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METHOD AND APPARATUS FOR BLENDING DISCRETE MATERIALS

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2 Sheets-Sheet 1

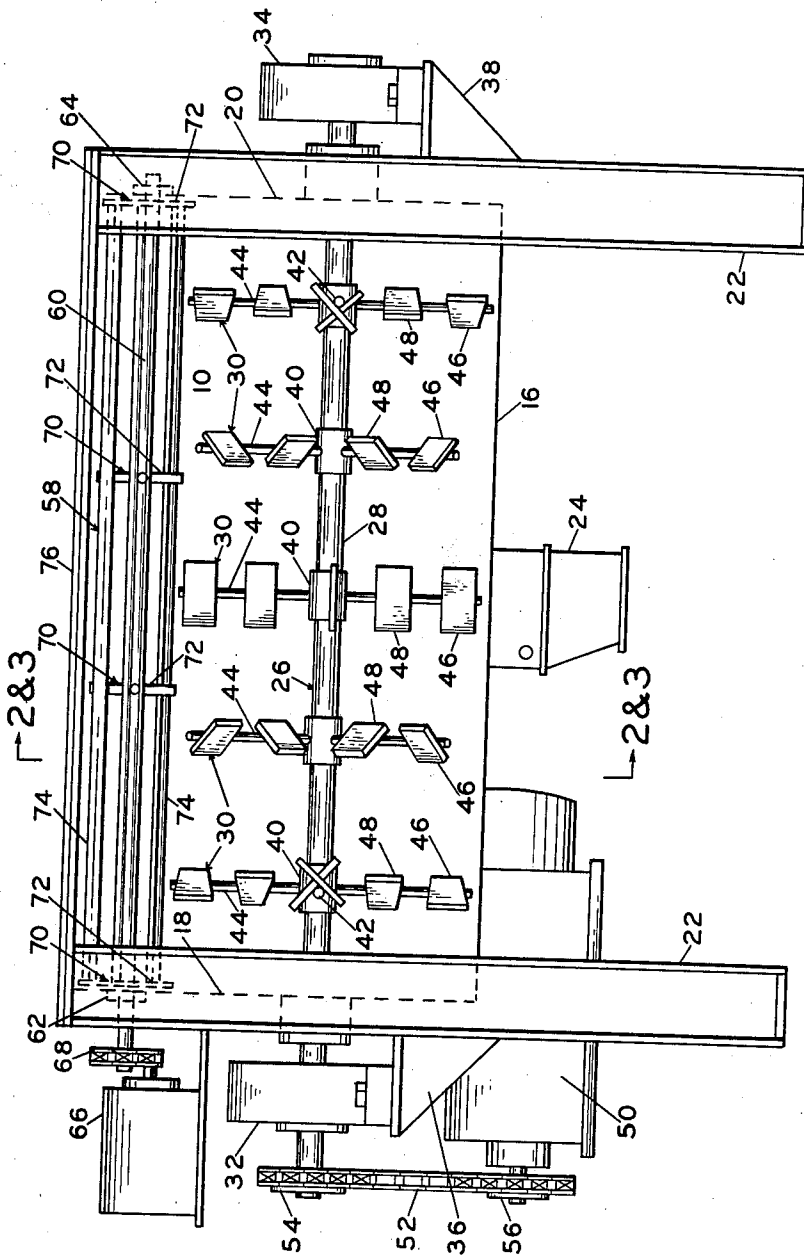


FIG. 1

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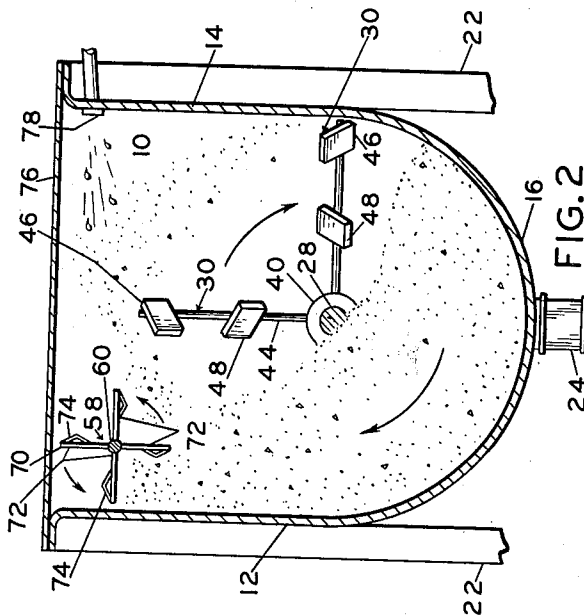
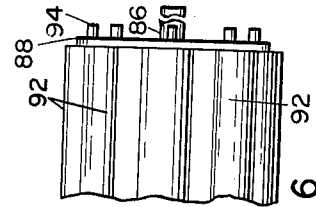
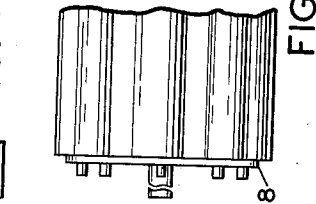
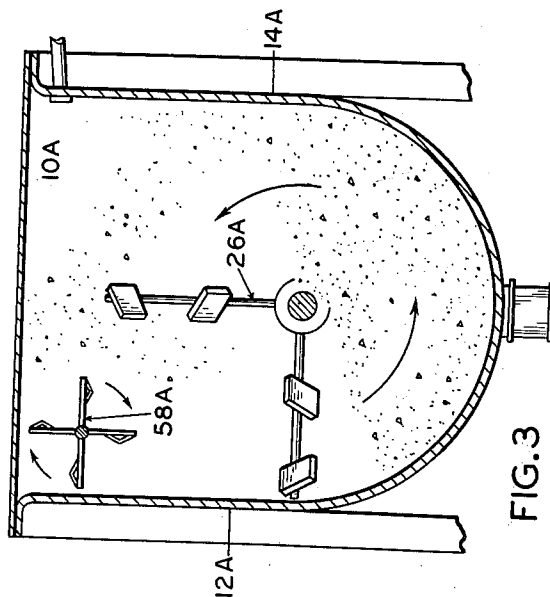
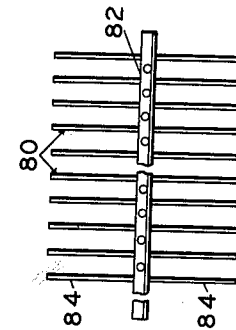
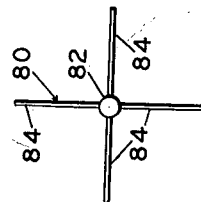
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METHOD AND APPARATUS FOR BLENDING DISCRETE MATERIALS

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2 Sheets-Sheet 2



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METHOD AND APPARATUS FOR BLENDING DISCRETE MATERIALS

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6 Claims. (Cl. 259-104)

This invention relates to an improved method and apparatus for intimately blending two or more discrete materials.

An accepted method and apparatus is to introduce two or more discrete materials in bulk into a tank and rotate a bladed agitator through the mass of the discrete materials to be blended. For many purposes this method and apparatus produces a satisfactory degree of blending though rather time consuming. Where the requirements are more exacting, that is, where a high degree of blending and homogeneity in the end product is desired, with substantially all agglomerated particles disintegrated, the above method and apparatus even after a prolonged time does not effect a satisfactory result. To meet such more exacting requirements, it has been necessary to employ more elaborate and expensive equipment.

An object of my invention is to provide an apparatus of the agitator type described above embodying means whereby the time required for intimately blending the several discrete materials is materially reduced, and wherein a more uniform and homogeneous blend of the materials is obtainable.

Another object is to provide a blender of this type that more effectively disintegrates agglomerated particles of the discrete materials to produce a more homogeneous blending of the materials.

Another object is to provide a blender productive of the above results that is simple in construction and inexpensive to manufacture as compared to existing apparatus for achieving similar results.

Another object is to provide a blender of the above type particularly adapted for addition of a liquid to the dry ingredients in a manner to minimize agglomeration of the ingredients and to effect a higher degree of dispersion of the wetting agent to obtain a more intimate and homogeneous blend of moistened but discrete ingredient particles.

Other objects and advantages more or less ancillary to the foregoing and the manner in which all of the various objects are realized will appear in the following description, which considered in connection with the accompanying drawings, set forth the preferred embodiments of the invention.

In the drawings—

FIGURE 1 is a side elevation of the apparatus embodying the invention, parts being broken away;

FIGURE 2 is a transverse sectional view taken on the line 2—2 of FIGURE 1 looking in the direction of the arrows;

FIGURE 3 is a transverse sectional view of a modified form of the invention, the section being taken through the apparatus similarly to the section shown in FIGURE 2;

FIGURE 4 is a side elevation of a modified form of auxiliary agitating means;

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FIGURE 5 is an end elevation of the agitating means shown in FIGURE 4;

FIGURE 6 is a side elevation of another modified form of auxiliary agitating means; and

FIGURE 7 is an end elevation of the agitating means shown in FIGURE 6.

Referring to the drawings, and particularly to FIGURES 1 and 2, the blender embodying the present invention includes a trough shaped receptacle 10 having substantially vertical side walls 12 and 14, a semi-cylindrical bottom wall 16 and vertical end walls 18 and 20. The blender receptacle 10 is supported up off the floor by suitable legs 22.

The bottom of the semi-cylindrical lower wall 16 is provided, midway between the vertical end walls 18 and 20 of the receptacle 10, with any suitable valve controlled discharge outlet 24, the details of which do not constitute a part of this invention and are therefore not shown in the drawings nor described.

A primary mixing or agitating means 26 is provided in the receptacle 10 and includes a shaft 28, the axis of which coincides with the center of curvature of the cylindrical lower wall 16. On the shaft 28 are mounted a plurality of longitudinally spaced mixing paddles 30, there being five such paddles shown for purpose of illustration, though the number may be increased or decreased depending on the length of the receptacle 10. The shaft 28 extends through the end walls 18 and 20 and is mounted in bearings 32 and 34 supported on brackets 36 and 38 suitably secured to the legs 22 at opposite ends of the apparatus.

Each of the mixing paddles is provided with a hub 40 secured to the shaft 28 by a set screw 42 or other suitable means. Projecting radially from each of the hubs 40 are four rods 44 spaced 90° apart. The rods of the two mixing paddles 30 at the left of the central mixing paddle 30, as viewed in FIGURE 1, are preferably offset 45° with respect to each other, as are also the rods 44 of the mixing paddles 30 at the right of the central mixing paddle 30, for a reason to be referred to later.

Fixed to the outer ends of the rods 44 of each of the mixing paddles 30 are an outer series of blades 46 disposed to follow closely the inner wall surface of the semi-circular bottom wall 16 of the receptacle 10 as the mixing paddles are rotated by rotation of the shaft 28. Also fixed to the rods 44 of each of the mixing paddles 30, approximately midway between the hubs 40 and the outer blades 46 are an inner series of blades 48.

The outer and inner blades 46 and 48 of the paddles 30 at each side of the central mixing paddle 30 are pitched at an angle with respect to the axial plane of the shaft 28, with the outer and inner blades of respective paddles being pitched in opposite directions. The outer and inner blades, pitched in opposite directions, effect movement of the material in opposite directions lengthwise of the receptacle which together with the rotational movement imparted to the material by rotation of the mixing paddles provides for intimate mixing of the materials to be mixed.

With the central discharge 24, the outer blades 46 of the mixing paddles 30, at each side of the central mixing paddle 30, are pitched in a direction so that with the agitating means 26 rotating in the direction of the arrows or clockwise as viewed in FIGURE 2, the material as it

is moved upwardly along the side wall 12 of the receptacle 10 is at the same time moved inwardly from the ends of the receptacle toward the center. In this manner, after a batch of material has been mixed, and the valved discharge outlet 24 is opened, it is moved toward the valved discharge outlet 24 to facilitate emptying of the receptacle 10. The outer and inner blades 46 and 48 of the central mixing paddle 30, which is directly over the discharge outlet 24, are preferably disposed in a plane parallel with the axial plane of the shaft 28 to facilitate delivery of the material to the discharge outlet.

The agitating means 26 is rotated in any suitable manner from the motor 50, as by a sprocket chain 52 trained over sprockets 54 and 56 mounted respectively on an extension of the shaft 28 and the motor shaft.

The preferred primary agitating means 26, above described, as well as other forms of rotating bladed agitators, effect a degree of blending of materials which for many purposes may be satisfactory, however for more exacting requirements, I have provided means cooperating with the primary agitating means 26 effecting a high degree of blending and homogeneity in the end product with substantially all agglomerated particles disintegrated.

In the form of the invention shown in FIGURE 2, the agitating means is rotated at a speed such that the centrifugal action thereof will raise the normal level of the material along the side wall 12 but insufficient to forcibly throw any appreciable amount over toward the side wall 14.

An auxiliary agitating means 58 is mounted in the upper portion of the receptacle 10 along and adjacent the side wall 12 and having its peripheral envelop extending partially within and projecting partially above the generally triangular space included between the side wall 12 and the peripheral envelop of the primary agitating means 26.

The auxiliary agitating means 58 includes a horizontal longitudinally extending shaft 60 in proximate spaced relation with respect to the receptacle side wall 12 and the peripheral envelop of the agitating means 26. The shaft 60 is rotatably journaled at its ends in bearings 62 and 64 carried by the receptacle and walls 18 and 20, and is driven by a motor 66 through suitable chain and sprocket means 68.

Mounted on the shaft 60 for rotation therewith are a plurality of multiple armed spiders 70 spaced along the length of the shaft 60. Each of the spiders 70 is shown as having four radially extending equidistantly spaced arms 72, to the outer ends of which are secured the longitudinally extending impeller bars 74. The impeller bars 74 of the auxiliary agitating means 58 are V-shaped in cross section and are disposed on the arms 72 so that with the agitating means 58 rotating in a counter-clockwise direction, as viewed in FIGURE 2, the open end of the V of the impeller bars 74 dig into the material mounded up by the primary agitating means 26 in the space between the receptacle side wall 12 and the peripheral envelop of the agitating means 26. Increments of the material are scooped up by the impeller bars 74 and are forcibly thrown by centrifugal force in a dispersed condition of temporary free flotation against the cover 76 and the side wall 14 of the receptacle 10, whereupon the energy imparted thereto is dissipated and the material drops down into the mass of material being blended.

The auxiliary agitating means 58 rotates at a very high rate of speed, many times that of the primary agitating means 26, so that a storm or hurricane of material is produced in the upper portion of the receptacle 10, effecting an intimate mixture of the materials, and the impact of the particles against each other and against the cover and side wall of the receptacle completely disintegrates any agglomerated particles, whereby a more highly uniform and homogeneous blending of the materials is obtained.

Where the materials being blended are to be treated by a liquid wetting agent, nozzle means 78 is provided in the

upper portion of the side wall 14 and is arranged to direct a spray of the liquid wetting agent counter-current with respect to the direction of movement of the material by the auxiliary agitating means 58. The introduction of the liquid in the form of a spray into the storm or hurricane of materials in the upper portion of the receptacle 10 effects a high degree of dispersion of the wetting agent and results in a more intimate and homogeneous blend of moistened but discrete ingredient particles.

Referring to FIGURE 3, there is shown a modified form of the invention wherein the relative disposition and construction of the elements are the same as in the preferred form of the invention shown in FIGURES 1 and 2, so that a detailed description thereof is dispensed with. In this form of the invention, the primary agitating means 26a is rotated at a speed so that the materials being mixed and blended are thrown by centrifugal force across the upper portion of the receptacle 10a from adjacent the side wall 14a toward the side wall 12a, the agitating means 26a being rotated in a direction opposite the rotation of agitating means 26 of the first form of the invention. The particles of material are thrown into the zone of action of the auxiliary agitating means 58a which is arranged to rotate in a direction opposite the direction of rotation of the primary agitating means 26a. The auxiliary agitating means 58a is arranged to rotate at a higher speed than the primary agitating means 26a. The particles intercepted by the auxiliary agitating means 58a are violently struck and impelled toward the receptacle side wall 14a which together with the impact of the colliding particles, completely disintegrates any agglomerated particles and effects a uniform and homogeneous blending of the materials.

In FIGURES 4 and 5 is shown a modified form of the auxiliary agitating means wherein a plurality of closely spaced multiple armed spiders 80 are secured along the length of the shaft 82. Each of the spiders 80 is shown as having four radially extending equidistantly spaced arms 84.

In FIGURES 6 and 7 is shown still another form of the auxiliary agitating means wherein the shaft 86, corresponding to the shaft 60 on the form of the invention shown in FIGURES 1 and 2, is provided at its ends with disks 88. Disposed in radial spaced relation about the shaft 86 are a plurality of longitudinally extending rollers 92, the ends of which are provided with pins 94 extending into radially elongated slots 96 disposed in circumferentially equidistantly spaced relation near the periphery of the disks.

The rollers 92 are moved to their outermost radial position by centrifugal force upon rotation of the shaft 86, in which position they are arranged to engage the side wall of the receptacle, whereby the particle size of the materials are caused to be finely divided.

As in the case of the auxiliary agitating means of the preferred form of the invention, the auxiliary agitating means of FIGURES 4 to 7, provides in the upper portion of the receptacle a zone of intense turbulent action to effect comminution and breaking up of agglomerated particles and a thoroughly uniform and homogeneous blending of the materials.

While the apparatus is shown and described herein as a batch apparatus, it is apparent that materials to be blended may be continuously introduced into one end of the receptacle and the blended materials discharged from the other end. In this case, the outer blades 46 of the mixing paddles 30 are preferably all pitched in a direction to move the materials toward the discharge end of the receptacle while the inner blades 48 are pitched in the opposite direction.

Although I have disclosed various exemplary embodiments of my invention herein for the purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated therein

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without necessarily departing from the spirit of the invention.

I claim:

1. In an apparatus for blending discrete materials, a closed tank having an arcuate bottom merging into upright side walls and confining a charge less than the capacity of said tank, a bladed agitator mounted within the lower portion of said tank for rotation about a horizontal axis in said charge of said discrete materials, said arcuate bottom wall closely fitting the lower portion of the peripheral envelope of said agitator and said upright side walls being in receding relation with respect to the upper portion of the peripheral envelope of said agitator, means for rotating said agitator, the blades of said agitator being formed to cooperate with the walls of said tank to raise said discrete materials along one upright side wall above the normal level of the material in said tank, an impeller disposed in the upper portion of said tank above the normal level of the discrete materials therein for rotation about an axis parallel with respect to the axis of said agitator and with its peripheral envelope disposed adjacent said one upright side wall between said one upright side wall and the axial vertical plane of said agitator and adjacent the peripheral envelope of said agitator, said impeller having impelling means disposed in a plane parallel with respect to the longitudinal axis of said tank to rotate into and engage and move discrete material delivered thereto by said agitator in a direction transversely of the axis of rotation of said impeller, and means for rotating said impeller in a direction and at a speed to propel said engaged material in said transverse direction over said agitator through said upper portion of the tank normally devoid of discrete materials in an air borne dispersed condition of temporary free flotation from said one side wall toward the opposite side wall of said tank.

2. An apparatus for agitating and blending discrete materials comprising a unitary trough-shaped tank having an arcuate-shaped bottom merging into upright side walls, agitating means positioned within the lower portion of said tank for rotation about an axis coinciding with the longitudinal axis of said tank, means for rotatably driving said agitating means, said agitating means being in close proximity to said bottom and side walls of said tank for mixing at low speed material within said tank and formed for simultaneously delivering portions of said mixed material to an upper zone along a side wall of said tank above the normal material level therein, impelling means positioned within the upper portion of said tank substantially co-extensive therewith and adjacent said side wall, said impelling means having impeller elements disposed in planar parallelism with respect to the longitudinal axis of said tank, and means for rotatably driving said last-mentioned means for engaging said material raised along said side wall and impelling said material transversely across said tank over said agitating means at high speed in temporary free flotation.

3. In an apparatus for blending discrete materials, an elongated closed trough shaped tank having upright side walls and an arcuate bottom and confining a charge of materials less than the capacity of said tank, a bladed agitator extending the length of said tank and mounted longitudinally therein contiguous to the arcuate bottom of said tank for rotation about a horizontal axis in said charge of materials, an impeller extending the length of said tank and mounted in the upper portion thereof above the normal level of the materials therein in axial parallelism with respect to said agitator and between one upright side wall of said tank and the axial vertical plane of said agitator, means for rotating said agitator, said agitator being formed to move the materials laterally toward one side wall of said tank and to cooperate with said side wall to raise said materials therealong above the normal level of the materials in the tank and into the zone of action of said impeller, said impeller having im-

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PELLER elements disposed in a plane parallel with respect to the longitudinal axis of the tank to engage and propel materials delivered thereto by said agitator in a direction transversely of the axis of said impeller and the longitudinal axis of the tank, and means for rotating said impeller in a direction and at a speed to propel said engaged materials in said transverse direction across said upper portion of the tank and over said agitator in an air borne dispersed condition of temporary free flotation from one side wall toward the opposite side wall of the tank.

4. In an apparatus for blending discrete materials, an elongated closed trough shaped tank having upright side walls and an arcuate bottom and confining a charge of materials less than the capacity of said tank, a bladed agitator extending the length of said tank and mounted longitudinally therein contiguous to the arcuate bottom thereof for rotation about a horizontal axis in said charge of materials, the blades of said agitator being formed and rotating in a direction to move the materials laterally toward one side wall of said tank and to cooperate with said wall to raise the materials upwardly therealong above the normal level of the materials in said tank, means for rotating said agitator at a speed to propel successive fractions of said raised materials in a dispersed condition of free flotation in a transverse direction across the upper portion of said tank from said one side wall toward the opposite side wall thereof, an impeller extending the length of said tank and mounted within the upper portion thereof adjacent said opposite side wall for rotation about an axis parallel with respect to the axis of said agitator and disposed in the path of the air borne materials propelled by said agitator, said impeller having impeller elements disposed in a plane parallel with respect to the longitudinal axis of said tank to engage and propel materials delivered thereto by said agitator in a direction transversely of the axis of said impeller, and means for rotating said impeller at a higher speed than said agitator and in a direction for propelling intercepted air borne materials in said transverse direction opposite said first named direction to effect violent impingement of materials against each other.

5. A method of blending a mixture of discrete materials, comprising introducing a charge of said materials in a closed elongated trough shaped container, the charge being less than the capacity of the container to normally provide therein a lower zone of said materials and an upper zone devoid of said materials, imparting a rotating agitating motion to the mass of materials about a horizontal axis extending longitudinally of the container for mixing the same and elevating successive portions of the materials along one side of said horizontal axis into and at one side of the upper zone normally devoid of materials, and then further mixing and blending said materials by violently propelling said successive portions of elevated materials through said upper zone in a direction normal to the said horizontal axis from said one side to the opposite side of said upper zone over the mass of materials mixed in said lower zone in an air borne dispersed condition of temporary free flotation for deposition on and incorporation into the mass of material being mixed in said lower zone.

6. A method of blending a mixture of discrete materials, comprising introducing a charge of said materials in a closed elongated trough shaped container, the charge being less than the capacity of the container to normally provide therein a lower zone of said materials and an upper zone devoid of said materials, imparting a rotating agitating motion to the mass of materials about a horizontal axis extending longitudinally of the container for mixing the same and elevating successive portions of the materials along one side of said horizontal axis into the upper zone normally devoid of materials along one side of the container and propelling them through said upper zone in an air borne dispersed condition toward

the opposite side of the container, intercepting the propelled materials at said opposite side of the container and propelling them at a higher speed through said upper zone in an air borne dispersed condition in a direction normal to the said horizontal axis and opposite the first direction of propelling the materials to effect violent impingement of particles of materials upon each other in said upper zone.

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