

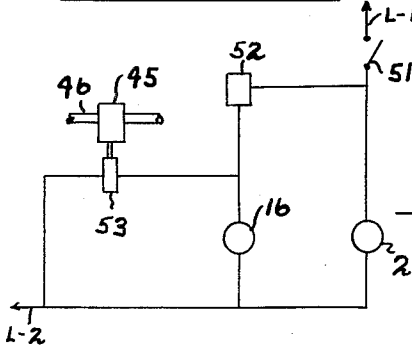
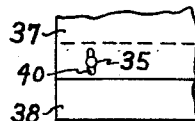
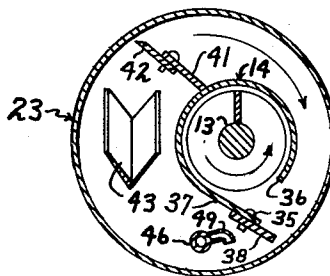
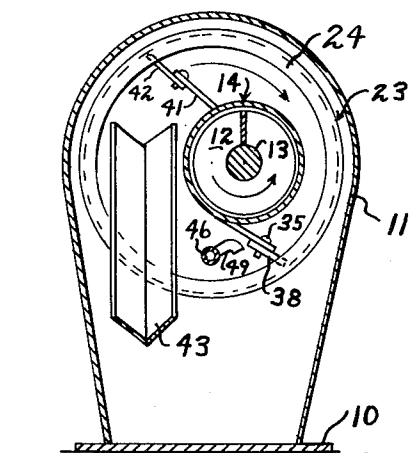
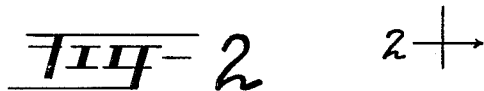
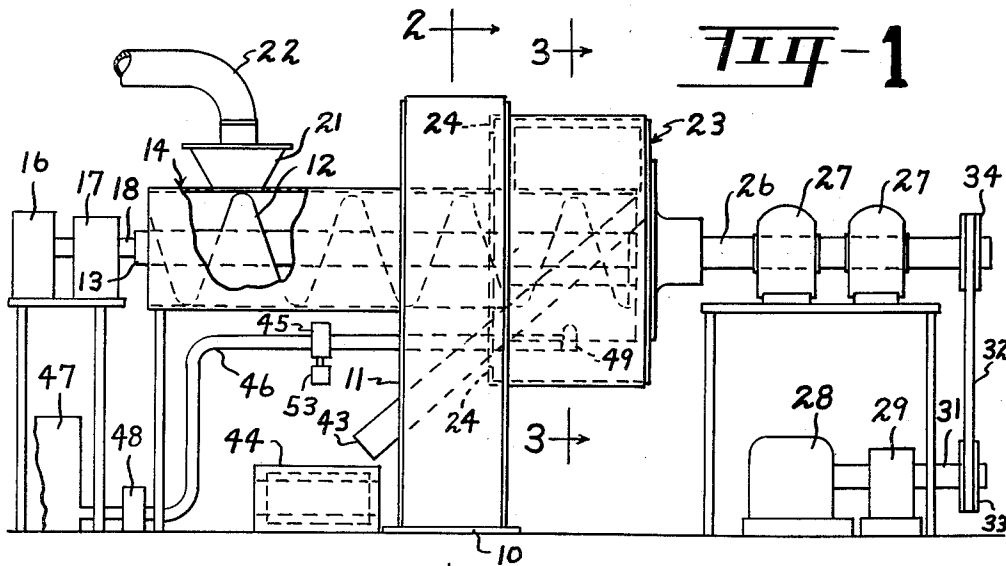
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APPARATUS FOR MIXING A LIQUID WITH FINE PARTICLES

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1

3,020,028 APPARATUS FOR MIXING A LIQUID WITH FINE PARTICLES

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This invention relates to apparatus for mixing a liquid with fine solid particles and more particularly to such apparatus in which it is desired to mix or add a predetermined amount of liquid to a predetermined amount of solid particles.

It is an object of the present invention to provide apparatus in which a layer of solid particles is deposited on the inner surface of a rotating member and while thereon a predetermined amount of liquid is sprayed or dispensed onto the layer.

A further object of the invention is to provide apparatus to apply or add a liquid to solid particles in which the particles are first deposited on the inner surface of a rotating drum in a layer of relatively uniform thickness, and in which the moving layer of particles is then sprayed with the liquid as the drum rotates.

Another object is to provide a rotating drum having one open end with a conveyor extending within said open end to deposit the solid particles therein, means to spray a liquid on the solid particles after the particles have been so deposited, and a scraper to remove the mixture of liquid and solid particles from the drum surface together with means to discharge the particles so removed from the drum.

A more general object is to provide apparatus in which a layer of fine, hard to wet particles is effectively wetted throughout by spraying or otherwise putting the liquid on the layer while the layer is rotating, whereby centrifugal force causes the liquid to permeate and wet the entire layer.

Apparatus embodying features of my invention is illustrated in the accompanying drawing, forming a part of this application, in which:

FIG. 1 is an elevational, partially diagrammatic view of my improved apparatus;

FIG. 2 is a sectional view taken generally along line 2-2 of FIG. 1 and showing a screw type conveyor extending within the open end of the drum;

FIG. 3 is a sectional view taken generally along line 3-3 of FIG. 1 and showing the rotating drum in which the liquid is mixed with the fine particles;

FIG. 4 is a fragmentary plan view of a connection of an adjustable plate; and,

FIG. 5 is a diagrammatic view of the electrical system.

Referring now to the drawing for a better understanding of my invention, I show a support 10 having an outer housing 11 mounted thereon. A screw conveyor 12 having a shaft 13 is mounted within a conveyor housing 14 in turn supported by outer housing 11. A motor 16 drives conveyor shaft 13 through gear box 17 and output shaft 18. A hopper 21 is disposed over housing 14 and particles of solid material may be deposited in hopper 21 to fall downwardly on screw conveyor 12 to be conveyed thereby. A conduit such as shown partially at 22 may be provided, if desired, to convey the fine particles to hopper 21. Fine particles as defined in the specification and claims may be on the order of from 5 microns up to and including particles that pass a 100 mesh screen.

A drum indicated generally by the numeral 23 is disposed at the end of screw conveyor 12 and has an open end to receive screw conveyor 12 and housing 14. A flange 24 may be formed, if desired, on the open end to keep the mixture of liquid and particles within drum

2

23 from spilling out the open end. Drum 23 preferably is mounted on a generally horizontal shaft 26 supported by bearings 27. Motor 28 drives shaft 26 through a gear reducer 29, output shaft 31, and pulley belt 32 extending between pulleys 33 and 34.

Conveyor housing 14 extends within the open end of drum 23 and has a cut away section forming an outlet 36 (see FIG. 3) adjacent the bottom of conveyor housing 14 within drum 23. An extension 37 to form a discharge plate for the material slopes downwardly from a side of the opening 36 in the bottom conveyor housing 14 and extends beneath the opening to deposit the particles onto inner surface of drum 23. An adjustable plate 38 may be secured to the outer edge of guide plate 37 to gauge the thickness of the layer of material on the inner surface of drum 23. Plate 38 may be adjusted to and from the inner surface of drum 23 by a bolt 35 positioned within slot 40 of guide plate 37 as shown in FIG. 4.

A blade support 41 is secured to housing 14 within drum 23 and extends upwardly therefrom. A scraper blade 42 is mounted on the outer edge of support 41 and is disposed adjacent the inner surface of drum 23 to scrape the wetted layer therefrom whereby the mixture falls downwardly by gravity. Scraper blade 42 may be adjusted on support 41 by a suitable nut, bolt and slot connection similar to the adjustable connection of plate 38. A chute or trough 43 is disposed within drum 23 and extends from beneath the scraper blade to a position outwardly to the drum. The mixture scraped from the inner surface of drum 23 falls downward into chute 43 where it moves by gravity onto a conveyor 44 disposed adjacent the lower end of the chute. The mixture of liquid and fine particles deposited on conveyor 44 is moved thereby to a suitable collection point (not shown) where the mixture may be loaded or stored.

A liquid conduit 46 extends within the open end of drum 23. A solenoid actuated valve 45 is interposed across conduit 46. A liquid reservoir is shown partially at 47 and a pump 48 is connected to reservoir 47 for pumping the desired liquid through conduit 46. Solenoid actuated valve 45 is interposed across conduit 46 to control the flow of fluid to drum 23. A spray nozzle 49 is disposed on the outer end of conduit 46 and suitable openings are provided therein so that a substantially equal distribution of liquid is obtained throughout the length of drum 23.

In operation, fine solid particles such as dust, fly ash, ore fines or the like, are deposited in hopper 21 and fall downwardly onto screw conveyor 12 to be conveyed into drum 23. The particles fall downwardly through outlet 36 onto the inner surface of drum 23 which is rotating and are retained thereon by the centrifugal force generated by the rotation of the drum and the adhesion of the wetted mixture to the drum. The thickness of the layer of particles formed on the inner circumference of drum 23 is limited by the distance of plate 38 from drum 23. Other factors which control the thickness of the layer are the quantity of particles being fed by hopper 21 and the speed at which screw conveyor 12 is rotated along with the speed of rotation of drum 23. As the layer of particles on the inner surface of drum 23 passes beneath spray nozzle 49, liquid, such as water, is sprayed from nozzle 49 onto the layer throughout the length of drum 23. The centrifugal force causes the liquid to permeate and thoroughly wet the layer of particles throughout the entire thickness thereof. If a more viscous liquid is used, or if the particles are more difficult to wet, the drum speed may be increased to provide greater centrifugal force thus to increase the permeating action of the liquid. Scraper blade 42 scrapes the wetted layer from the surface of drum 23 whereby the mixture

falls downwardly onto chute 43 and is transferred thereby to conveyor 44.

Referring to FIG. 5 I show controls for my improved apparatus including power lines L_1 and L_2 . A master switch 51 controls the operation of my apparatus and upon closing switch 51 drum motor 28 is energized. A time delay switch 52 permits the flow of current there-through after drum motor 28 has brought the drum up to speed thereby energizing screw conveyor motor 16 and solenoid 53 to actuate valve 45 and screw conveyor 12. Thus, after the drum has reached a desired speed of rotation, the particles are fed into drum 23 and the liquid sprayed thereon.

As a specific but non-limiting example, a drum approximately 16 inches in diameter and rotating at a speed of 500 r.p.m. was employed with red ore dust particles, 34% of which were under 10 microns in diameter and the remainder between 10 and 74 microns in diameter. The screw conveyor was rotated at 25 r.p.m. and the dry particles were fed into the drum at a rate of 15,450 pounds per hour, or about 103 cu. ft. per hour. The material weighed about 150 pounds per cubic foot. Water was applied at the rate of 773 pounds per hour or approximately 1.50 gallons per minute. My apparatus performed very effectively under such conditions of operation and the product was almost completely dust free.

From the foregoing, it is understood that I have provided apparatus in which a liquid is mixed with solid particles while the particles are held on the inner surface of a rotating drum-like member and the liquid caused to permeate the layer by centrifugal force. A predetermined amount of liquid is sprayed on the layer of particles as it travels past the liquid dispenser. My improved apparatus thus is quite flexible and is operable over wide ranges of particle sizes, required degrees of wetness, and varying rates of feeding the particles.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. Apparatus for mixing liquid with fine solid particles comprising a drum mounted for rotation generally on a horizontal axis and having one open end, means to rotate said drum, a screw conveyor extending through said

open end to deliver particles within the drum, a housing extending about said conveyor and having an outlet on the lower side thereof within said drum, a discharge plate connected to the housing and positioned under said outlet to receive said particles, said plate having its outer edge substantially parallel to and uniformly spaced from the inner surface of the drum to form a uniform layer of particles on the drum, means to dispense liquid on the layer of particles while on the drum, a scraper disposed adjacent the inner circumference of the drum to scrape the mixture of liquid and particles from the inner circumference of the drum, and a chute disposed under said scraper and extending through the open end of the drum to receive said mixture after being removed by the scraper and to convey the mixture outwardly of the rotating drum.

2. Apparatus defined in claim 1 in which said discharge plate extends to a position adjacent the inner surface of the drum and may be adjusted relative to the inner surface of the drum to determine the thickness of the material thereon.

3. Apparatus for mixing a liquid with fine solid particles comprising a drum mounted for rotation generally on a horizontal axis and having one open end, means to rotate said drum, a screw conveyor extending through said open end to deliver particles within the drum, a housing extending about the conveyor and having an outlet in the bottom thereof adjacent the drum, a discharge plate adjacent the outlet of the housing to receive the particles from the conveyor and to place the particles in a relatively uniform layer on the drum, the outer edge of the discharge plate being substantially parallel to the adjacent inner surface of the drum, means to dispense liquid onto the layer of particles while on the drum surface, a stationary scraper disposed adjacent the inner surface of the drum to remove the mixture of liquid and particles from the drum surface, and a chute disposed under said scraper and extending through the open end of the drum to receive the mixture of liquid and particles after being removed by the scraper and to convey the mixture outwardly of the rotating drum.

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