Jan. 14, 1964 A. E. PEARCE ETAL 3,117,671

LIVE-BOTTOM BIN

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FIG. 1

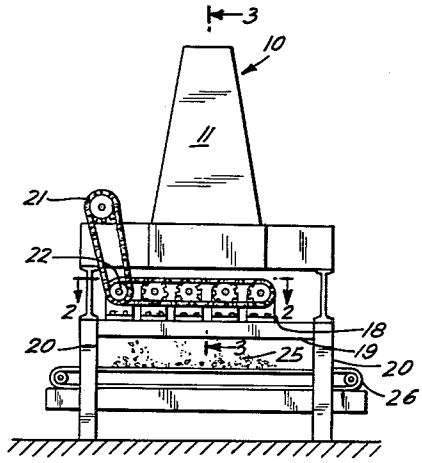


FIG. 2

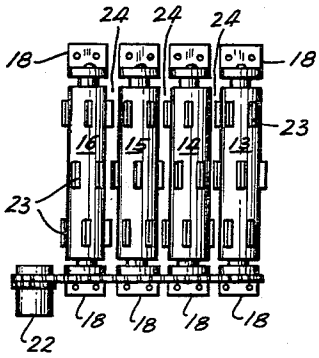


FIG. 3

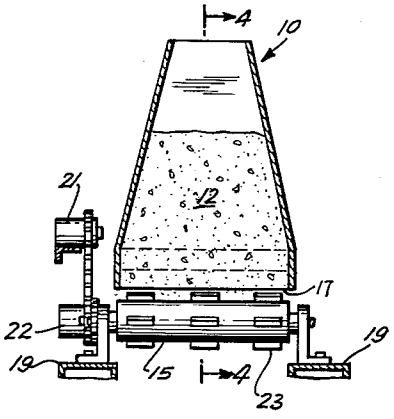
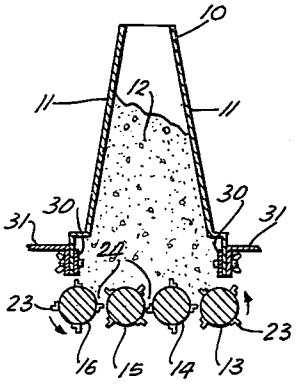


FIG. 4



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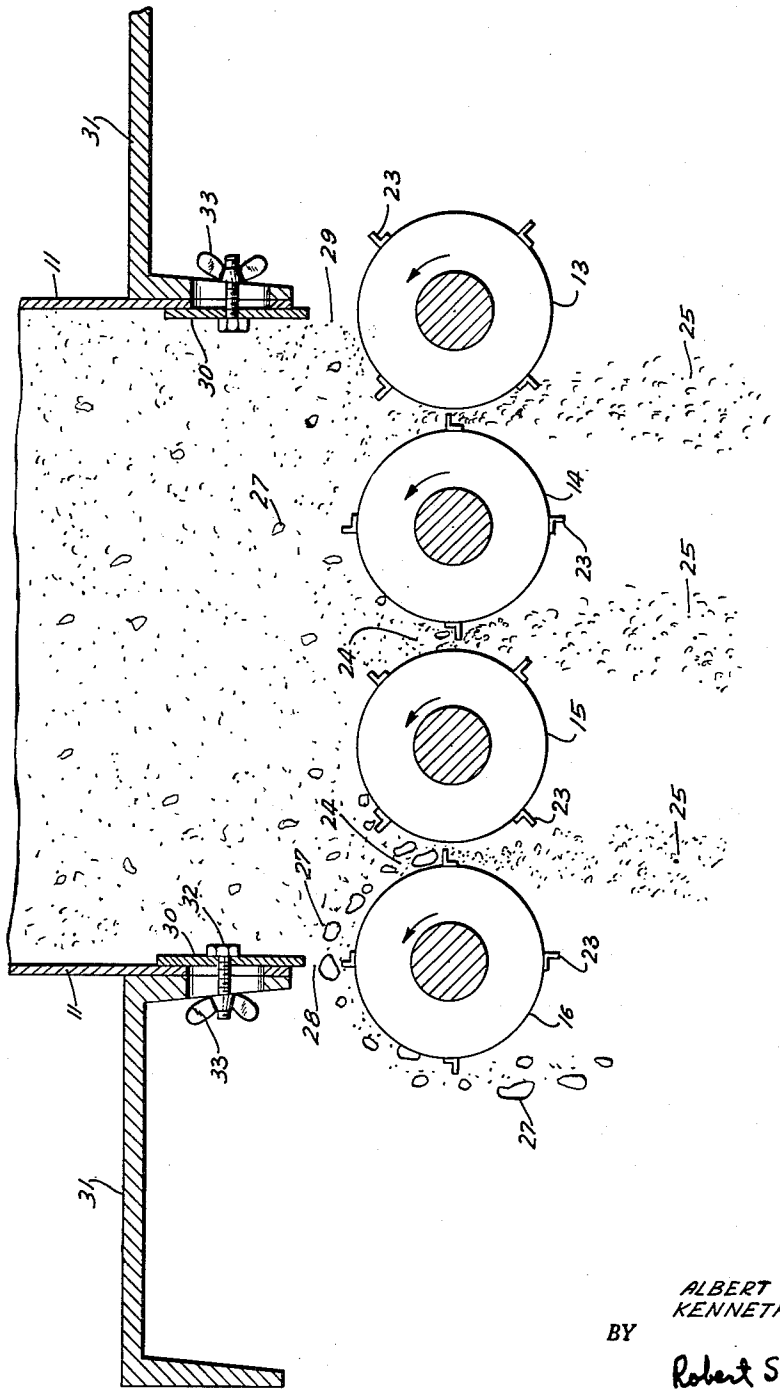


FIG. 5

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LIVE-BOTTOM BIN

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5 Claims. (Cl. 209—106)

This invention relates to storage bins and like containers for bridgeable materials, such as chips, shavings, bark, and other fibrous materias, or mineralogical materials, that are readily flowable when not compacted, yet are interlocking and self-supporting when under pressure, and relates particularly to so-called "live-bottom" storage containers provided with rotatable rolls across the bottoms thereof.

The materials to be stored in the live-bottom bin of this invention possess potentially inter-adherent surfaces creating the distinctive and critical property, when compacted, of forming a concave, self-supporting structure above an underlying void at the bottom outlet of the bin. Such materials are commonly identified as bridgeable and present many difficulties in handling and metering.

The particular bridgeable material for which the bin of this invention is especially useful is the bark removed from pulpwood used in the production of paper and paperboard. Citing southern pine, such as slash pine, as an example, it is commonly estimated that ⅛ of the raw pulpwood weight is bark at a natural moisture content of about 30%–35%. During the debarking operation, water is often sprayed onto the pulpwood logs to lubricate their passage over steel surfaces and to wash away sand and dirt. Use of spray water increases the moisture content of the bark issuing from a typical barking drum to about 50%. This fairly wet bark is generally burned as a source of power in the more modern pulp mills. In handling the bark for this purpose. It may be sent to rough storage and thence to a power boiler, it may be delivered directly to the boiler, or it may pass, enroute to the boiler, through a hammermill type of attrition machine which reduces overly large pieces to a more manageable size. After such shredding, slabs or pieces of wood, up to one or two feet in length or more, may be left as oversize pieces.

Silos or storage bins which discharge sideways and have screw discharging devices, drag chain devices, or rotating rolls forming "live-bottoms" have been developed in the prior art for storage and metering of some bridgeable materials. Live-bottom bins having rotating rolls as the only bottom retaining surface and which discharge directly downwards are also known. Nevertheless, live-bottom bins are generally troubled with problems of handling and disposition of oversize pieces and with repairs caused by jamming of oversize pieces between the rolls or between the stationary and moving parts. When such jamming occurs, it is a common characteristic of live-bottom bins in the prior art that repairs or replacements to damaged screws, rolls, etc., are expensive and time-consuming because the material in the bin must usually be dislodged or removed manually before the feed devices may be approached from above for repairs or replacement.

The objects of this invention are to provide means in a live-bottom bin for classifying oversize pieces from acceptable material, for ejecting the oversize pieces from the bin, for delivering the acceptable material in a uniform manner, at a desired rate, and in a fragmented state to disposal means, and for replacing or mechanically repairing the rotating rolls in a simple and inexpensive manner.

In the accompanying drawings:

FIGURE 1 shows, schematically, a side view of a small live-bottom bark bin constructed in accordance with the principles of this invention and constituting a particular working embodiment of the invention.

FIGURE 2 is a plan view, somewhat enlarged, showing the rolls comprising the live-bottom of the bin taken along line 2—2 of FIGURE 1 in the direction of the arrows.

FIGURE 3 is a vertical sectional view of a portion of the bin, taken along line 3—3 of FIGURE 1 in the direction of the arrows and showing bark in the bin.

FIGURE 4 is a cross-sectional view of a portion of the bin, taken along line 4—4 of FIGURE 3 in the direction of the arrows.

FIGURE 5 is an enlarged cross-sectional view of the live-bottom area of FIGURE 4.

As shown in the drawings, storage bin 10 has walls 11 sloping outwardly at the bottom to help prevent excessive arching or bridging of the bark 12 which is fed into the open top of the bin from a conveyor. Four steel rolls 13, 14, 15, 16, which can be made of pipe, are rotatably mounted parallel and at equal distances apart at the bottom discharge opening 17 (FIG. 4). The rolls are supported by pillow block bearings 18 on each side thereof which are bolted on horizontal frame member 19 which is supported by legs 20. Bearings 18 are so located as to be accessible from the outside of the bin. The rolls 13, 14, 15, 16 are powered by a varidrive unit 21 and a reducer 22 through conventional sprocket and chain drive as shown which rotate the rolls all at the same speed and in the same direction. Reversing mechanism (not shown) may be provided for changing the direction of rotation of the rolls.

Four cleats or ribs 23 of angle iron are rigidly attached along the circumference of the rolls 13, 14, 15, 16 in each of three evenly staggered groups, 90° apart and parallel to the longitudinal axes of the rolls, as shown in FIGURES 2 and 3. The cleats of each roll preferably are out of phase with the cleats of each neighboring roll by a maximum amount, leaving a clearance between a cleat 23 and an opposing roll surface and a larger clearance where bare rolls are opposed. The cleats 23 obviously can take the form of other kinds of projections, such as pins, spikes, prongs, or the like for providing a raking action. The elongated slots 24 between the rolls 13, 14, 15, 16 vary in shape periodically and rapidly with rotation of the rolls. The staggered pattern of cleats on an individual roll decreases the amplitude of periodic rotational stresses on the rolls but is not essential to the invention. If the rolls 13, 14, 15, 16 are stopped, no difficulty is experienced with unwanted escape of bark because the bridgeable characteristics of the bark 12 cause arch-like structures to form above the slots 24 almost immediately after stoppage of the rolls.

Acceptable bark 25 which has fallen through the slots 24 is caught and removed by horizontal conveyor 26 (FIG. 1). Slabs of bark, logs, or other wood fragments of overly-large size 27 (FIG. 5), are selectively rejected at one side of the bin through the left reject slot 28 above the side roll 16 when all of the rolls 13, 14, 15, 16 are rotating in the direction of rotation indicated by the arrows in FIGURE 5, or through the right reject slot 29 above the side roll 13 if the direction of rotation is reversed. An extension of the bin walls 11 by way of vertically adjustable panel members 30 can be used to control the width of the reject slots 28, 29 through which rejected material 27 must pass. While the invention is operable with reject slots 28 and 29 of a fixed width (as long as they are wider than slots 24 between the rolls), the panels 30 are a major control feature of the invention. The panels 30 as shown in FIGURE 5 are located inside two of the bin walls 11 at the bottom thereof and adjacent inverted channel members 31 which are welded to

the outside of such walls. The shanks of bolts 32 are passed through matching narrow vertical slots in the sides of inverted channel members 31 and walls 11 and through holes in panels 30. Wing nuts 33 are fastened on the threaded ends of bolts 32 to hold the panels 30 in place and this arrangement permits adjusting the panels up or down by sliding the bolts up or down in the narrow slots in the sides of the inverted channel members 31 and walls 11.

Preferably, panels 30 are located directly above the axes of the outermost rolls and thus provide reject slots 28 and 29 over the axes of such rolls.

Accordingly, each reject slot is so positioned as to accept reject material that is flowing directly toward it in a horizontal path level with the reject slot opening. If the reject slot is inboard of the axis of an outermost roll, the flow of reject material reaches the reject slot opening while it is traveling upwardly toward the top of the roll and at an angle to the reject slot opening. As a result, some of the material small enough to pass through the slot is not ejected as early as it might because of being directed upwardly against the top of the reject slot and falling back into the bin.

Location of a reject slot slightly outboard of the axis of an outermost roll is a workable alternative but the reject slot must be above the roll and not at one side of the roll in order to avoid the wedging action of reject material between the roll and a side of the bin.

It is quite obvious that the reject slots 28 and 29 should always be wider than slots 24 between the rolls, yet not so wide as to allow an excess of material to pass through. As the level of material in the bin drops, the pressure at the bottom from the weight of material decreases and the bridging effect at the reject slots becomes less pronounced. Therefore, it may be advisable to adjust the reject slots to a narrower width when the level in the bin reaches certain lower limits.

When the bin is wholly or partly filled with a bridgeable material such as bark, the slots 28, 29 are solidly packed from the roll surfaces upwards by the compacted bark which easily maintains a vertical surface or curtain in the slot areas. As the rolls 13, 14, 15, 16 rotate counterclockwise as shown in FIGURE 5, the cleats 23 on the rolls forcibly disrupt the packed bark in their line of travel and impart agitation and forward motion to a layer or area of bark above and beyond the peripheral range of the cleats. A fraction of the bark pieces passes through slots 24 between the rolls. The larger pieces 27, being too large to pass through the slots, are rolled over the rolls toward the direction of rotation of the rolls, the last roll 16 in FIGURE 5 receiving the rejected pieces 27 from the other three rolls. The oversize pieces 27, together with a relatively small quantity of smaller pieces are directly impelled by the cleats of the last roll 16 and are forcibly ejected through the bark curtain at the left reject slot 28. The bark beyond the cleat tips, possessing lower momentum, cannot break through the bark curtain extending downwards from the left adjustable slot control panel 30 and the arm of the left chanel 31 at the upper side of the left vertical reject slot 28. Because the bark in this region is compressed, possessing depth in a horizontal direction and upwards into the bin, it has considerable strength to resist rupture and deformation. However, a relatively large and solid reject, such as a small log, can be given sufficient momentum by direct contact with the cleats 23 of the last roll 16 to disrupt and break through the bark curtain. Accordingly, the bin can act as an effective classifier if separate collecting means are provided for the rejected pieces, since only a very small percentage of the acceptable smaller pieces are permitted to pass through the reject slots.

The existence of the bark curtain at the reject slots 28, 29 also tends to create a back pressure upon the entire system so as to increase the passage of acceptably sized material through slots 24.

By means of this invention bark can be fed at a fairly uniform rate, it begins to feed immediately each time the rolls are started, and the bottom seals itself off each time the rolls are stopped.

The bin of this invention will handle rough, unhogged bark very efficiently. The large pieces of bark and broken pulpwood which can not pass through the slots are conveyed from one roll to the next, beneath the bark, until the reject slot is reached. The accessible roll bearings permit easy removal of the rolls from below and installation of replacement rolls. Further minor repairs to the rolls, when needed, can be done directly from the bottom of the bin without emptying the bin. When a damaged roll is removed from the live-bottom layer of the full bin, the bark in the bin above simply falls through the greatly enlarged slot until an arched tunnel structure has formed in the bark above the opening and this arched condition remains stable as long as the rolls are not in motion.

Uneven distribution of the bark within the bin can be avoided by reversing the rotational direction of the rolls. The rotating rolls cause the bark to increase in height more rapidly on the side toward the direction of movement of the tops of the rolls 13–16 when the rolls are operated in one direction for a protracted time.

While there has been described a preferred embodiment of this invention, it will be understood that the invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

What is claimed is:

1. A live-bottom bin for storing, classifying, and dispensing desired quantities of bridgeable particulate material having varying shapes and sizes, comprising:

(*a*) a container having a bottom discharge opening whose cross section is at least equal in area to its top cross section and wall means for retaining bridgeable material over the entire bottom area,

(*b*) a plurality of rotatable cylindrical rolls which are aligned substantially horizontally, in mutually parallel relationship, and spaced appreciably apart to define elongated slots therebetween, said rolls substantially occupying said bottom discharge opening and supporting the bridgeable material in the container,

(*c*) rows of cleats affixed to said rolls which are axially aligned in mutually parallel rows and which extend radially from the surface of any roll for raking and agitating the bridgeable material when the rolls are rotating, the rows of cleats on any roll being so positioned as to be out of phase with the rows of cleats on the adjacent rolls to either side,

(*d*) power means operable to rotate the rolls so that the upper surfaces of said rolls move all in the same direction toward a side of the bin, whereby as the rolls are so rotated bridgeable material too large to pass through the slots between the rolls is conveyed across the top of the rolls toward said side of the bin, while the remainder of the bridgeable material passes downward through the slots between the rolls, and

(*e*) reject classification means at said side of the bin:

(1) which are substantially parallel to the longitudinal axes of the rolls,

(2) toward which the upper surfaces of the rotating rolls move when rotated,

(3) and against which the bridgeable material in the bin is urged by the rotating rolls to create within the bin a pile having a surface of repose sloping away from said side of the bin,

said reject classification means being an elongated opening which is located above an outermost roll and having the upper surface of said outermost roll as a lower boundary thereof, said elongated opening being of greater width than any slot between the rolls yet sufficiently narrow to support a substantially vertical curtain of bridgeable material within the bin in front of said elongated opening, said curtain

having considerable strength to resist rupture and deformation, whereby relatively large and solid objects possessing sufficient momentum are passed through said curtain and are then ejected from the bin through the reject classification means, while material small enough to be downwardly dispensed between the rotating rolls is substantially prevented by said curtain from being ejected from the bin.

2. The live-bottom bin of claim 1 in which a second reject classification means is located at the side of the container opposite the first reject classification means and the power means is equipped with reversing mechanism to rotate the rolls all together toward the second reject classification means.

3. The live-bottom bin of claim 1 in which the two opposite sides of the container slope inwardly toward the top.

4. The live-bottom bin of claim 1 in which the top of the elongated opening forming the reject classification means is vertically adjustable in parallel relation to the upper surface of the roll which forms the lower boundary of said opening, whereby the height of the reject classification means may be varied in order to control the rigidity of the curtain for regulation of the size of the ejected objects and compensation for variations in height of the stored bridgeable material.

5. The live-bottom bin of claim 1 wherein attachment means are provided which permit any roll selected from the rolls comprising the live bottom to be removed downwardly while the bin contains a substantial quantity of bridgeable material.

References Cited in the file of this patent

UNITED STATES PATENTS

935,630	Abernathy	Oct. 5, 1909
1,500,275	Shick	July 8, 1924
2,743,813	Erickson	May 1, 1956
2,826,300	Ross	Mar. 11, 1958
2,907,445	Jones	Oct. 6, 1959

FOREIGN PATENTS

451,452	Germany	Oct. 20, 1927
870,376	Germany	Mar. 12, 1953