This invention relates to storage bins and like containers for bridgeable materials, such as chips, shavings, bark, and other fibrous materials, 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 ¼ 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 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, entrained 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 oversized 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 rotative 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 oversized pieces and with repairs caused by jamming of oversized 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 device 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 oversized pieces from acceptable material, for ejecting the oversized 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 2-3 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 14, 15, 16, 17, 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 the 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 variable 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 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 randomly 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 ejected 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 that 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 act as 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 part 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.

When this invention has been described in present 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 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 rotateable cylindrical rolls which are aligned substantially horizontally, in mutually parallel relationship, and spaced appropriately 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 all other rolls of the same set,

(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 said 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, 1956
2,907,445 Jones ----------------- Oct. 6, 1959

FOREIGN PATENTS

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