Jan. 10, 1967 E. E. LANGFORD ETAL 3,296,711

LINING FOR ROTARY VESSELS

Filed June 18, 1964 3 Sheets-Sheet 1

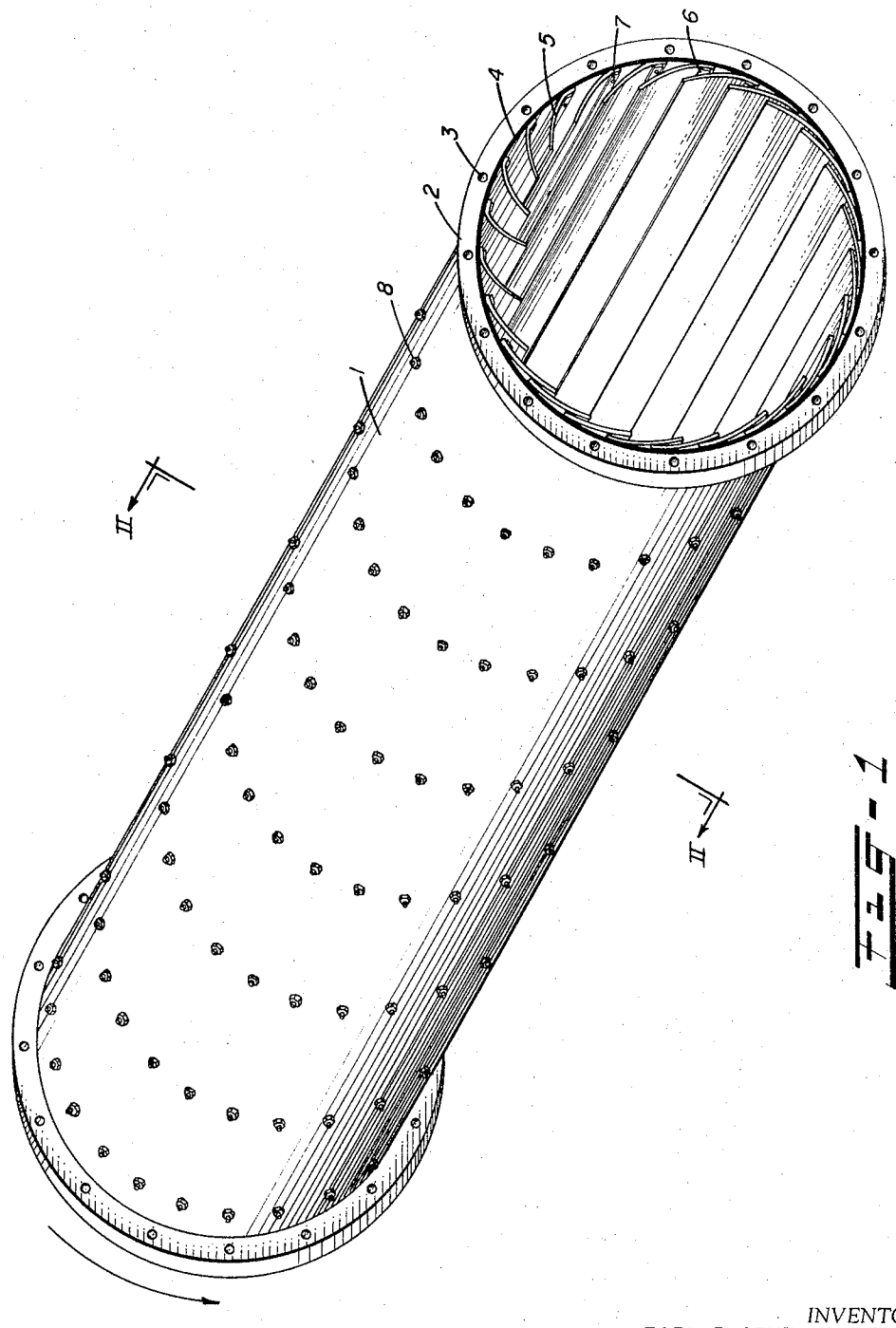


FIG. 1

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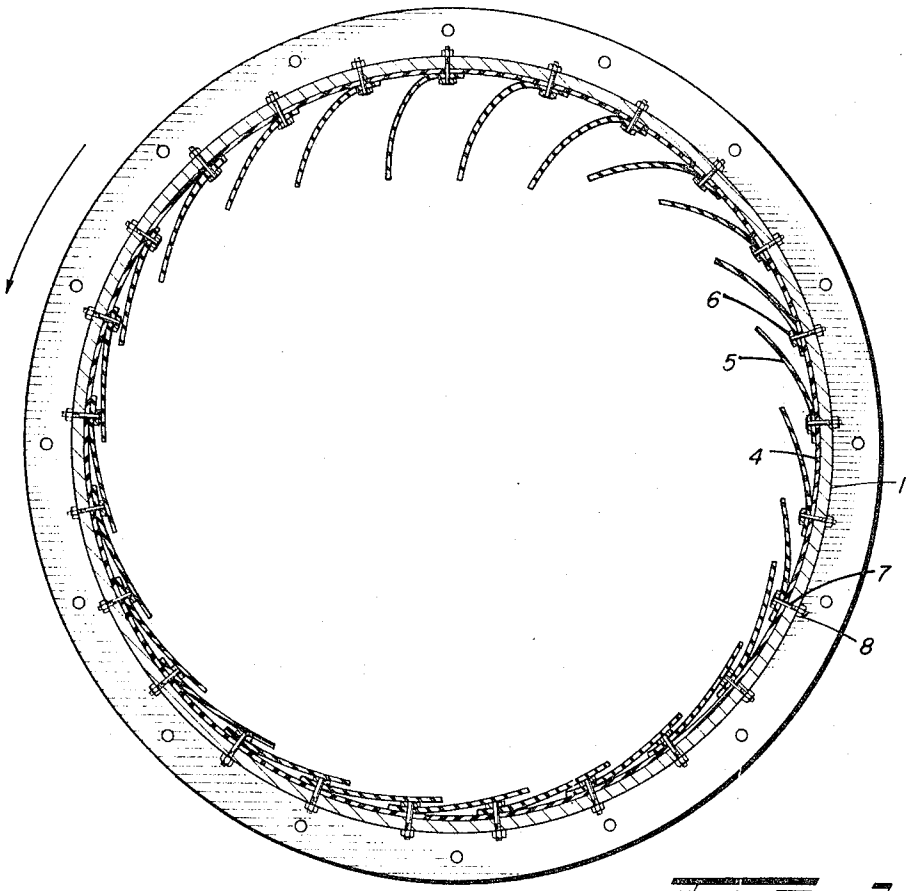


FIG-2

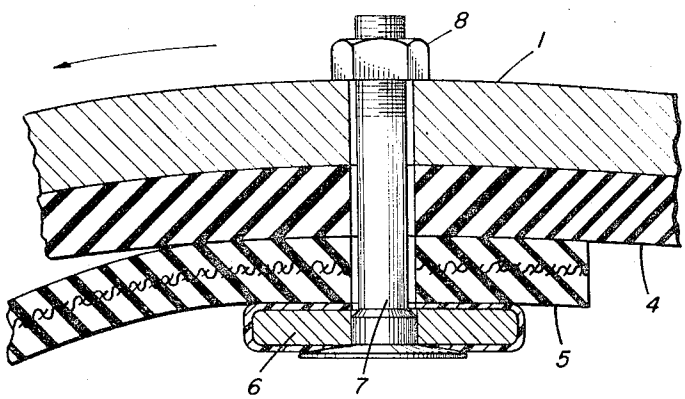


FIG-3

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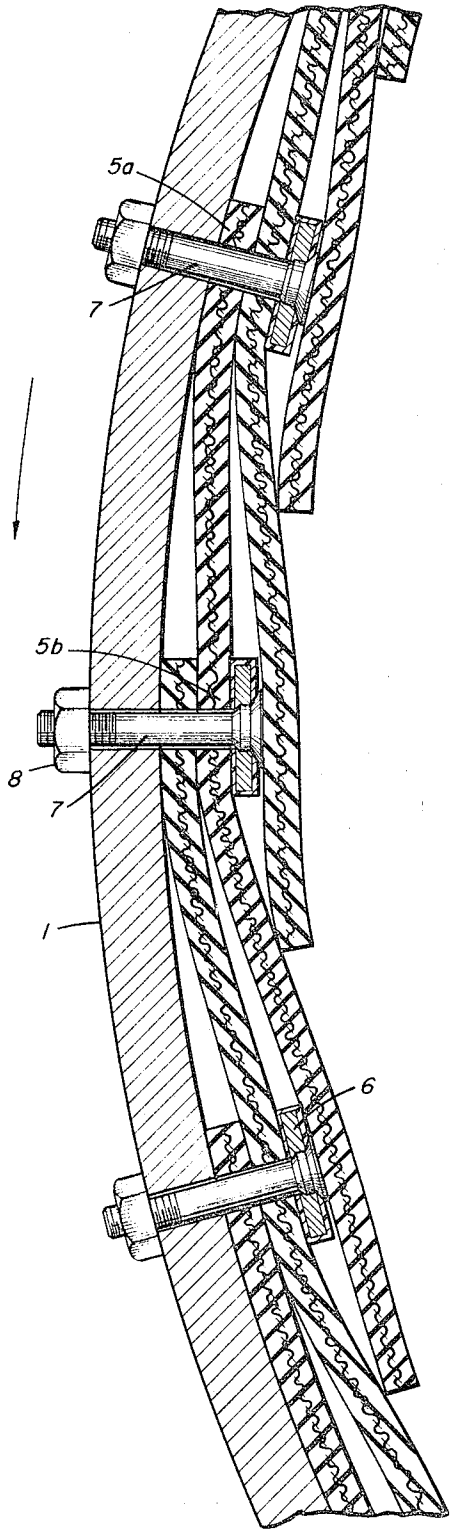


Fig - 4

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LINING FOR ROTARY VESSELS

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2 Claims. (Cl. 34—109)

This present invention relates to an improved rotary drum, particularly adapted for handling sticky materials. More particularly, the invention is concerned with a novel internal flexible liner arrangement adapted to prevent agglomeration or accumulation on the walls of a rotary drum.

Rotary drums operating at varying elevated temperatures are employed in the drying of wet materials. Particular difficulty is experienced in the drying of sticky green triple superphosphate which tends to harden to a rock-like state around the walls and ends of the drum. This drastically increases power consumption and in a relatively short period of time fills the drum such that additional material can not be introduced for drying. This requires expensive and time consuming shut down of the drum to remove the so-formed hard cake.

Several suggestions have been reported in recent years to alleviate build-up of difficult-to-remove material in a rotary drum. However, none is wholly successful. A commonly employed technique is the use of stationary scrapers which may be provided inside the rotary drum. The noise is unbearably excessive, since the drum rotates with respect to the scraper. Further, scrapers wear rapidly and need frequent replacement. In a second procedure, a plurality of knockers is used. The knockers are arranged so that they impinge against the drum at least once during each revolution. Heavy pads are required under the points of impact to prevent serious damage to the drum. Loss of efficiency in dislodging the sticky material is apparent. This procedure has, therefore, not gained universal acceptance. In a third proposal, it has been suggested that an impervious flexible sheet lining coupled with mechanical means to exert a flexing force intermittently on the outer surface of the sheet material of the lining facing the rotary drum can be employed. This tends to discharge material accumulated on the inner surface of the lining. However, the application of mechanical pressure frequently results in the rupturing of the lining. Replacement of liner is both costly and time consuming. It would be highly desirable to provide a lining for a rotary drum which is both long-lasting and efficient to prevent or substantially lessen material build-up on its walls.

It is, therefore, a principal object of the invention to avoid the deficiencies of the prior practice and to provide for an internal flexing liner which functions in the absence of an imposed mechanical means which flex the lining. It is a further object of the invention to provide a flexible lining of simple, overlapping construction which relies on gravity to maintain essentially a non-packed inner drum surface. These and other objects will become apparent from the following description.

It has been found that the foregoing objects have been attained when flexible lining materials inert to high temperatures and corrosive action are employed to cover the inside of a rotary drum by attaching the flexible lining materials to the drum in shingle-like fashion. For instance, the lining material is fastened to the drum at the edges parallel to the center line of the drum. Thus, as the drum revolves effectuated by suitable means, the lining at the top-most portion of the drum falls due to the force of gravity, and flexes or shakes off the material being treated. At the bottom, the lining will conform to the drum maintaining an approximately smooth surface, so as not to degrade the product so treated and to allow for granulation type service.

In general, the attachment of the flexible lining to either a rubber-lined drum or a non-lined drum involves the use of a plurality of strips which overlap and run the length of the drum. These are fastened to the drum by a plurality of substantially equidistant parallel bolting strips or bars secured by spaced nuts and bolts. The strips can be attached to an inflexible rubber lining which is mechanically or chemically bonded to the drum's interior. Alternatively, the strips can be attached in shingle-like fashion directly to the drum's interior. Illustrative of the flexible liners are elastomers, such as either reinforced or non-reinforced butyl rubber, neoprene, or hypalon rubbers and equivalents thereof.

The accompanying drawings illustrate embodiments of the invention, in which the arrows indicate the direction of rotation of the vessel and in which:

FIG. 1 is a perspective view of a cylindrical portion of a rubber-lined rotary drum with the lining in place, the end pieces removed and not shown;

FIG. 2 is a cross sectional view of the rotary drum along the sectional line as indicated by reference numerals II—II;

FIG. 3 is an enlarged transverse sectional view of a portion of the rotary drum shown in FIG. 2; and

FIG. 4 is a transverse sectional view of a portion of a rotary drum illustrating an alternative method for fastening the flexible linings or flaps to a non-lined rotary drum.

Referring to the drawings, there is shown illustratively in FIG. 1 a metal shell **1** which constitutes the cylindrical portion of a rotary drum. The shell is provided with a flange **2** having bolt holes **3** for attachment of the end plates (not shown). The interior of the shell is covered by a chemically bonded, continuous inflexible butyl rubber lining **4**. Attached to the latter are flexible lining strips **5** which are secured by bar **6**. A plurality of holes is provided along the bar so that the fastening of the bar-length flexible strips to the drum by means of elevator bolt **7** secured by nut **8** is effected. The strips cover the inflexible rubber lining and overlap the equidistant parallel bars as well as each other by collectively forming a continuous rubber lining around the inside of the drum in all positions other than at the uppermost point of rotation.

In FIG. 2, there is shown in cross-section, the continuous lining of the drum **1** taken across the portion of the drum designated as II—II. In the "down" position, there is overlapping of each lining strip **5** even to the extent of overlapping the elevator bolt **7** and the parallel bar **6**. Hence, the drum is suitable for granulation type service where an essentially smooth inner drum surface is a prerequisite. In general, the minimal width of each strip should be slightly wider than the distance between each adjacent bar attachment. Thus, the strips can cover the bolted bars in the down position. This type of attachment is shingle-like and highly advantageous to effect inner surface cleaning of the rotary drum while maintaining surface continuity for granulation type service.

To illustrate the individual bolt attachment, reference is made to a preferred embodiment in FIG. 3, wherein an elevator bolt **7** fastens the flexible lining **5** to the inflexible lining **4** by utilizing a suitable bar **6** running parallel to the center line of the drum. Thus, the bolt **7** secured by nut **8** attaches the flexible lining flap as well as the metal bar **5** to the shell **1**.

Alternatively, the inflexible liner **4** can, if desired, be omitted. Where this omission is made, each flexible flap must be secured to the drum **1** at two points positioned between adjacent bars so as to form a continuous liner. This is illustrated in FIG. 4 wherein a portion of the drum

is shown in cross section. Two points of attachment for fastening each flexible lining strip is shown at **5***a* and **5***b*, at approximately one of its ends as well as the midpoint thereof, respectively. In general, the width of each strip should be made approximately two and one-half times as wide as the distance between each of two parallel adjacent bars fastened by bolt **7** and nut **8**. Further, the strip is sufficiently wide for its end portion to overlap a third bar and bolt immediately adjacent to the two adjacent bars.

In practice, the flexible flaps at the "bottom" will tend to conform to the drum and seal against each other under the weight of the load, forming a continuous smooth lining. At the "top," as the drum revolves, sticky particles as triple superphosphate and equivalents thereof will be flexed off by means of the inert flexible flaps so that shut down for cake-removing operations of the drum is avoided for periods of time hitherto unknown.

We claim:

1. In an improved rotary drum adapted to dry, wet sticky solid substances, which comprises in combination: a rubber lined rotary drum; a plurality of equidistant bolting strips positioned parallel to the center line of said drum; a plurality of flexible rubber flaps, each being the length of the drum and at least as wide as the distance between adjacent bolting strips; means for fastening each of said flaps positioned longitudinally along the axis of said rubber lined drum in an overlapping fashion, whereby one edge of each flap is fastened to the rubber lined drum by means of a bolting strip and the other edge of the flap overlies an adjacent bolting strip.

2. In an improved rotary drum adapted to dry, wet sticky solid substances, which comprises in combination: an unlined rotary drum; a plurality of equidistant bolting strips positioned parallel to the center line of the drum; a plurality of flexible rubber flaps, each being the length of the drum and substantially two and one-half times the width of three adjacent bolting strips; means for fastening each of said flaps positioned longitudinally along the axis of said drum in overlapping fashion, whereby (a) the width portion of each flap is attached to two adjacent bolting strips at two points, one of which being at the upper edge of the flap and the other at its midpoint, respectively, and (b) the lower edge of each flap overlaps the third adjacent bolting strip.

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