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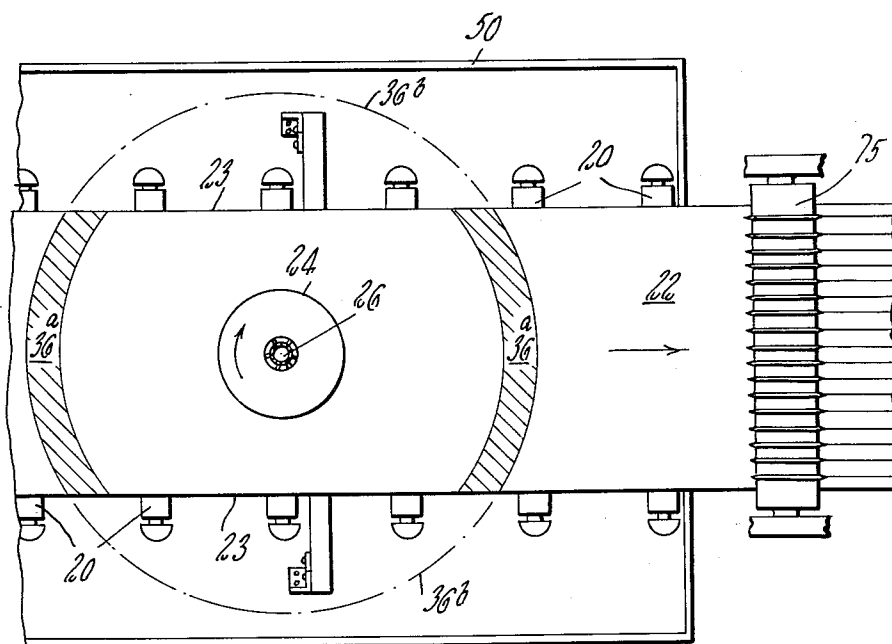
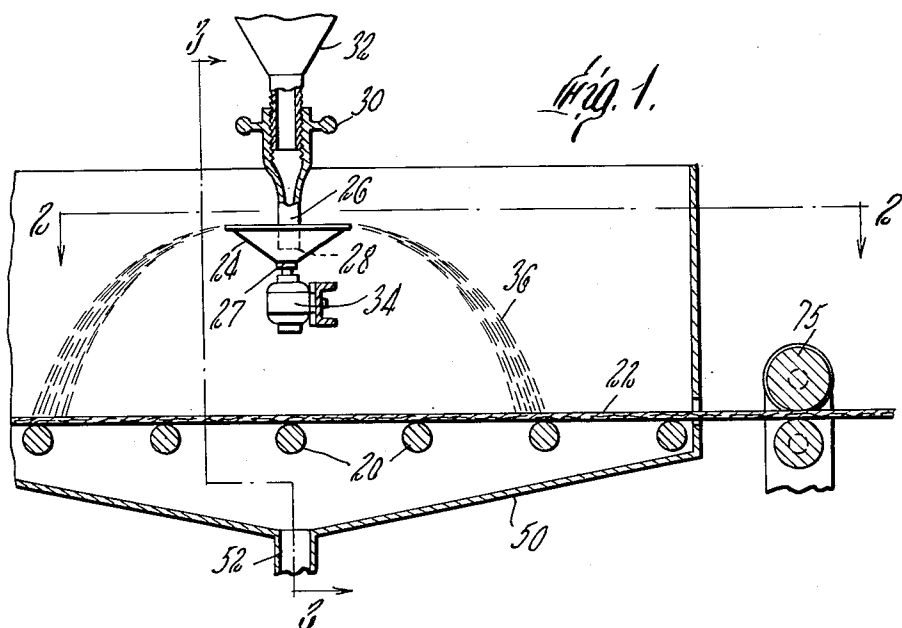
S. H. SALLIE

3,014,812

METHOD AND APPARATUS FOR SPREADING PARTICLES

Filed Nov. 21, 1958

2 Sheets-Sheet 1



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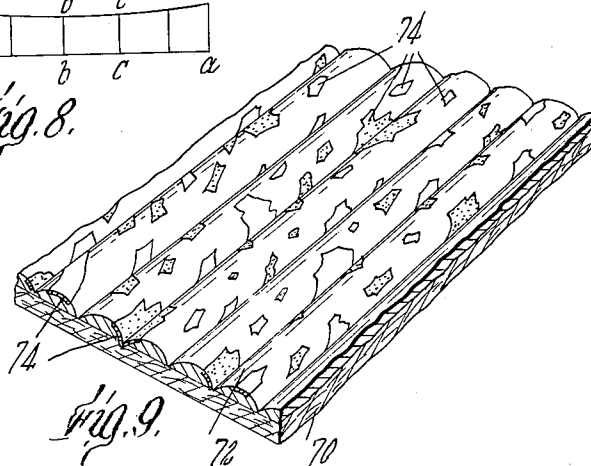
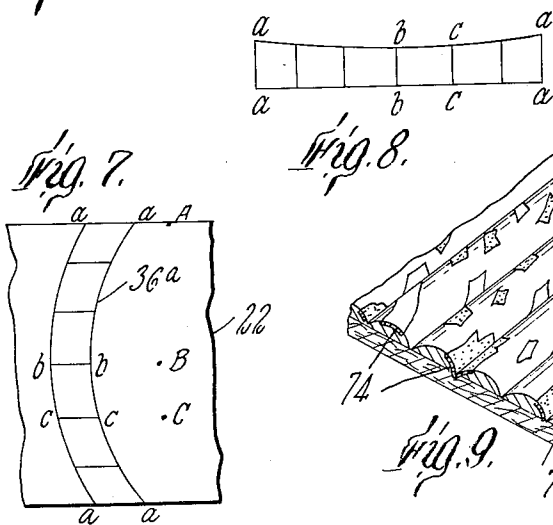
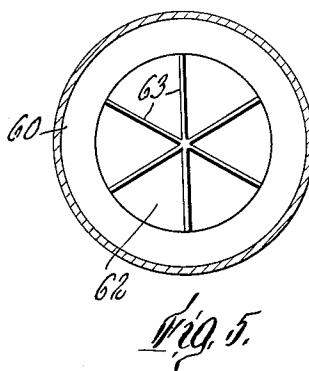
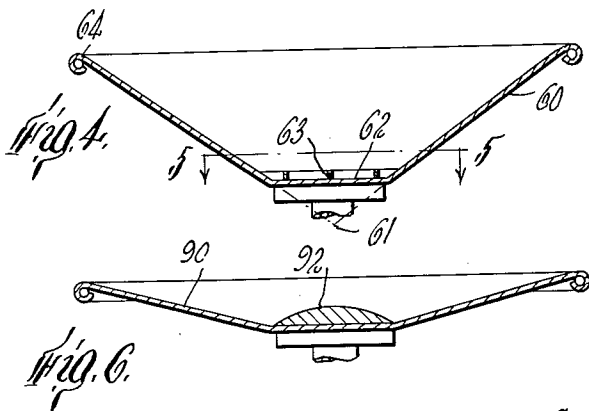
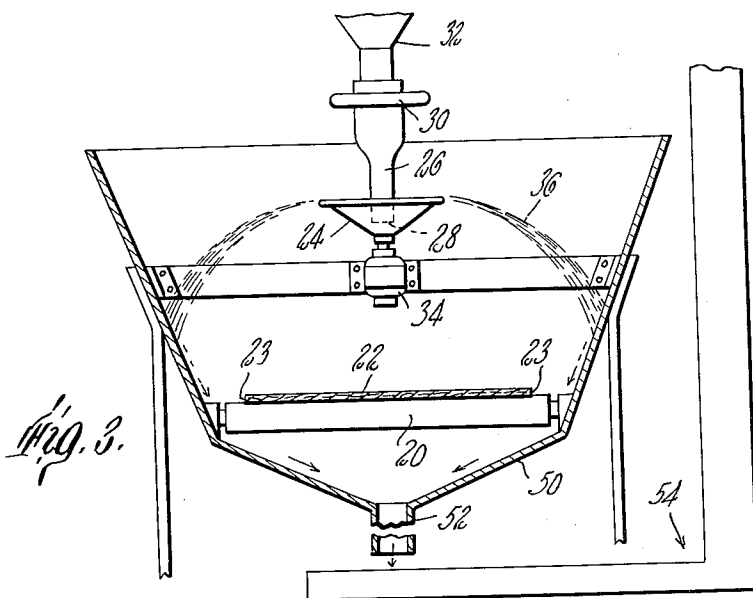
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METHOD AND APPARATUS FOR SPREADING PARTICLES

Filed Nov. 21, 1958

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3,014,812 METHOD AND APPARATUS FOR SPREADING PARTICLES

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Filed Nov. 21, 1958, Ser. No. 775,473
6 Claims. (Cl. 117-24)

This invention relates to the spreading of particulate matter and generally to the spreading of particles across the width of a travelling substrate.

Many composition materials are fabricated in part by the process of dropping on to a substrate particulate matter, such as sand and pigmented resins. Where it is desired to have a complete covering, this is easily accomplished by shaking onto the substrate by means of a vibration feeder an excess amount of material and subsequently, after binding particles to the surface, letting the excess fall off or be sucked or scraped away from the covered surface. Difficulties are encountered, however, where it is desired to spread particles upon a surface in an even dispersion which does not completely cover the surface. To achieve such a cover it is necessary to accurately regulate the flow of particles so that from instant to instant the amount falling upon a below-passing substrate is equal. Gating or otherwise impeding the flow of particulate matter from a hopper to a vibratory feeder has been utilized in an attempt to achieve even distribution of particles. Many particles do not flow freely under such circumstances, and clogging frequently occurs. Where the particles to be distributed are of differing sizes, stratification likewise results, and it is impossible to achieve an even distribution of particles upon a below-passing substrate. Even with steady flow from a gate to a vibratory feeder, the particle discharge rate obtained varies with the cyclical positions of the vibrator. Objectionable striations occur with such variations in particle flow. It is therefore desirable to achieve a new method and apparatus for spreading particles which does not entail the above disadvantages of vibratory feeders and other known distributors.

Accordingly, it is an object of this invention to provide a method for dispersing particles onto a moving substrate in a predetermined pattern in an accurate manner.

A further object of this invention is to provide a new method for creating an even dispersion of particulate matter across the width and along the length of a substrate.

It is another object of this invention to provide an apparatus for distributing particulate matter upon a substrate in a steady flow without the danger of clogging or stratification of the particles.

Still another object is to fabricate a composition comprised in part of a binding base material and in part of pellets.

Other objects of this invention are in part obvious and will in part appear hereinafter.

Further objects include providing improved feed control by feeding a column of particles downwardly to a horizontally rotating surface, and restricting the flow from the column by the impedance of the closely related rotating surface and providing improved distribution control by centrifugally forming a penumbra of the particles as they flow from the column and passing a substrate through said penumbra with a substantial arc of the penumbra on each side of the substrate falling beyond the lateral edges of the substrate, as it passes through the penumbra.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings wherein:

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FIG. 1 is a schematic, partially sectional side view illustrating one preferred embodiment of the apparatus of this invention;

FIG. 2 is a schematic, partially sectional plan view of the preferred embodiment of FIG. 1 taken on line 2-2;

FIG. 3 is a schematic partially sectional end view of the preferred embodiment of FIG. 1, in which the recycling feature of this invention is illustrated;

FIG. 4 is a vertical section through the center of one preferred embodiment of the impeller portion of this invention;

FIG. 5 is a top sectional view of the impeller of FIG. 4 taken on line 5-5;

FIG. 6 is a vertical section taken through another preferred impeller;

FIG. 7 is a schematic plan view indicating the uniformity of particle coverage;

FIG. 8 is a graphical illustration of the coverage obtained in FIG. 7; and

FIG. 9 is a magnified cross-sectional and perspective view of a typical product of this invention.

Referring now to the drawings wherein like numerals refer to like elements the invention will be described in more detail.

In FIG. 1, means 20 are adapted to pass a web of substrate 22 in a line. A hollow frustum shaped impeller 24 with its projected apex bottom-most and center line vertical is rotatably mounted above the substrate so as to spin about its center line. This impeller is preferably formed of smooth, imperforate material such as sheet metal, metal casting, shaped plastic or the like. An electric motor and gear members 34 are provided to spin the conical impeller at speeds in the range between 25 and 500 r.p.m. A storage means partially shown at 32 is positioned well above the conical impeller 24. From this storage means extends a feed pipe 26 down into the impeller. The end 28 of the pipe 26 extends close to but is spaced apart from the flattened bottom 27 of the impeller. Height-adjusting means 30 permits the raising or lowering of the feed pipe as desired. The operation of this apparatus is as follows:

Substrate 22 is moved at a steady rate below the impeller. Feed pipe 26 is lowered to a position barely spaced apart from the flattened bottom 27. Storage means 32 is filled up with particulate matter to be dispersed, and accordingly, feed pipe 26 is filled. The space between the end 28 of the feed pipe 26 and the flattened bottom 27 of the impeller is so small as to prevent a flow of particles from the pipe into the impeller while the impeller is stationary. The impeller is then rotated by drive means 34 and as the speed picks up, pipe 26 is raised or lowered so as to adjust the distance between the end 28 of the pipe and the bottom 27 of the impeller to control the desired amount of flow. As the impeller rotates, particles coming from the pipe are centrifugally forced up the sides of the impeller and out over the substrate forming a penumbra of falling particles, which is essentially a curtain of particles in a trajectory created substantially by the combination of accelerations due to gravity and to substantially horizontal centrifugal forces. Particles in the penumbra fall upon the moving substrate.

In addition to the horizontal centrifugal force, such as is created by rotation of a flat disc which alone is sufficient in some instances to define a suitable penumbra, an upward acceleration is imparted to the particles by this preferred conical impeller, permitting better distribution and, better feeding in some instances.

The apparatus in FIG. 2 and FIG. 3 illustrates the preferred embodiment of the invention of FIG. 1 where a specific relationship exists between the elements. Substrate moving means 20 is adjusted to move the substrate

22 at a steady rate. Impeller 24 is positioned substantially above the center of the moving substrate. The height of the impeller 24 and its lateral position with respect to the below substrate, the dimensions of the impeller and its speed of rotation are all so related that the penumbra of falling particles created when particles are fed to the rotating impeller contacts the below-passing substrate in a circular band indicated at the shaded areas 36a. Substantial arcs of the penumbra 36b fall beyond the lateral edges 23 of the substrate 22. With this apparatus steady movement of the substrate beneath the operating impeller causes progressive, even distribution of the particles along it. As shown in FIG. 3, baffles 50 extend from a conveyor pick-up point 52 upward at an angle beyond the lateral edges 23 of the substrate. A recirculating conveyor 54 is connected to the conveyor pick-up point 52 and extends upward to the storage means 32. The operation of this preferred embodiment of the invention is as follows:

The impeller 24 is rotated and particles fed from the storage means 32 through the feed pipe 26 are flung in a penumbra 36 from the impeller. Portions of the penumbra in line with the substrate fall upon the substrate in an even distribution. Particles in the penumbra beyond the lateral edges of the substrate fall upon baffles 50 and are directed to conveyor pick-up point 52. These excess particles are carried by the recirculating conveyor back to the storage means 32 whereby they are recycled.

FIGS. 4 and 5 illustrate a preferred embodiment of the impeller or flinger of this invention. The impeller is comprised of a hollow frustum 60 with its projected apex 61 bottom-most. This frustum surface is of a smooth, imperforate material having sufficient rigidity to maintain its form while it is spun in projecting particles to be spread. A substantially flat horizontal bottom 62 is provided. With such a configuration a vertical feed pipe extending close to the center of the impeller is blocked by the bottom surface 62. With the feed pipe filled and the impeller rotating the feed pipe end 28 and the bottom surface 62 cooperate to form a restricted passage through which particles from the pipe flow to the impeller. The impedance offered by the bottom 62 is essential in providing an accurately controlled rate of particles.

From the center of the bottom 62 a plurality of evenly spaced, slightly raised vanes 63 extend radially from the center along the flat bottom, foreshortened to terminate a substantial distance from the rim 64 of the impeller. In operation, the whirling, slightly-raised vanes 63 cause an irritating feeding motion which promotes steady flow of the particles from the feed pipe to the impeller. Clogging and stratification of the particles is avoided. Steady flow is attained and slippage is prevented at the center with this impeller even at high rates of speed. The foreshortened nature of the vanes prevents pulsations in the flow of particles.

FIG. 6 is another preferred impeller. The outer impelling surface 90 is of a very low pitched frustum shape with its projected apex bottom-most. The center portion of the bottom 92 is a substantially horizontal extension from the conical surface of the frustum. This bottom does however, have a slight domed contour with a diameter substantially larger than the diameter of a circular vertical feed pipe with which it is designed to cooperate in controlling the flow of particles to be spread. Such an impeller spun slowly is capable of creating such impedances to the flow of particles as to permit the control of very low but steady feed rates.

As mentioned before a mere smooth and flat rotating disc is sufficient to centrifugally spread particles, but the upward thrust of the preferred conical impellers imparting an upward component in the movement of particles as they leave the impeller causes particles to be moving in substantially vertical lines when the particles impinge upon the below passing substrate. This is an

especial advantage where high speed spinning is involved because particles travelling fast horizontally tend to skid and leave marks on many substrates, and also tend to pile up in uneven dispersions.

With reference to FIGS. 7 and 8 the nature of the even dispersion attained by this invention is better explained. A substrate schematically shown at 22 passes through a penumbra of falling particles which creates a circular band 36a with substantial segments of the penumbra falling beyond the lateral edges of the substrate. There is a steady flow of particles and steady movement of the substrate. At points A, B and C on the substrate the length of the lines aa, bb, and cc are directly proportional to the density of particles falling on an increment of width of the substrate at points A, B and C, respectively.

FIG. 8 graphically illustrates that the maximum density occurring at point A is virtually the same as the minimum density occurring at point B.

FIG. 9 illustrates a typical product obtainable with the apparatus and method of this invention. There is illustrated an asphalt-saturated felt 70 with a top layer on the felt comprised of a mixture of asphalt and mineral filler 72. On the upper surface of this top layer, flat pigmented resin chips 74 having diameters in the range of between .01 and 1 inch reside in an even dispersion. As shown, this top surface has been embossed subsequent to the dispersion of the chips, and the chips conform to the ridges of the embossment. This product is formed in the following manner:

A saturated felt web is coated with a mixture of hot asphalt and mineral filler. This combination is allowed to cool and is passed through a penumbra of falling pigmented resin chips with substantial portions of the penumbra falling beyond the lateral edges of the moving felt. After passing through the penumbra, the moving composition is treated with mineral dust, cooled to a predetermined condition and eventually preferably embossed by embossing roll 75 shown in FIGS. 1 and 2, after preliminary rollings by apparatus not shown. The embossing and preliminary rolling cause the pigmented chips to be embedded in the top layer of asphalt and mineral filler whereby a substantially even surface is created with embossed depressions.

The foregoing embodiments are only exemplary of the method and apparatus of this invention and therefore should be taken in a descriptive and not in a limiting sense.

What is claimed is:

1. A method of depositing particles in spaced relationship onto a surface which comprises introducing said particles onto an impeller, rotating said impeller about an axis to give to said particles by centrifugal force a component of motion in a plane perpendicular to said axis to throw said particles off said impeller in a stream of uniform density, said stream having the cross-sectional configuration in at least some planes perpendicular to said axis of a closed band, and moving said surface through said stream in a direction generally parallel to said planes, said surface being of width less than the distance between any two opposed portions of said band, and being so oriented with respect to said stream that no particle of said stream falling in a path lying in a plane passing through said axis and transversely of said surface falls onto said surface.

2. The method of claim 1 in which said impeller has an outwardly upwardly extending surface, whereby said particles thrown off by centrifugal force additionally have an upward component of motion, and in which said surface is moved through said stream beneath said impeller.

3. A method of depositing particles in spaced relationship onto a surface which comprises centrifugally forming said particles into a stream defining in transverse cross-section a closed band of even particle density, and moving said surface in a transverse direction through

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said stream, said surface being of width less than the distance between any two opposed portions of said band, and the entire width of said band, in at least certain portions on each side thereof, falling by opposite sides of said surface without impingement thereon.

4. A particle distributor which comprises an impeller mounted for rotation about a vertical axis, a feed pipe mounted above said impeller with a lower end adjacent said impeller, conveyor means beneath said impeller for moving a substrate in a generally horizontal plane therebeneath, and particle-collecting means alongside said conveyor means thereabove and therebelow.

5. The particle distributor of claim 4 in which said impeller is outwardly of cone frustum configuration.

6. The particle distributor of claim 4 in which said impeller carries upstanding ribs beneath said lower end

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and said lower end is selectively vertically adjustable to cooperate with said ribs in controlling feed rate.

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