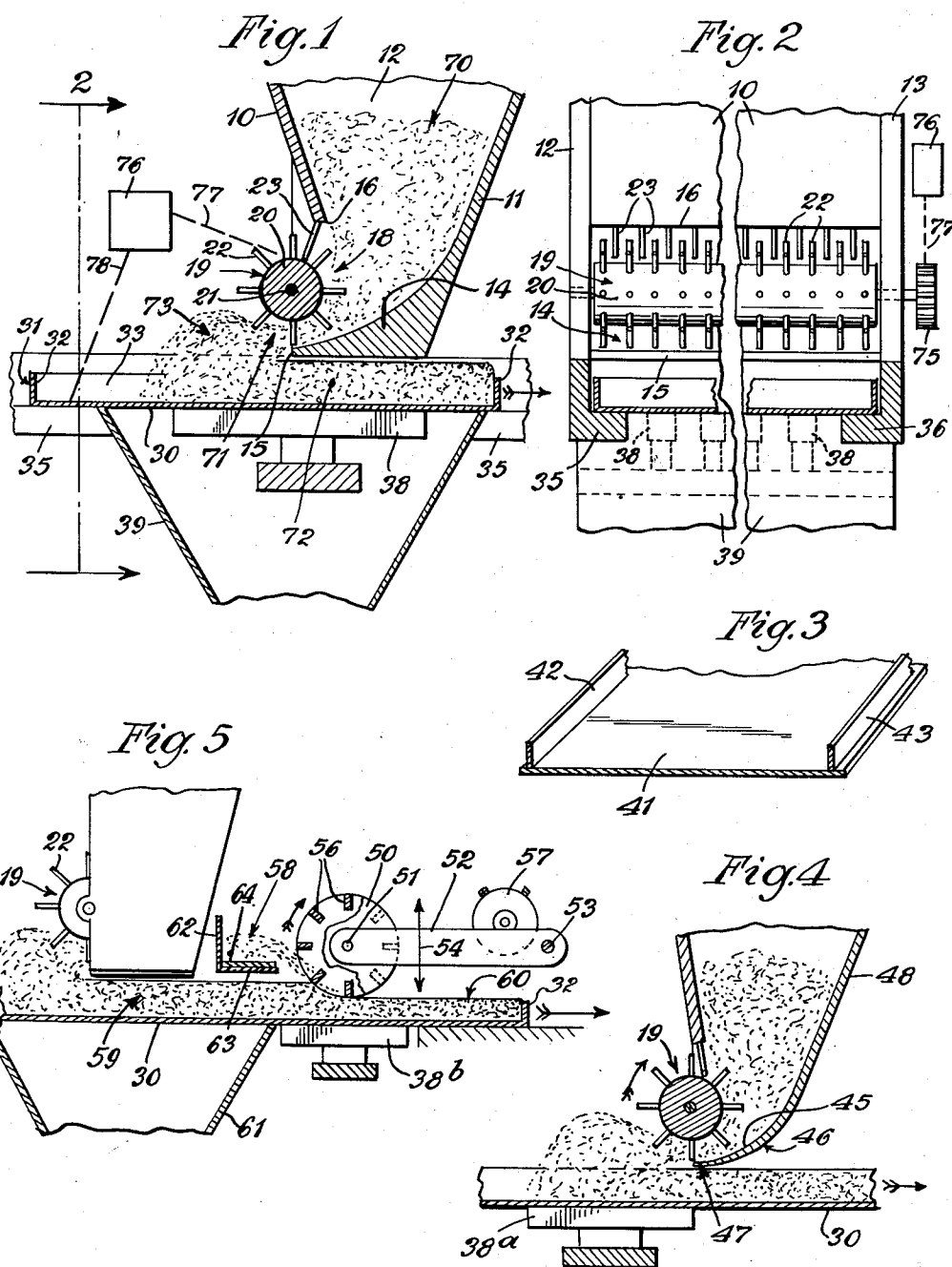


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LOADING APPARATUS AND METHOD

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LOADING APPARATUS AND METHOD

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The present invention relates generally to loading methods and apparatus for feeding dry loose granular material onto a carrier base as a uniformly dense homogeneous layer, and in particular it relates to the loading of material which has a wide range of particle sizes in a manner to minimize or prevent fractionation of the component particles.

The invention is applicable to a wide range of materials, but it has particular reference to feeding a mixture which is predominantly wood sawdust or mill waste into forms for molding to an integrated product such as a board-like panel characterized by uniformity in density and by homogeneity in substance. Hence, the invention will be explained with reference to its application in the field of making panel boards from dry mixtures chiefly of sawdust, and containing 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 a tray 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 may readily be 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 layer 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

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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 opportunity for falling and being simultaneously dispersed.

It is a particular object of the invention to provide a simple apparatus for loading a travelling carrier base to a uniform height with material at a uniform density.

It is also an object of the invention continuously to form a uniformly dense and homogeneously mixed layer of substantially dry granular material of varying particle size onto a moving carrier base by transfer from a hopper-like supply thereof in a manner to minimize size separation.

Various other and ancillary object 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 is a view of the apparatus of Fig. 1 looking to the right in Fig. 1 on the line 2—2.

Fig. 3 represents a continuous belt to be loaded from the hopper of Fig. 1.

Fig. 4 is a partial view showing a modified form of hopper bottom.

Fig. 5 shows a combination of a loading device on the order of Fig. 1 operating in combination with a leveling rotor.

It is to be understood that the invention is not limited to or by the exemplary forms 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 carrying out the invention the material may be loaded into a single tray, or into a series of spaced or abutting trays, or onto a continuously moving belt-like conveyer or carrier. Where the material is to be hot-molded directly on the loaded sheet, the latter may be a metal-bottomed tray with side walls, especially where such a tray is inserted in a platen press; or it may be an endless belt as of thin metal, where roll or other continuous processing equipment is involved. The loading device is useful in all such circumstances.

A characteristic of the present invention is that the material when loaded is in a loose form

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having substantially uniform density and homogeneity as to the distribution of its particle sizes, and additionally, is loaded to a uniform planar level. Where the carrier sheet at the region of loading is perfectly flat and parallel with the intended loaded level, the fill is of uniform depth. Such a loaded fill may be platen-pressed to produce a panel of uniform thickness and density, and of uniform quality from face to face. The height of the loaded level may be varied by mechanical adjustment of the parts, and operation thereof, within certain limits.

Loading at uniform density is of first importance, and in some ways, as later described, the final depth on the carrier may be made uniform by other means useful in conjunction with the loader of the present invention.

In Figs. 1 and 2 there is shown a hopper having a front wall 10, rear wall 11, side walls 12 and 13 and bottom 14. The bottom is provided with a relatively thin horizontal straight edge 15 over which material is fed outwardly and under which the loaded material moves away from the loading zone. The front wall 10 has a horizontal lower edge 16 located and spaced in the general region above straight edge 15, providing a rectangular lateral opening 18 for the hopper. In the opening 18 is located a horizontal rotor 19 having horizontal mandrel 20 on axis 21 and a cylindrical contour or face defined by the terminal ends of a series of teeth or spikes 22 preferably arranged on the mandrel like a plurality of rakes or combs. The teeth 22 are such in form and arrangement that they plow through the granular material and thereby agitate it when the material is not free to move, and so that they engage and move the material when its movement is not obstructed. Thus, the rotor breaks up and feeds loosened material laterally from the hopper off the bottom 14. The rotor 19 is set so that its cylindrical face is close to the straight edge 15, thus to feed what may be termed a sheet of the material from the bottom in a substantially horizontal direction and at a velocity determined by the speed of the rotor. With a full hopper the material is thus discharged in the form of a sheet as confined, but nevertheless as a loose mass. In the event that loose material may gradually accumulate and cake at the base of the teeth in the rotor, this result may be obviated by providing stationary teeth so arranged as to project into the face of the rotor 19 at locations to be cleared by the teeth 22 of the rotor. The bottom edge of the front wall is a convenient location on which to mount a series of comb-like teeth 23 projecting into the rotor to keep it clear of caked material.

The location horizontally of the straight edge 15 with reference to the rotor axis 21 is variable. It may be vertically under the axis in which case the discharged material at the edge 15 leaves in a horizontal direction and then tends to fall as a mass. The invention aims to use the force of the horizontal component of the discharging material as a kinetic doctor to level the load being carried away by the carrier sheet. Therefore, the load being formed is moved in a direction to oppose the material leaving the hopper. Hence, the force exerted for leveling is dependent upon both the velocity of discharge and the velocity of the movement of the carrier base with its load. Deviations from said vertical alinement of the edge 15 and axis 21 are obviously permissible so long as the function

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to level in operation is not lost. The limits are variable with variation in the speed of the rotor and of the load, as will be readily appreciated. By moving the edge 15 toward the rear wall 11 from said vertical alinement there is a tendency to introduce and increase the vertical component in the direction of discharge and to decrease the horizontal component used for leveling. A point will, therefore, be reached for given conditions of operation where the edge 15 or any lower portion of the bottom 14 will become a mechanical doctor, and thus disrupt and disturb the top layer with the possible results of leaving ripples, and of effecting fractionation in the topmost particles of the fill. The latter results because the large particles which project higher than adjacent smaller particles are pushed back in the leveling and thus possibly pushed down into the load with disturbance of uniformity of density and of distribution of particle sizes.

On the other hand, the edge 15 may be moved forwardly of the vertical line with the axis 21, without introducing any vertical component, but with loss of effective force in the horizontal component. The result will be that the material merely piles up ahead of edge 15, and at the limiting position the load is levelled by the edge 15. However, for simplifying the explanation of the present invention, the preferred location of the edge 15 is chosen as vertically under the axis 21 of the rotor.

The location of the edge 16 of the front wall 10 is subject to variation depending upon the character of the material, its tendency to flow, and hence its normal angle of repose, and also on the spacing, form and arrangement of the teeth 22, and of the teeth 23. Material entering the hopper should not flow over the top of axle 20 when the rotor is idle, and hence it will not do so when the rotor is turning clockwise in Fig. 1 in its normal feeding operation.

The hopper is so arranged that a carrier base may move under it in open space below the straight edge 15. The base may be a flat bottom 30 of a tray 31 having end walls 32 and side walls 33, these walls being at or below the level of the fill to be effected, and hence freely movable under the hopper. Suitable positioning supports for such a carrier base or tray are provided, as exemplified by the parts designated 35 and 36.

In the case of carrier bases, and especially trays of sheet steel in which the fill is hot-molded on a platen press, the repeated heating and cooling, and the handling, eventually produce deviations from a planar form variously called warping, buckling or bulging. When such a non-planar carrier sheet passes under the loader, its levelled load is not of uniform depth even though its density is uniform. To compress such a load to a uniform thickness creates non-uniformity of density in the molded panel. For hot-pressing to uniformly dense and thick panels, the fill must be brought to a condition of uniformity in mass per unit of area. This is best accomplished by affecting both uniformity in depth and uniformity in density.

One way to effect this ultimate result is to hold the carrier sheet in a plane as it passes through the loading zone and under the hopper bottom. In Fig. 1 wherein a magnetic bottom 30 is shown there are located a bank of permanent magnets 38 positioned to provide a planarizing platform and functioning to pull or push

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the passing sections of the magnetic sheet into a plane parallel with the front edge 15 of the hopper bottom. The magnets are preferably spaced and located in the opening of a collecting hopper 39. Where trays are used, the passage of the tail end of a lone tray, that is, one not followed by another tray in contact therewith, permits excess material to fall into the hopper for re-use. Where the carrier sheet is a continuous conveyer, the hopper 39 may be dispensed with.

Fig. 3 is a representation of a section of a continuous conveyer 41 comparable to tray bottom 30. Over its edges may be located vertical stretches 42 and 43 of two other endless belts forming load-retaining walls for the carrier sheet 41, comparable to tray side walls 33.

Fig. 4 is a modification of the bottom of the hopper. It shows a bottom 45 having an underside 46 upwardly inclined from the discharging lip or edge 47 to remove it from possible contact with the fill when the latter may rise after release of the bottom 30 from magnets 38^a. The upper face of the bottom 45 is shown with a structure curving into the interior face of the rear wall 48 of the hopper. Magnets 38^a are shown as having less extent in the direction of movement of the carrier, and hence are limited to functioning largely in the loading zone. The straight edge 47 of the bottom 45 is very thin in order to give full effect in doctoring the fill by the emerging stream of material. This construction gives more latitude in adjusting the relative speeds, and the speeds themselves, of the carrier sheet 30 and of the rotor 19.

Fig. 5 is a modified form in which the magnetic holding means 38 of Fig. 1 may be dispensed with advantageously at the loading zone. In the absence of the magnetic holds at the loading zone, a magnetic sheet carrier 30 may be unlevel and the fill on it be of various depths on the carrier base even though it may have a level top. Magnets 38^b are located to act on the carrier sheet 30 at a location beyond the loading zone, as shown, but under a leveling rotor 50, arranged to spin at a speed sufficiently high to kick off the particles in the top layer and thereby reduce the depth of fill to a new and lower level over a planarized bottom 30. The leveling rotor 50 is vertically adjustable, as for example, by being rigid with its horizontal axle 51 carried in a swinging frame of which an arm 52 is shown pivoted at 53. The two headed arrow 54 indicates the adjustability of the frame to raise and lower the striking level of the rotor 50. The rotor 50 has a cylindrical face or contour formed by and comprised of spaced striking bars, preferably arranged as geometrical elements of the cylinder. These are represented as rectangular steel bars or strips 56 circumferentially disposed in spaced relation around the face of the cylinder. Any suitable driving means may be used, such as motor 57, mounted on the frame having arm 52 to spin the rotor 50 in a direction to lift the material from the fill as a spray of granules generally indicated at 58. The rotor is illustrated as turning in a direction to kick the material in the direction toward the load 59 approaching the leveling rotor. This load is reduced in level to the line 60.

The material removed by the rotor may be collected by suitable means. When the rotor kicks material in a direction to fall onto the oncoming load, it should be collected when the carrier sheet 30 is a continuous one, but it need not be collected where the carrier sheet is a

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spaced succession of trays. In the latter case, accumulated material drops between trays into a saving hopper 61. Collection of kicked material 58 may be accomplished by providing a collecting trough in which there is a moving conveyer such as a worm screw or a traveling belt. As shown a trough is formed by vertical wall 62 and horizontal shelf 63, on which moves a flat stretch 64 of an endless belt. The latter discharges the collected material beyond the confines of the apparatus illustrated.

The arrangement of Fig. 5 is advantageous in more exactly fixing the final depth of the fill. For molded panels of different thicknesses produced from fills made by the apparatus of Fig. 1, it is necessary to vary the depth of fill by moving the hopper vertically relative to the carrier sheet 30. In large equipment this is clumsy and over-all accuracy is threatened by sagging or warping of a long span of the hopper bottom 14, and by inequality in the vertical adjustments of one side wall of the hopper relative to the other. On the other hand the leveling rotor 50 may be far more accurately positioned over its full length. In using the combination of loader and leveler as shown in Fig. 5, the loading rotor 19 may be operated in a hopper positioned to over-fill the tray or carrier, and the leveling rotor 50 may be used to remove the excess.

The successful operation of the present invention depends upon relating certain dimensions and speeds, to secure the desired kinetic doctoring. This is best explained by reference to Fig. 1. The material 70 is fed from the hopper 10 over the edge 15, as shown at 71. The density of the material 71 is substantially the same as the density of the material carried away by the sheet carrier 30 or tray. Hence, the material may be considered, in terms of units of volume. If the distance from the lower face of mandrel 20 to the edge 15 of the hopper bottom is the same as a uniform depth of fill 72, the speed of the rotor must be (a) just sufficient to feed out all that is carried away, or (b) the speed must be even greater to feed more than is carried away. In case (a) the conditions require an out-feeding layer in one direction moving at the same linear velocity as the layer carried away as a fill. This is equivalent to bending the out-fed layer (considered as a mass) around the edge 15. The result is no kinetic doctoring. In case (b) the out-fed layer moves faster than the tray, with kinetic doctoring, but with a surplus accumulating faster in proportion to the increase of the differential of linear velocity of out-feed over the velocity of fill removal. To secure the benefit of the speed differential for kinetic doctoring, with accompanying minimizing of accumulation of surplus, the vertical dimension of the out-feed orifice from the mandrel 20 to the bottom, or the edge 15 in Fig. 1, is made less than the thickness of fill carried away. Thus, the two conditions are the out-feed of a layer of less thickness than the load carried away, and an out-feed velocity greater than the velocity of the loaded carrier base. These factors may be relatively adjusted to feed out as much as is carried away or to control the rate of accumulation of surplus.

Since the rotor slips through the material as well as feeds material, it follows that the peripheral speed of the rotor is somewhat greater than the linear speed of the out-fed layer.

In actual practice excellent results have been obtained using a mandrel and apron so spaced as to form an out-feeding layer one and one-

quarter inches thick, to provide fills varying from one and one-half to two and one-half inches thick. The velocities are regulated to provide a hump as described but to minimize accumulation and excessive growth of the hump.

In operation as described with reference to Fig. 1, the hopper is maintained well supplied with granular material 70, such as a mixture of comminuted wood, preferably sawdust, and a thermosetting resin powder. The latter may be used in proportion from 4 to 25 parts by weight to 100 parts of wood (oven-dry basis). The moisture content of the sawdust or mixture should be uniform for uniformity of panels, but it may vary over a wide range, preferably being dry at around 10% to 20% by weight. Higher and lower moisture contents are permissible. The distance between the mandrel 20 and the top of edge 15 is less than the distance from the top of sheet 30 to the underside of the hopper. Rotor 20 feeds material 70 out of the hopper along its floor 14 and generally horizontally as shown at 71 off the straight edge 15. The speed of rotor 20 moves the material out of the hopper as a layer or stream 71 moving at a velocity greater than the velocity of the sheet 30, all relative to the hopper, whereby the stream at 71 acts as a kinetic doctor to level the load 72 already deposited. The teeth 22 break and loosen the material 70 where it may tend to cake in the hopper and that which is fed out is loosened and of constant density, of course where the character of the mixture remains constant. The stream at 71 moves as a granular mass and then falls or moves by gravity without fractionation. Preferably, more material is fed out by the rotor than is taken away as load 72. The result is to form a growing hump 73 of excess material to and under which the bare carrier sheet 30 moves as it is loaded by the hump. Then the kinetic doctor 71 levels off the load as it passes under the hopper bottom. The speed of the rotor may be regulated so as to minimize or even prevent the accumulation of excess, but it is preferably operated so that the hump grows only slightly as an assurance against some temporary reduction in the out-feed. Numeral 76 (Figs. 1 and 2) represents control means to rotate the rotor 19 and means to move the carrier base 30 in timed relation to the speed of the rotor, the controls being indicated by dotted lines 77 and 78, all for the reasons and purposes described.

When spaced trays are used, the passing of the trailing tray end lets the material of hump 73 fall into hopper 38. To initiate the filling of a tray, its leading end is arrested at the loading zone until a sizeable hump 73 is formed, and then the tray is allowed to move in timed relation to the speed of the rotor 19 so that the hump is maintained, and preferably grows for assurance. The excess material in the hump 73 is a reserve supply in the event of an air pocket or other inequality of out-feed over straight edge 15.

Where a continuously moving endless carrier base 30 is used, the size of the hump 73 may be controlled by changing the relative speeds of the rotor and of the carrier base 30, or by keeping these unchanged and changing the vertical separation of the carrier base 30 and the hopper, within the limits described, however. The latter method is a practical control where the leveling rotor of Fig. 5 is used for effecting the final depth of fill.

It is to be understood that the expressions "continuously loading" and "continuously mov-

ing" as used herein and in the claims comprehend the action taking place between the starting and stopping of the base being loaded, whether it be an endless carrier base or an elongated rigid tray, as shown and described. Inasmuch as there is a controlled relation between the velocity of the carrier base in one direction and the velocity of the out-fed stream in the opposite direction, continuous motion at such related velocities is in order, as against, for example, a series of short advances and momentary halts.

From the foregoing it will be appreciated that various changes and modifications may be made without departing from the spirit and scope of the invention as expressed in the appended claims.

I claim:

1. The method of continuously loading a moving carrier base to a predetermined height with granular material which comprises continuously moving a uniformly thick layer of granular material at a feeding velocity in a generally horizontal direction from a region above a fixed horizontal plane, continuously moving a carrier base to be loaded in said plane at a lower velocity in a direction opposed to the moving material whereby the fed material gravitates as a mass to said base, the distance from said plane to the bottom of said layer being predeterminedly greater than the thickness of said layer, and relating the feeding velocity of said layer to the velocity of movement of said base so as to form and maintain a ridge of material on the moving base at least as high as the bottom of said layer, whereby the force of the moving material at the bottom of said layer functions mechanically as a doctor to level the material being carried away from said ridge by said carrier base, the said greater distance being such that the resulting doctored fill carried away on said base has a thickness in the range from at least as thick as to thicker than the thickness of the said layer.

2. The method of continuously loading a moving carrier base to a predetermined height with granular material which comprises maintaining a supply of such material, continuously moving a uniformly thick layer of granular material at a feeding velocity in a generally horizontal direction from the bottom of said supply at a region above a fixed horizontal plane, continuously moving a carrier base to be loaded in said plane at a lower velocity in a direction opposed to the moving material whereby the fed material gravitates as a mass to said base, the distance from said plane to the bottom of said layer being predeterminedly greater than the thickness of said layer, and relating the feeding velocity of said layer to the velocity of movement of said base so as to form and maintain a ridge of material on the moving base at least as high as the bottom of said layer, whereby the force of the moving material at the bottom of said layer functions mechanically as a doctor to level the material being carried away from said ridge by said carrier base, the said greater distance being such that the resulting doctored fill carried away on said base has a thickness in the range from at least as thick as to thicker than the thickness of the said layer.

3. The method of continuously loading a moving carrier base to a predetermined height with granular material which comprises continuously moving a uniformly thick layer of granular material at a feeding velocity in a generally hori-

zontal direction from a region above a fixed horizontal plane, continuously moving a carrier base to be loaded in said plane at a lower velocity in a direction opposed to the moving material whereby the fed material gravitates as a mass to said base, the distance from said plane to the bottom of said layer being predeterminedly greater than the thickness of said layer, relating the feeding velocity of said layer to the velocity of movement of said base so as to form and maintain a ridge of material on the moving base at least as high as the bottom of said layer, whereby the force of the moving material at the bottom of said layer functions mechanically as a doctor to level the material being carried away from said ridge by said carrier base, the said greater distance being such that the resulting doctored fill carried away on said base has a thickness in the range from at least as thick as to thicker than the thickness of said layer, said carrier base being flexible and subject to deviation from a plane, planarizing the base carrying the resulting load, and skimming off to a plane face the topmost particles of the load over the planarized base.

4. The method of continuously loading a moving carrier base to a predetermined height with granular material which comprises maintaining a supply of such material, continuously moving a uniformly thick layer of granular material at a feeding velocity in a generally horizontal direction from the bottom of said supply at a region above a fixed horizontal plane, continuously moving a carrier base to be loaded in said plane at a lower velocity in a direction opposed to the moving material whereby the fed material gravitates as a mass to said base, the distance from said plane to the bottom of said layer being predeterminedly greater than the thickness of said layer, relating the feeding velocity of said layer to the velocity of movement of said base so as to form and maintain a ridge of material on the moving base at least as high as the bottom of said layer, whereby the force of the moving material at the bottom of said layer functions mechanically as a doctor to level the material being carried away from said ridge by said carrier base, the said greater distance being such that the resulting doctored fill carried away on said base has a thickness in the range from at least as thick as to thicker than the thickness of the said layer, said carrier base being flexible and subject to deviation from a plane, planarizing the base carrying the resulting load, and skimming off to a plane face the topmost particles of the load over the planarized base.

5. The method of continuously loading a moving carrier base to a predetermined height with granular material which comprises continuously moving a uniformly thick layer of granular material at a feeding velocity in a generally horizontal direction from a region above a fixed horizontal plane, continuously moving a carrier base to be loaded in said plane at a lower velocity in a direction opposed to the moving material whereby the fed material gravitates as a mass to said base, the distance from said plane to the bottom of said layer being predeterminedly greater than the thickness of said layer, relating the feeding velocity of said layer to the velocity of movement of said base to form and maintain a ridge of material on the moving base at least as high as the bottom of said layer, whereby the force of the moving material at the bottom of said layer functions mechanically as

a doctor to level the material being carried away from said ridge by said carrier base, the said greater distance being such that the resulting doctored fill carried away on said base has a thickness in the range from at least as thick as to thicker than the thickness of said layer, said carrier base being flexible and subject to deviation from a plane, and planarizing the carrier base at the region of said doctoring, whereby the doctored level is parallel to the planarized base at a predetermined height thereon.

6. The method of continuously loading a moving carrier base to a predetermined height with granular material which comprises maintaining a supply of such material, continuously moving a uniformly thick layer of granular material at a feeding velocity in a generally horizontal direction from the bottom of said supply at a region above a fixed horizontal plane, continuously moving a carrier base to be loaded in said plane at a lower velocity in a direction opposed to the moving material whereby the fed material gravitates as a mass to said base, the distance from said plane to the bottom of said layer being predeterminedly greater than the thickness of said layer, relating the feeding velocity of said layer to the velocity of movement of said base to form and maintain a ridge of material on the moving base at least as high as the bottom of the said layer, whereby the force of the moving material at the bottom of said layer functions mechanically as a doctor to level the material being carried away from said ridge by said carrier base, the said greater distance being such that the resulting doctored fill carried away on said base has a thickness in the range from at least as thick as to thicker than the thickness of said layer, said carrier base being flexible and subject to deviation from a plane, and planarizing the carrier base at the region of said doctoring, whereby the doctored level is parallel to the planarized base at a predetermined height thereon.

7. Apparatus comprising a hopper having a lateral opening at the bottom of its front wall, said opening being defined at the bottom by a straight edge at the bottom of the hopper, a horizontal cylindrical rotor mounted in said opening with its face close to said straight edge, said rotor having an inner mandrel and spaced teeth projecting from said mandrel, the ends of said teeth defining the cylindrical face of the rotor, means to turn the rotor to feed material at a feeding velocity out of the hopper as a layer in a substantially horizontal direction off said straight edge, means providing a support for moving a carrier base at a level spaced below said hopper and horizontally in a direction opposed to material fed from the hopper by the rotor, and means to move said carrier base at a lower velocity whereby to form and maintain a ridge of out-fed material on said base forward of the hopper, whereby said base carries a depth of fill away from said ridge, the distance from said mandrel above the edge of the bottom opening being such as to provide an out-feeding layer thinner than the depth of said fill, whereby the force of moving material in the bottom of said out-feeding layer functions mechanically to doctor the fill to a uniform level.

8. Apparatus comprising a hopper having a lateral opening at the bottom of its front wall, said opening being defined at the bottom by a straight edge at the bottom of the hopper, a horizontal cylindrical rotor mounted in said open-

ing with its face close to said straight edge, said rotor having an inner mandrel and spaced teeth projecting from said mandrel, the ends of said teeth defining the cylindrical face of the rotor, means to turn the rotor to feed material at a feeding velocity out of the hopper as a layer in a substantially horizontal direction off said straight edge, means providing a support for moving a magnetic sheet carrier base at a level spaced below said hopper and horizontally in a direction opposed to material fed from the hopper by the rotor, magnetic means arranged to provide a planarizing platform at said level and under the hopper for a said magnetic sheet carrier base, and means to move said carrier base at a lower velocity whereby to form and maintain a ridge of out-fed material on said base forward of the hopper, whereby said base carries a depth of fill away from said ridge, the distance from said mandrel above the edge of the bottom opening being such as to provide an out-feeding layer thinner than the depth of said fill, whereby the force of moving material in the bottom of said out-feeding layer functions mechanically to doctor the fill to a uniform level.

9. Apparatus for filling a sequence of trays comprising a hopper having a lateral opening at the bottom of its front wall, said opening being defined at the bottom by a straight edge at the bottom of the hopper, a horizontal cylindrical rotor mounted in said opening with its face close to said straight edge, said rotor having an inner mandrel and spaced teeth projecting from said mandrel, the ends of said teeth defining the cylindrical face of the rotor, means to turn the rotor to feed material at a feeding velocity out of the hopper as a layer in a substantially horizontal direction off said straight edge, means providing a support for moving a tray at a level spaced below said hopper and horizontally in a direction opposed to material fed from the hopper by the rotor, means to move said tray at a lower velocity whereby to form and maintain a ridge of out-fed material on said tray forward of the hopper, whereby said tray carries a depth of fill away from said ridge, the distance from said mandrel above the edge of the bottom opening being such as to provide an out-feeding layer thinner than the depth of said fill, whereby the force of moving material in the bottom of said out-feeding layer functions mechanically to doctor the fill to a uniform level, and a hopper below said level opening under the location of said ridge to receive the material of the ridge on passage of a lone tray under the hopper.

10. Apparatus for filling a sequence of trays having a magnetic sheet bottom, comprising a hopper having a lateral opening at the bottom of its front wall, said opening being defined at

the bottom by a straight edge at the bottom of the hopper, a horizontal cylindrical rotor mounted in said opening with its face close to said straight edge, said rotor having an inner mandrel and spaced teeth projecting from said mandrel, the ends of said teeth defining the cylindrical face of the rotor, means to turn the rotor to feed material at a feeding velocity out of the hopper and as a layer in a substantially horizontal direction off said straight edge, means providing a support for moving such a tray at a level spaced below said hopper and horizontally in a direction opposed to material fed from the hopper by the rotor, spaced magnetic means arranged to provide a planarizing platform at said level and under the hopper for the magnetic bottom of a tray, means to move such a tray at lower velocity whereby to form and maintain a ridge of out-fed material on said tray forward of the hopper, whereby said tray carries a depth of fill away from said ridge, the distance from said mandrel above the edge of the bottom opening being such as to provide an out-feeding layer thinner than the depth of said fill, whereby the force of moving material in the bottom of said out-feeding layer functions mechanically to doctor the fill to a uniform level, and a hopper below said level opening under the location of said ridge to receive the material of the ridge on passage of a lone tray under the hopper, the opening of the hopper containing said spaced magnetic means.

11. The method of loading a moving carrier to a doctored level with flowable material, which comprises moving the carrier horizontally in one direction, feeding over and onto the carrier in a substantially horizontal direction a relatively thin layer of the material at a velocity in the feeding direction greater than the velocity of the carrier in the opposite direction, the location of the carrier below said feeding layer being such as to carry material away in quantity varying in the range from less than to as much as the quantity of material being fed as said layer, whereby the bottom of said layer functions as a mechanical doctor to level the material carried away by said carrier, and any excess of feed material accumulates on said carrier ahead of the out-feeding layer.

FREDERICK WEYERHAEUSER.

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