This invention relates to rotary drum mixers for mixing powdered and granular materials, with or without liquids.

The horizontal rotary drum mixer is particularly suitable for high throughput, e.g., for mixing iron ore, coke, etc., but is not itself adapted to blend materials fed into it in large individual batches. Improved blending is obtained by the use of an independently driven scroll or paddle shaft arranged lengthwise of the interior of the drum within the position occupied by the material as it is lifted up one side of the drum by the rotation. The paddles of the scroll are set at an angle to propel the material lengthwise, but their tips lie clear of the drum to allow some of the material to be carried up close to the shell by the rotation of the drum without being affected by the paddles. This lifted material cascades at a height approximately that of the horizontal centre line of the drum as gravity overcomes the friction with the shell, and the material falls on to the bed of material that has been projected forward by the paddles. The relative longitudinal movement that takes place between the part of the material projected by the paddles and the part that is cascaded produces a blending, and opposes the tendency for successive batches of the materials to be incompletely mixed by passing through the drum still as batches with the mixing resulting from the turning over in cascading mainly confined to where one batch adjoins another.

For some purposes, however, still better blending is desired, and the object of the invention is to provide a mixer of this drum and scroll type capable of giving improved blending.

According to the present invention, a horizontal rotary drum mixer comprises a drum provided with two or more scrolls or paddle shafts (hereafter referred to as "scrolls") disposed longitudinally of the drum within the position occupied during rotation of the drum by the material to be mixed, with means for rotating the scrolls at different speeds with respect to each other. Since the rotation of the drum lifts the material up one side of the drum to a height from which it repeatedly cascades, the scroll shafts occupy approximately different heights inside the drum. Thus, with two scrolls, the lower scroll shaft is preferably somewhat offset from the vertical centre line of the drum in the direction of rotation of the drum, and the upper scroll shaft is much further offset, to lie somewhat below the horizontal centre line of the drum. Conveniently, the two shafts may lie at the same radial distance from the axis of the drum. In the case of both scrolls, there is clearance between the tips of the paddles and the inside of the drum shell. With paddles of the same radius on shafts at the same radius from the drum axis, each scroll provides the same clearance between its paddles and the shell.

The radial of the paddles is such that the scrolls will be wholly or substantially immersed in the material being mixed, with the material amounting to say one-third of the volume of the drum.

The tip speed of a scroll is substantially in excess of the peripheral speed of the shell, e.g., 5 to 20 times as great. The direction of rotation should be in the same direction as that of the drum, to assist both the lifting and the cascading of the material.

With the scrolls driven at different speeds with respect to each other, material propelled longitudinally by one scroll reaches a longitudinal position different from that propelled by the other scroll, so that the material subjected to direct propelling action by the scrolls there is repeated mixing as the material progresses from end to end of the drum. In addition, material lifted by the drum from the neighbourhood of the lower scroll and carried through the clearance between the shell and the paddles cascades on to the more elevated scroll and is mixed by that scroll with material in which that scroll is rotating, to effect further blending. Consequently, at any position in the length of the drum, part of the material is being moved lengthwise of the drum by the scrolls, and this, with the further blending of the cascaded material, strongly opposes any tendency of the material to progress through the drum as incompletely mixed batches. Successive charges of material are thus well mixed before they reach the discharge end of the drum.

By way of example, one construction of two-scroll mixer according to the invention will now be described in greater detail with reference to the accompanying drawings, in which:

Figure 1 is a side elevation, largely in section; Figure 2 is a section on the line 2—2 of Figure 1; Figure 3 is a plan; and Figure 4 is an end elevation corresponding to Figure 2.

The drum 1 is provided with the usual types 2 resting on rollers 3 and guided by rollers 4. It is closed at one end by a stationary plate 5 incorporating a feed chute 6, and projects at the other end into a discharge chute 7, from which the mixed material drops, for removal by conveyor belt or otherwise, any steam, water vapour, or gas being exhausted upwardly. The drum is driven by a motor 8 through worm bearing 9 and a toothed girth ring 10.

Two scroll shafts 11, 12 of square section inside the drum, pass through sealing plates 13, 14 in the closing plate 5 and in the far side of the chute 7, to be carried by bearing housings 15, 16 at positions in relation to the cross-section of the drum 1 clearly shown in Figure 2. With the drum rotated clockwise in Fig. 2, the lower shaft 11 is offset to the left of the vertical centre line 17, and the upper shaft lies somewhat below the horizontal centre line 18 and is substantially offset to the left of the vertical centre line, so that both lie immersed in the material 19 that is lifted up the left-hand side of the drum to a height somewhat above the line 18 before it cascades towards the bottom of the drum.

Each face of the square section of each shaft 11, 12 carries paddles 20 in staggered pairs, obliquely pitched to propel the material 19 towards the discharge end, and, as shown in Figure 2, set obliquely to the face of the shaft so as to slice through the material. Although both shafts are shown identical in the pitching of the paddles, as is generally convenient, this is not essential; moreover, either of the scrolls may have paddles omitted at intervals, to reduce the local rate of projection by that scroll with respect to the other scroll.

At the feed end, the shafts 11, 12 are driven by a common gear-box 21 from a reduction gear 22 driven by a motor 23, which enables the rate of rotation of the scrolls to be selected as may be required in relation to the rate of rotation of the drum. The common gear-box 21 drives the shafts 11, 12 at appropriately different speeds, the lower shaft 11, say, rotating about 50% faster than the upper shaft 12, although the upper scroll could be the one to rotate faster.
The tips of the paddles of the two scrolls rotate clear of each other, and have a clearance from the inside of the drum shell approximating to one-tenth of the overall diameter of each scroll. A satisfactory arrangement for a 9" diameter drum rotated at 3 to 4 R. P. M. has two scrolls of about 2 1/2" diameter, and the lower tip of the paddles, with the lower scroll rotated at 150 R. P. M. and the upper scroll at 100 R. P. M. This results in the material being moved forward approximately 3" 6" by the lower scroll for every revolution of the drum, and approximately 2" 6" by the upper scroll.

The mixing drum is particularly well suited to the mixing of iron ore, coke, flue dust, and water for sinter plants, which materials require more thorough incorporation than is possible with mixers of previous types. Thorough mixing and blending results, even when the drum is fed with each ingredient in a substantial batch, or with wide differences in the size of the batches of successively fed ingredients.

One or more scraper blades may be fitted inside the drum, to remove material that adheres to the shell instead of cascading completely, particularly if liquids are to be introduced into the mixture, as in the case of sinter plant mixtures, as mentioned above.

What I claim is:

1. A horizontal rotary drum mixer, comprising a rotary drum with feeding means at its inlet end and a discharge opening at its outlet end, at least two paddle scrolls disposed longitudinally of the drum within the position occupied during rotation of the drum by the material to be mixed, and each adapted to move the mixed material from the inlet to the outlet of the drum, at least one of the scrolls having its axis offset from the vertical center line of the drum in the direction of rotation of the drum, the scrolls having their peripheries spaced from the drum surface to allow material to be moved past the tips of the paddles by frictional contact with the drum surface to be later cascaded onto the scrolls, means for driving the scrolls at different speeds with respect to each other in the same direction of rotation as that of the drum to effect the movement of the mixed material from inlet to outlet, the tip speed of the scrolls being substantially in excess of the peripheral speed of the drum.

2. A horizontal rotary drum mixer, comprising a rotary drum with feeding means at its inlet end and a discharge opening at its outlet end, at least two paddle scrolls disposed longitudinally of the drum with their axes at the same radial distance from the axis of the drum within the position occupied during rotation of the drum by the material to be mixed, and each adapted to move the mixed material from the inlet to the outlet of the drum, at least one of the scrolls having its axis offset from the vertical center line of the drum in the direction of rotation of the drum, the scrolls having their peripheries spaced from the drum surface to allow material to be moved past the tips of the paddles by frictional contact with the drum surface to be later cascaded onto the scrolls, means for driving the scrolls at different speeds with respect to each other in the same direction of rotation as that of the drum to effect the movement of the mixed material from inlet to outlet, the tip speed of the scrolls being substantially in excess of the peripheral speed of the drum.

3. A horizontal rotary drum mixer, comprising a rotary drum with feeding means at its inlet end and a discharge opening at its outlet end, at least two paddle scrolls disposed longitudinally of the drum within the position occupied during rotation of the drum by the material to be mixed, and each adapted to move the mixed material from the inlet to the outlet of the drum, the paddles of the two scrolls being of the same radius, at least one of the scrolls having its axis offset from the vertical center line of the drum in the direction of rotation of the drum, the scrolls having their peripheries spaced from the drum surface to allow material to be moved past the tips of the paddles by frictional contact with the drum surface to be later cascaded onto the scrolls, means for driving the drum, and means for driving the scrolls at different speeds with respect to each other in the same direction of rotation as that of the drum to effect the movement of the mixed material from inlet to outlet, the tip speed of the scrolls being substantially in excess of the peripheral speed of the drum.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>393,043</td>
<td>Twist</td>
<td>Nov. 20, 1888</td>
</tr>
<tr>
<td>451,992</td>
<td>Baldwin</td>
<td>May 12, 1891</td>
</tr>
<tr>
<td>1,980,10</td>
<td>Fasting</td>
<td>Oct. 3, 1914</td>
</tr>
<tr>
<td>2,570,864</td>
<td>Rowson</td>
<td>Oct. 6, 1934</td>
</tr>
<tr>
<td>2,592,334</td>
<td>Reiffen</td>
<td>Apr. 8, 1935</td>
</tr>
</tbody>
</table>