hold the heavy ball in the head thereof until rotation of the dryer shell brings the housing to approximately the highest point of rotation, in which position of the housing the ball will be permitted a substantially free fall into contact with the rotary dryer. This free-fall position is controlled by suitable adjustment means positioned in the head of the housing. When the ball rests in contact with the dryer shell, rotation of the dryer downwardly causes the ball to roll to the head of the housing for retention there until moved into the free-fall position.

Referring now to the drawings wherein is illustrated one embodiment of the invention, Figures 1 and 2 show a material conveyor or rotary dryer drum 10 of a well known type supported near its ends on roller bearings such as 11 and 12 with the horizontal axis on a slight angle to the vertical for the purpose of assuring

the movement of loose material from the upper to the lower end of the drum. At the receiving end of drum 10 is an opening 13 through which projects a feed chute 14. Drying air passes in parallel flow to material in the drum and is of the induced draft type, although countercurrent air flow is equally applicable. A fan 15 sucks hot gas, which is a combination of air and combustion gases, through the dryer. At the discharge end of drum 10, the drum projects through one wall of a chamber 16 in which the drum turns freely. Dried material is delivered to a discharge hopper 17 and passes to a suitable packaging station not shown.

Housing units 20 may be fabricated from hollow members of round, square or other suitable cross sectional configuration, and consist of a leg portion 21 and a head portion 22.

If fabricated from a square member, the head portion may be formed by bending an elongated wall starting at a point horizontally opposite the end of the corresponding opposite or short wall through an arc of 90 degrees. The radius of this primary curvature is approximately the width of the hollow member. From the point 90 degrees from the point of starting the curvature, the elongated wall is bent upon a second radius of curvature of one-half the width of the member centered about the point vertically removed from the first center of curvature at the end of the short wall and the second radius of curvature distance removed therefrom. By this method of fabrication the elongated wall is smoothly and convexly curved to meet the short wall at the end of the short wall making a complete enclosure. The two walls are secured together by suitable means such as brazing, welding and the equivalent thereof.

If fabricated from a round member head portion 22 is formed by bending the upper end portion of the tubular member through an arc of 90 degrees. This curvature is effected beginning at a point on the face of the tube and striking a long radius whose point of origin is on the outside face of the tube 180 degrees removed in a horizontal plane from said beginning point and bending the tube to conform to the arc swung through an angle of 90 degrees from said point of origin. This brings the open end of said tubular member into the vertical plane. The open end is then capped with a hemisphere of a radius approximately equal to the radius of the tube which may be secured by suitable means such as welding, threaded connection or the like. This mode of fabrication provides a pocket 24 into which ball 25 recedes during the drum rotation from the lowest to the highest point.

Housing unit 20 is secured to shell 10 by suitable means 26 such as bolts, rivets, welding and the like. The attachment may be by direct means or through a wall plate 27 intermediate thereof so that contact of the hammer means will not be directly on the dryer shell. Before attachment of the housing unit 20, a heavy ball 25 of steel or the like is inserted in the housing 20. The length of the tubular unit, or stated another way, the length of free-fall path of a ball 25, may be of any predetermined length, limited only by the height above the ground at which the rotary dryer is positioned. Tubular portions of ten to fifteen inches are preferred when housings are attached to rotary drum dryers of five to six feet in diameter.

Head portion 22 of housing 20 is provided with stop means 28 which is insertable through an aperture 29 in the hemispherical wall. This stop means is adjustable to limit the depth to which ball 25 seats in pocket 24. Stop means 28 in a preferred simple embodiment consists of a threaded bolt 30 having threads 31 thereof adapted to cooperate with threads 32 of aperture 29. Ball 30 is provided with a lock nut 33 to insure that repeated contact with the ball 26 does not alter the predetermined setting.

The following descripion will illustrate details of the preferred type of installation. Four housing units are equilaterally spaced around the outside steel shell of five feet diameter rotary dryer at a distance of about four feet from the inlet end. The tubular portion of each housing unit is six inches in diameter and the shortest leg is ten inches. The radius of curvature of the 90° arc is six and one-quarter inches and the radius of curvature of the 180° curve of the hemisphere is three and one-eight inches. The housing carried a steel ball of approximately five inches in diameter weighing approximately 18 pounds. Between each housing and the dryer shell is positioned a two-inch thick wear plate. This wear plate is welded to the shell and the housing welded to the wear plate.

Each housing is attached to the wear plate so that the housing is positioned at right angles to the longitudinal axis of the dryer and, in addition, so that the longitudinal axis of the housing is angled in the direction opposite to the direction of rotation of the dryer. This angle of cant is variable depending upon speed of rotation of the dryer, weight of ball and the distance the ball falls. For a speed of about 5 to 8 revolutions per minute the angle of cant is about 20 degrees from the radial line.

The free fall distance for the ball hammer under this arrangement is slightly less than ten inches and the adjustment is such that the ball contacts the wear plate with timing giving contact at plus or minus ten degrees from the vertical axis.

Wet crystalline potash material is fed to this dryer at a mixture content of approximately 8% and is dried in hot gases, having a temperature of approximately 600° F. entering the drum, to a mixture content of less than 1%. Three wall hammers have maintained the shell free from adhering salt cake.

Having thus fully described the nature and character of the invention without intention to be limited to the specific embodiment shown therein, what is desired to be secured and claimed by Letters Patent is:

1. In an apparatus for drying materials, a rotary drum, at least one hollow tubular housing secured to the exterior of the drum shell with the central axis thereof projecting outwardly from said drum shell, and a heavy ball in said housing of dimensions freely movable within said housing, said housing being closed at one end by the drum shell and closed at the opposite end by an extension of the tubular portion which forms a head member of a size capable of seating said ball and which extension projects to an offset position from the central axis of said housing in a direction opposite from the direction of drum rotation.

2. In an apparatus for drying materials, a rotary drum, at least one hollow tubular housing secured to the exterior of the drum shell with the central axis thereof projecting outwardly from said drum shell, a heavy ball in said hous-

ing of dimensions freely movable within said housing, said housing being closed at one end by said drum shell and closed at the opposite end by a continuously smooth and convexly curved extension of the tubular portion which forms a head member capable of seating said ball and which extension projects to an offset position from the central axis of said housing in a direction opposite from the direction of drum rotation, and head recess depth control means mounted in the wall of said head member of said housing.

3. In an apparatus for drying materials, a rotary material-conveying drum, a hollow tubular housing secured to the exterior of the drum shell with the central axis thereof disposed transversely to the longitudinal axis of the drum and angled from the radial line in a direction opposite to that of the drum rotation, a heavy ball in said housing of dimensions freely movable within said housing, said housing being closed at one end by the drum shell and closed at the opposite end by an extension of the tubular portion which forms a head member of a size capable of seating said ball and which extension projects to an offset position from the central axis of said housing in a direction opposite from the direction of drum rotation, and an adjustable length member mounted in the head of said housing whereby the depth of the head recess is limited.

4. In an apparatus for drying materials, a rotary drum mounted to turn about an axis disposed at an angle to the vertical and having secured at different points in the length thereof hollow tubular housings secured to the exterior of the drum shell with the central axis thereof projecting outwardly from said drum shell, and a heavy ball in said housing of dimensions freely movable within said housing, said housing being closed at one end by the drum shell and closed at the opposite end by an extension of the tubular portion which forms a head member of a size capable of seating said ball and which extension projects to an offset position from the central axis of said housing in a direction opposite from

the direction of drum rotation, and an adjustable length member mounted in the head of said housings whereby the depth of the respective head recesses are limited.

5. In an apparatus for drying material, a rotary drum mounted to turn about an axis disposed at an angle to the vertical, at least one hollow tubular housing of square cross sectional configuration secured to the exterior of said drum with the central axis thereof projecting outwardly from said drum shell, a heavy ball in said housing of dimensions freely movable within said housing, said housing having the straight hollow leg member closed at one end by the shell and closed at the other end by an extension of the leg member which forms a head member of a size capable of seating said ball and is formed with continuously smooth convex curvature produced by bending an elongated wall through a primary curvature of radius equal to approximately tube width followed by a secondary curvature of radius of approximately one-half the primary curvature, thereby bringing the edge of the elongated wall into contact with the end of the shorter opposite wall to form a ball receiving recess, a threaded aperture in the wall rearwardly disposed during drum rotation, rod means provided with a threaded portion adapted for cooperation with the threads of said aperture to insert into and to withdraw said rod means from the recess in said head member, and lock means mounted on said rod for securing the same in fixed position.

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