

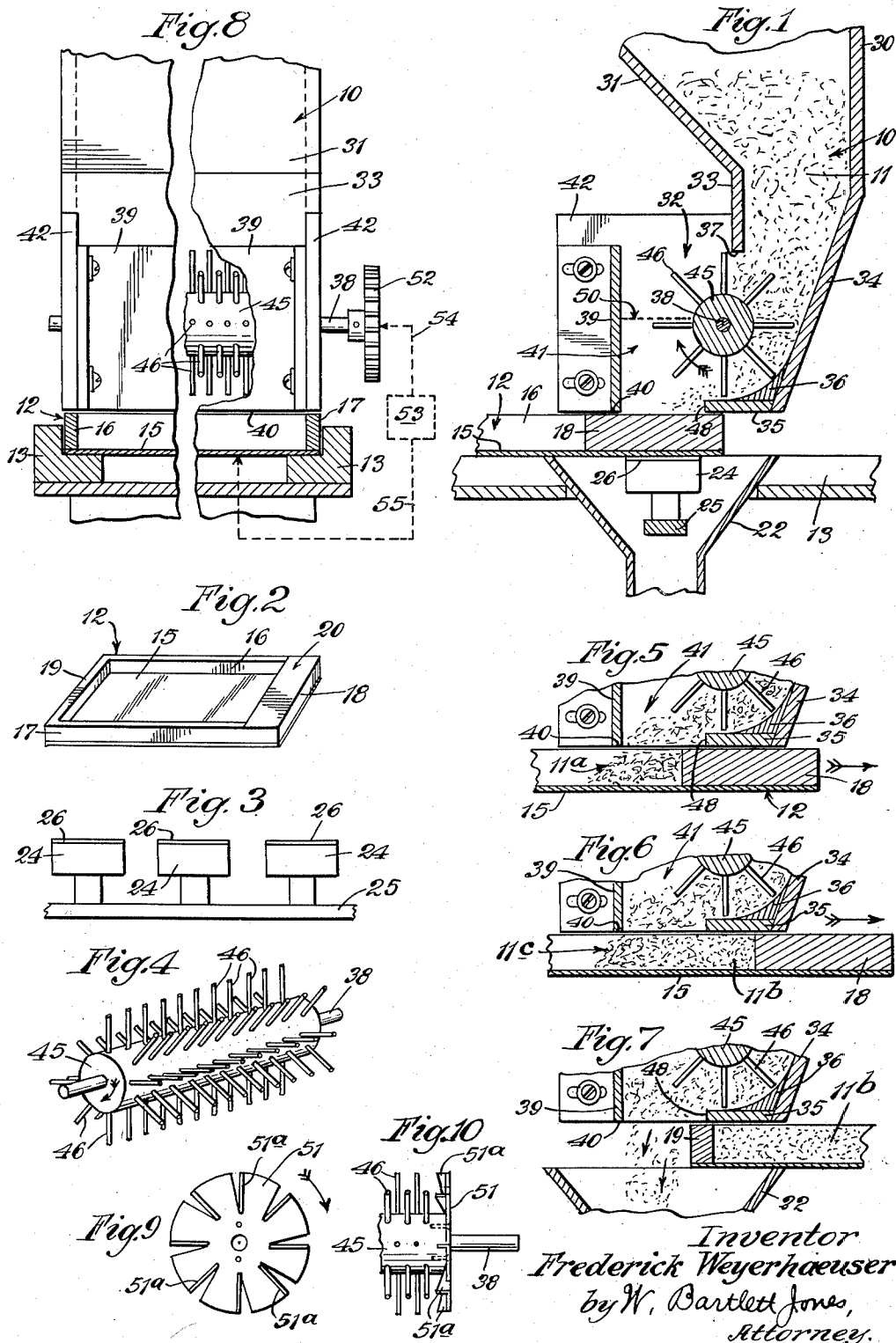
Dec. 25, 1951

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2,579,527

METHOD AND MEANS FOR LOADING DRY GRANULAR MIXTURES

Filed July 23, 1948



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UNITED STATES PATENT OFFICE

2,579,527

METHOD AND MEANS FOR LOADING DRY
GRANULAR MIXTURES

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Application July 23, 1948, Serial No. 40,383

13 Claims. (Cl. 25—103)

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The present invention relates generally to feeding or loading methods and devices for feeding loose material in controlled amounts or at controlled rates, and in particular it relates to the feeding of material which has a wide range of particle sizes in a manner to minimize or prevent separation of sizes.

The invention is applicable to feeding such mixtures of variable ingredients, but it has particular reference to feeding a mixture which is primarily wood sawdust or mill waste into forms for molding to an integrated product such as a board panel, with preservation of uniformity of mixture. Hence the invention will be explained with reference to its application in the field of making panel boards from dry mixtures primarily of sawdust, with a suitable binder ingredient, such as thermosetting synthetic resin-forming powder.

In the field of molding panels from mill waste sawdust characterized by a high content of flour-like fines, as well as by a variable content of coarser sizes, it is important to secure a product with the same surface texture or characteristics on both sides of the panel, and at inner faces which may be produced by milling or sanding. To illustrate, it is a practice to use as raw material a dry mixture of unclassified mill waste sawdust with a suitable dry binder content such as thermosetting resin material. This mixture is loaded onto a plate or into trays on or in which a panel is to be formed by hot-pressing. The mere act of pouring such a dry mixture causes separation of particles by reason of the differential rates of falling under the influence of gravity. In such an undesired pouring step, the fine particles commonly fall faster than the coarser particles. Thus, on pouring such bulk material to form a moldable layer, the bottom of the layer has a surplus of fines and the top of the layer is deficient in fines. Such a poured layer produces a board with faces of different texture, and in the case of a deficiency of content of fines, the top face becomes proportionately pitted by reason of the absence of fines to fill in the spaces between coarser particles.

The present invention overcomes these undesirable results and provides a method and means for loading such a separable dry mixture into a moldable form without inducing separation of fines and coarse particles. It is a general object of the invention to maintain the mixture to be used in a bulk form and to move it from a supply of such, bodily onto a receiving member on which it is to be molded, and with a minimum of oppor-

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tunity for falling and being simultaneously dispersed.

It is a particular object of the invention to provide apparatus for filling trays in the manner described.

It is an object of the invention to feed material at a fixed rate greater than the normal rate of absorbing the fed material, for accommodating abnormal conditions encountered regularly or accidentally.

It is also an object of the invention continuously to form a uniformly dense and homogeneously mixed layer of substantially dry granular material on a moving conveyor member by transfer from a hopper-like supply thereof in a manner to minimize size separation, or compensate therefor.

Various other and ancillary objects and advantages of the present invention will become apparent from the following description and explanation of the invention as it is set forth with reference to an exemplary device illustrated in the accompanying drawings, in which:

Fig. 1 is a vertical cross-section of a feeding device showing the relationship of the principal parts thereof, including a supply hopper and a rotary device to move material laterally from the hopper.

Fig. 2 represents a tray to be filled by the hopper of Fig. 1 and in particular it illustrates a broad surfaced end wall on the tray for cooperation with the feeding device.

Fig. 3 is a detailed illustration of a portion of a magnetic device looking at the same laterally in the position shown in Fig. 1.

Fig. 4 is a perspective view of a feeding rotor for the apparatus.

Fig. 5 is a diagrammatic view of a portion of the structure in Fig. 1 showing the tray of Fig. 2 advanced to the right from the position shown in Fig. 1.

Fig. 6 shows a view similar to Fig. 5 showing the tray sufficiently advanced for the main filling operation.

Fig. 7 is a view similar to Fig. 5 showing the same tray as it has been completely filled and as it is about to leave the feeding device.

Fig. 8 is an endwise view of the apparatus shown in Fig. 1.

Fig. 9 shows an optional impeller device for overcoming side-wall friction.

Fig. 10 is a profile view showing the device of Fig. 9 mounted on the end of the working portion of the rotor.

It is to be understood that the invention is not limited to or by the exemplary form shown in

the drawing, or by the description thereof, and that other changes and modifications are contemplated as falling within the scope of the invention as expressed in the appended claims.

In applying the invention, the panel to be molded may be of very large size economically permitting considerable edgewise trimming, thus introducing an item of waste. Also, the panels may be small in size, such that the same degree of trimming must be avoided, for economical reasons. These extremes pertain to the care with which the edges of the panel are formed, and this goes back to the manner in which the edges of the layer to be molded are formed. For example, for the said large panel, a flat sheet without side walls may be the receiving means on which a layer of the sawdust mix is formed at a uniform depth, except for banked edges sloping at the angle of repose. To avoid banked edges, the sheet may have confining side walls so that the edges are as thick as the middle. In making a small panel, a tray with side walls is employed as the receiving means to minimize trimmable waste in the finished panel.

The loading means of the present invention is designed for uniformly filling trays, large or small, and its structure and operations are hereinafter explained by reference to filling trays. But it will be understood that the same device may be used to load sheets without sidewalls, without departure from the broadest aspects of the present invention.

In the drawings, Fig. 1 represents a hopper 10 adapted to feed a dry bulky sawdust-base mixture 11 into a molding tray 12 which moves under and past a bottom opening of the feeding device on suitable supporting means 13. The material supplied to the hopper 10 may come from any suitable mixing device in which the ingredients are homogeneously incorporated and in which the various particle sizes are suitably homogeneously distributed throughout the mass. It is a purpose of the invention to maintain a supply of such material in the hopper 10 and to move it bodily therefrom into the tray with substantial avoidance of any dropping by gravity except dropping of the mass as a whole, whereby dispersion and separation of particle sizes is thus practically avoided. An accompanying objective is to maintain the mass being moved at a uniform density so that when a given volume of the mass is placed in a tray the amount of material per unit area is constant.

Since the device is preferably arranged for filling trays of various depths, or a tray to various depths, for making boards of various thicknesses and densities, there may be provided trays of various depths according to the general form illustrated in Fig. 2. To accommodate deposited layers of varying thicknesses, the space between the main feeding device 10 and the foundation 13 is variable to permit vertical adjustment so that a tray moves along the foundation under the feeding device 10 in a manner to form a charge having a fixed top level, preferably flush with the side walls of the tray. Only one depth of tray is illustrated in the drawings, and hence only one position of adjustment.

The tray 12 may assume a variety of forms, but for the purpose of illustrating the present invention, a simple form is shown in Fig. 2. The tray has a sheet metal bottom 15 which is preferably of magnetic material such as iron or steel for a purpose connected with filling the tray to a constant depth. The tray has side walls 16 and

17 and end walls 18 and 19, all of the same height. End wall 18, when it is used as the leading end in advancing a tray relative to hopper 10, is especially thick to provide a wide platform area 20 to function as a gate in connection with operation of the loading device.

The tray will be hereinafter described as moving to the right in the drawing, so that the end wall 18 is the leading end and the end wall 19 is the trailing end. When the trailing end passes the filling area of the device, and when no tray follows in abutting relation thereto, it will appear that a surplus of the mixture in the feeding device may drop therefrom. Consequently, there is provided at or below the level of the supports 13 a suitable collecting hopper 22 from which the collected material may be returned to hopper 10.

Where a sheet metal bottom is used for the tray it may, in time, assume a non-planar or warped condition as a result of repeated heating, cooling, handling, and manhandling. Since the tray is filled to a uniform top level, a warping of the tray bottom in the filling operation would produce variations in the depth of the fill, which would effect inequalities in the character of the pressed panel. To avoid this, the tray bottom is brought to its proper normal level at the time when the space above it is filled to the desired level. To accomplish this, the tray bottom 15 is magnetic, and is made to pass over a magnetic grid or platform at the normal level for the tray bottom. The platform either pushes or pulls upon the bottom to bring it to its proper level for filling above it. Such a magnetic platform may be provided as a grid formed by a series of permanent bar magnets illustrated at 24 supported on a cross-bar 25. On the magnets is a suitable thin non-magnetic separator layer 26 to limit sliding friction of the tray over the magnets, yet to permit sufficient magnetic flux for the desired flattening of the bottom. The magnetic platform is secured to the supports 13 so as to be adjustable with it.

In filling a tray 10 it is the objective to provide a homogeneously mixed supply of dry material, largely sawdust particles with coarse members and fine members, and suitable binder properly incorporated into the mixture. The material moves as a body, either by gravity or by mechanical means to avoid dispersion thereof in falling by gravity. To this end, the hopper 10 is generally vertical with side walls at an angle with the horizontal greater than the angle of repose for the material. Thus, the top part of the hopper 10 has a vertical wall 30 and an inclined wall 31 at 45° or more with the horizontal. At the bottom of the hopper 10 there is an out-feed device herein shown as a feed rotor 32, having a form comparable to several comb-like elements with widely spaced teeth whereby the rotor tends to feed, or permits the feed of the material as and when demanded. The rotor feeds the material substantially horizontally from the hopper and it is mounted in a lateral opening in a constricted bottom part of the hopper, which part is more nearly a vertical passageway than the upper part of the hopper between walls 30 and 31, thus to avoid bridging of material as a result of some of it being moved away by operation of the feed rotor. Agitators (not shown) may be located in the hopper 10, especially where it is deep, to avoid bridging. The bottom part of the hopper has a vertical wall 33 joining wall 31, and a slightly in-

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clined wall 34 which is at least 65° with the horizontal.

The hopper bottom has a floor in the form of a fixed horizontal apron or closure plate 35 joining with wall 34, and preferably provided with a fillet 36 closely following the contour of the path of the feed rotor 32, to prevent stagnant material in the location of the fillet. The hopper 10 thus has a rectangular lateral opening at a space between the apron 35 and the bottom edge 37 of the wall 33. It is at this opening, but slightly outwardly of it, that the axis of the feed rotor 32 is mounted for operation and in a manner so that the bottom part of the rotor tends to feed material horizontally along and off the apron 35. The position and structure of the rotor are such that the space between it and the edge 37 does not permit free flow of the mixture from the hopper. The rotor is mounted on horizontal axis 38 which is preferably slightly outside of the hopper and away from the vertical line of the wall 33. The rotor has a diameter to operate with a slight clearance of the edge 37 of the wall 33, and a slight clearance with reference to the hopper wall 34 and the bottom plate 35. Beyond the rotor 32 is a substantially vertical baffle plate 39 with its edge 40 in substantially the same plane as the bottom of the apron 35, thus both forming a horizontal opening for filling the tray 12. The baffle plate 39 is horizontally adjustable toward and away from the rotor 32 in order to vary the volume of a resulting accumulation chamber 41 thus formed by the baffle, the rotor and side walls 42 between which the baffle 39 is located and movable, which side walls are extensions of the vertical sides of the hopper in which the rotor 32 bears.

The rotor has a main cylindrical mandrel 45, and finger-like projections, preferably as radial spikes 46 which constitute the feeding means of the rotor. It is preferred that the spikes 46 be uniformly arranged over the circumference of the mandrel 45 and that they all be of the same length to give a fixed diameter to the rotor. For example, where the mandrel 45 is 1¼ inches in diameter, the spikes 46 are 1½ inches long and are spaced 1 inch apart in eight rows, each row being a geometrical element of the mandrel. The spikes in adjacent rows are staggered with respect to each other. Thus, each row is like a coarse comb or rake. The rotor turns in the direction of the arrow 47, thus to move material to the left horizontally on the apron 35 of the hopper 10.

The apron 35 has a terminal edge 48 located to the left of the rotor axis 38 by a distance found experimentally best to be one-eighth the diameter of the rotor, or in other words, for the 4-inch diameter rotor described, a distance of ½ inch to the left of center. Thus, the teeth or spikes 46 move upwardly and away from this projecting edge of the apron 35 tending to leave a pile of material on the edge, which pile offers friction and opposes dripping of sawdust mix from the hopper when the rotor may be idle. The apron thus positioned prevents the rotor feeding forcefully in a downward direction.

The accumulation chamber 41 begins to function when a tray 12 starts through the device to be filled. Fig. 1 shows a tray 12 with its broad end wall 18 in position to function as a gate to close the downwardly facing open space between the edges 40 and 48. With the end wall 18 of the tray in this gate-closing position and with the rotor in operation, there is feed of material out of

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the hopper, and the material has no place to go except upwardly in the space between the baffle 39 and the rotor drum 45. Hence the material may move and pile up in this space 41 to the top of the brush, with material riding around with the brush should the gate remain closed. However, before the chamber 41 is so filled, normal operation calls for opening the gate by the tray-wall 18 moving away to present the tray bottom. At this opening of the gate the material may be at a level represented by the dotted line 50, for example.

The preliminary piling of material upwardly into the accumulation chamber is purposeful, and is related to the initial filling of the tray 12 behind the tray-wall 18 as the tray advances. Were the device operated to feed always at a fixed rate downwardly into the tray, the leading edge of the fill would be banked. This arises from the fact that the tray is moving in the direction opposite to the direction of feed into the tray, and because it takes a finite time for the sawdust to fall from the level of the apron 35 to the bottom of the tray, and the deeper the fill the longer the time. When the tray moves at a regular rate during this finite time, the leading edge of the fill would be banked and the tray not filled to the end wall. In compensation for this, the material is first made to pile up in the chamber 41 by closing the gate while operating the rotor, by suitable gate-closing means, preferably the wide leading end wall 18 of the tray. So as soon as the end wall 18 moves to open the gateway the surplus material in chamber 41 drops en masse. The position of baffle wall 39 is adjusted to predetermine the surplus available for the drop, as variably required, for example, by the depth of the charge to be produced. In dropping the surplus material in part at least passes downwardly through the upwardly moving rotor teeth. It is for this reason that spaces are provided between the teeth.

When the gate is fully opened, the rotor is preferably adjusted to feed out of the hopper at a rate greater than the rate of feed into the tray. This effects a second accumulation in chamber 41, so that in the event there should be a void pocket in the material within the rotor, there is material in chamber 41 to supply the deficiency. Consequently, there is normally an upwardly moving working level of sawdust mix in chamber 41 while filling the major portion of a tray, and the rotor teeth constantly emerge from below this working level. However, it is to be understood that this working level may not prevail horizontally to the side plates 42 of the hopper, and in fact, it is experienced that the level is higher in the center of the hopper than at the side plates. This is due to the fact that the added friction at the side plates 42 opposes the flow of material, and hence less material accumulates where the greater friction prevails.

The effect of friction at the side plates 42 may be minimized by making movable surfaces at this area. In Figs. 9 and 10 an optional device for this purpose is illustrated as a disk 51 carried by the rotor axis 38. The disk lies against the side plates, and is suitably provided with positive impelling areas to act on the adjacent portions of the mix. Such impellers are shown as blades 51a in radial planes, as a result of folding permitted by cuts into the disk from the periphery.

Fig. 8 is an endwise view of the apparatus shown in Fig. 1 looking to the left. It shows the relation of the side walls 16 and 17 of the tray 12

to the feeding device, and illustrates the mechanical operation of the moving parts. The rotor 32 is indicated as driven by a gear 52 under control of mechanism 53 through speed-ratio or like devices indicated by the dotted line 54. The dotted line 55 also indicates mechanism for controlling the rate of travel of the tray 12 past the feeding device.

It is to be understood that the invention is not limited to use of a tray. The tray is merely an example of a continuously moving conveyor which may be loaded over its major crosswise extent to a uniform depth. It is in part for purposes of economy that the conveyor is made as a tray with side walls to minimize forming selvedge edges on the resulting panel to be formed.

When a tray is used, the device may be operated intermittently in filling one tray at a time, as described. The end wall 18 of the tray acts to close and open the gateway. During the passage or the positioning of this end wall under the opening of the chamber 41, the rotor is operated to build up the shallow-depth column which is required for the initial drop. Fig. 5 shows the material 11^a falling from the feeding device into the tray 12 as the end wall 18 is moving out from under the opening. It is characteristically important that the continuously forming edge of the deposit is banked as shown. Fig. 6 shows the tray bottom 15 functioning as a continuous conveyor. The material 11^b already loaded on to the conveyor 15 is carried laterally as a continuous layer away from the feeding device. As it is withdrawn, more material 11^c drops down onto the newly exposed portions of the conveyor 15 as it advances. Fig. 7 shows a tray 12 with its trailing end wall 19 leaving the feeding device with the tray filled with material designated 11^b. End wall 19 prevents the feeding material flowing on to form a banked edge, and upward accumulation increases. When no tray follows, as indicated in Fig. 7, the accumulated material in the chamber 41, considering that the rotor 32 has stopped operation, will drop into the collector 22 for recirculation in the system.

When a sequence of trays is used in abutting relation, thin vertical end walls may be employed with no need for the function performed by closing the gate prior to the initial drop. Because there is always a tendency to build up an accumulation while each tray is being filled, there is always a surplus in the chamber 41 when thin vertical partitions between two adjacent trays pass under the gate. This partition obstructs the progress of the banked advancing edge of the fill. Without a surplus to drop into the next tray at the leading end, that end of the fill would be banked.

The tray may be moved in either direction under the hopper, but there is a special advantage in moving it in a direction opposing the direction of movement of the material on the apron 35. As described, the rotor pushes material substantially horizontally along and off the said apron against the moving piled material already placed in the tray. The stream leaving the apron acts as a scraper to level the charge, leaving a zone of physical clearance between the charge and the apparatus above it. There is no physical scraping means functioning in this manner of operation. But, were the direction reversed, the edge 40 of the baffle 39 would be the scraper.

It will therefore be appreciated that numerous changes and modifications are contemplated as

falling within the scope of the invention as expressed in the appended claims.

I claim:

1. The method of loading loose granular material at a uniform density, which comprises maintaining a shallow-depth laterally confined column of substantially dry granular material, agitating said column by plowing upwardly moving elements therethrough, feeding more such granular material in a loosened mass laterally into said column at a regular rate, locating below and spaced from said column a horizontally movable receiving member to be loaded with said material and arranged for travel horizontally under and past the bottom of said column, whereby material in the column flows as a loosened mass to said receiving member in continuation of said column, and moving said receiving member horizontally at a regular rate past said column to carry away as a continuous layer the material which flows thereon.

2. The method of loading loose granular material at a uniform density, which comprises maintaining a shallow-depth laterally confined column of substantially dry granular material, agitating said column by plowing upwardly moving elements therethrough, feeding more such granular material in a loosened mass substantially horizontally at a regular rate in one direction into the bottom of said column above a horizontally movable receiving member spaced below the bottom of said column to be loaded with said material and arranged for travel horizontally under and past the bottom of said column, whereby material in the column flows as a loosened mass to said receiving member in continuation of said column, and moving said receiving member horizontally and parallel to said infeding material at a regular rate past said column to carry away as a continuous layer the material which flows thereon.

3. The method of loading loose granular material at a uniform density, which comprises maintaining a shallow-depth laterally confined column of substantially dry granular material, agitating said column by plowing upwardly moving elements therethrough, feeding more such granular material in a loosened mass substantially horizontally in one direction at a regular rate into the bottom of said column above a horizontally movable receiving member spaced below the bottom of said column to be loaded with said material and arranged for travel horizontally under and past the bottom of said column, whereby material in the column flows as a mass to said receiving member in continuation of said column, and moving said receiving member horizontally in a direction opposite to said first-mentioned direction at a regular rate past said column to carry away as a continuous layer the material which flows thereon, whereby the infeding material effects a leveling of the top of said layer.

4. The method of loading loose granular material onto a relatively moving receiving member which comprises forming and maintaining above said member a column of said material, agitating said column by plowing upwardly moving elements therethrough whereby to minimize particle size separation of the material, continuously moving said member relatively past the bottom of said column at a predetermined location below the bottom of the column, whereby continuously to expose beneath said column empty space filled by material dropping from

the bottom of the column to be carried away by said member, and continuously feeding more such loose granular material laterally into said column at a rate at least equal to the rate at which material is removed from the column by said member whereby to maintain a minimum height for said column.

5. The method of loading loose granular material onto a relatively moving receiving member which comprises forming and maintaining above said member a column of said material, agitating said column by plowing upwardly moving elements therethrough whereby to minimize particle size separation of the material, continuously moving said member relatively past the bottom of said column at a predetermined location below the bottom of the column, whereby continuously to expose beneath said column empty space filled by material dropping from the bottom of the column to be carried away by said member, continuously feeding more such loose granular material horizontally into the bottom of the column at a rate at least equal to the rate at which the material is removed from the column by said member whereby to maintain said column.

6. The method of loading loose granular material onto a relatively moving receiving member which comprises forming and maintaining above said member a column of said material, agitating said column by plowing upwardly moving elements therethrough whereby to minimize particle size separation of the material, continuously moving said member horizontally in one direction relatively past the bottom of said column at a predetermined location below the bottom of the column, whereby continuously to expose beneath said column empty space filled by material dropping from the bottom of the column to be carried away by said member, continuously feeding more such loose granular material horizontally in the opposite direction into the bottom of the column at a rate at least equal to the rate at which the material is removed from the column by said member whereby to maintain said column, whereby the infedding material levels the material carried away by said member.

7. A loading device comprising an open-bottom hopper for containing a relatively shallow-depth column of loose granular material, feeding means arranged and operable so as continuously to introduce said material into said column below the top of the column, agitating elements arranged to plow upwardly within the column, a movable receiving member arranged for horizontal movement under and past said column at a level fixed below said column for receiving material falling masswise from said column, whereby material falling as a mass from said column forms a continuous layer on said receiving member as the latter moves, and means to move said receiving member and operate said feeding means in timed relation to maintain a minimum height for said column.

8. A loading device comprising an open-bottom hopper for containing a relatively shallow-depth column of loose granular material, feeding means arranged and operable so as continuously to introduce said material into the bottom of said column, agitating elements arranged to plow upwardly within the column, a movable receiving member arranged for horizontal movement under and past said column at a level fixed below said column for receiving material falling masswise from said column, whereby material falling

as a mass from said column forms a continuous layer on said receiving member as the latter moves, and means to move said receiving member and operate said feeding means in timed relation to maintain a minimum height for said column.

9. A loading device comprising an open-bottom hopper for containing a relatively shallow-depth column of loose granular material, feeding means arranged and operable so as continuously to introduce said material and horizontally in one direction into the bottom of said column, agitating elements arranged to plow upwardly within the column, a movable receiving member arranged for horizontal movement in the opposite of said direction under and past said column at a level fixed below said column for receiving material falling masswise from said column, whereby material falling as a mass from said column forms a layer on said receiving member as the latter moves, and means to move said receiving member and operate said feeding means in timed relation to maintain a minimum height for said column.

10. A loading device comprising an open-bottom hopper for containing a relatively shallow-depth column of substantially dry granular material, a container immediately adjacent to and laterally of said hopper for a supply of said material and opening into said hopper upwardly from the bottom of the hopper, a horizontal rotor located in the opening between said hopper and said container, said rotor having spaced teeth thereon arranged both to move and to slip through said granular material, the axis of said rotor being horizontal and lying substantially in the division line between said hopper and said container, whereby during rotation the teeth feed the material in bulk from the bottom of the container into the bottom of the hopper, then plow upwardly through the material in the hopper with agitation thereof, and carry material tending to accumulate above an equilibrium level back into the container, a movable receiving member arranged for horizontal movement past said column at a level fixed below the bottom thereof for receiving material falling masswise from the column, whereby material falling as a mass from said column forms a continuous layer on said receiving member as the latter moves, and means to move said member and operate said rotor in timed relation to maintain a minimum height for said column.

11. A loading device comprising an open-bottom hopper for containing a relatively shallow-depth column of substantially dry granular material, a container immediately adjacent to and laterally of said hopper for a supply of said material and opening into said hopper upwardly from the bottom of the hopper, a horizontal rotor located in the opening between said hopper and said container, said rotor having spaced teeth thereon arranged both to move and to slip through said granular material, the axis of said rotor being horizontal and lying substantially in the division line between said hopper and said container, whereby during rotation the teeth feed the material in bulk from the bottom of the container into the bottom of the hopper, then plow upwardly through the material in the hopper with agitation thereof, and carry material tending to accumulate above an equilibrium level back into the container, a movable receiving member arranged for horizontal movement in the opposite of said direction past said column at

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a level fixed below the bottom thereof for receiving material falling masswise from the column, whereby material falling as a mass forms a continuous layer on said receiving member as the latter moves, said layer being leveled off by the infeding material, and means to move said member and operate said rotor in timed relation to maintain said column.

12. A loading device comprising an open-bottom hopper for containing a relatively shallow-depth column of substantially dry granular material, a container immediately adjacent to and laterally of said hopper for a supply of said material and opening into said hopper upwardly from the bottom of the hopper, a horizontal rotor located in the opening between said hopper and said container, said rotor having spaced teeth thereon arranged both to move and to slip through said granular material, the axis of said rotor being horizontal and lying substantially in the division line between said hopper and said container, whereby during rotation the teeth feed the material in bulk from the bottom of the container into the bottom of the hopper, then plow upwardly through the material in the hopper with agitation thereof, and carry material tending to accumulate above an equilibrium level back into the container, a movable receiving member arranged for horizontal movement past said column at a level fixed below the bottom thereof for receiving material falling masswise from the column, whereby material falling as a mass from said column forms a continuous layer on said receiving member as the latter moves, means providing an elevated platform on said receiving member located to serve as a closure for the bottom of said hopper whereby to build higher

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the column as the platform passes the opening of the hopper, and means to move said member and operate said rotor in timed relation to maintain a minimum height for said column.

13. In a loading device, in combination an open-bottom hopper for containing a relatively shallow-depth column of substantially dry granular material, a container immediately adjacent to and laterally of said hopper for a supply of said material and opening into said hopper, a horizontal rotor located in the opening between said hopper and said container, said rotor having spaced teeth thereon arranged both to move and to slip through said granular material, the axis of said rotor being horizontal and lying substantially in the division line between said hopper and said container, whereby during rotation the teeth feed the material in bulk from the bottom of the container into the bottom of the hopper, then plow upwardly through the material in the hopper with agitation thereof, and carry material tending to accumulate above an equilibrium level back into the container, and means for removing material in said hopper from the bottom thereof at an average rate not greater than the rate of feed into said hopper.

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