

Dec. 15, 1942.

E. E. HARPER

2,305,350

METERING AND FEEDING MECHANISM FOR DRY MATERIALS

Filed April 13, 1940

2 Sheets-Sheet 1

Fig. 2.

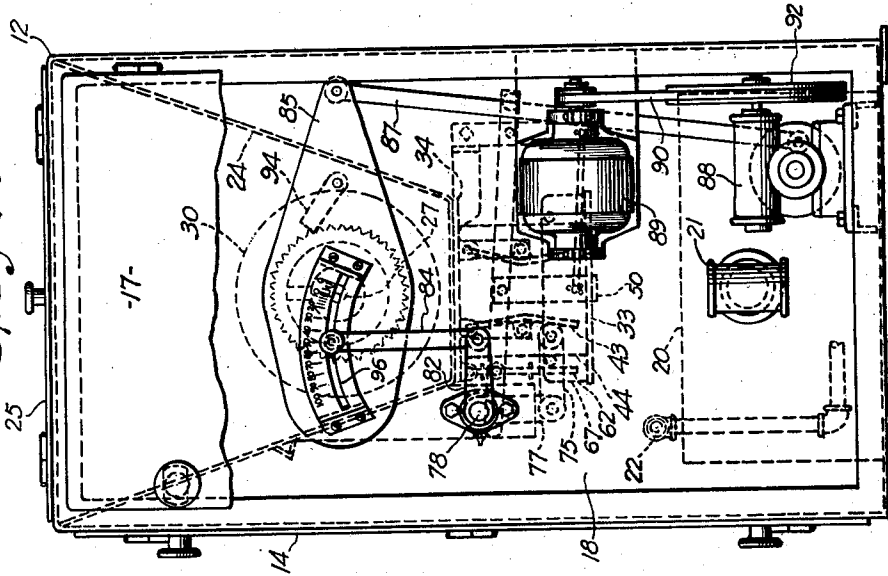
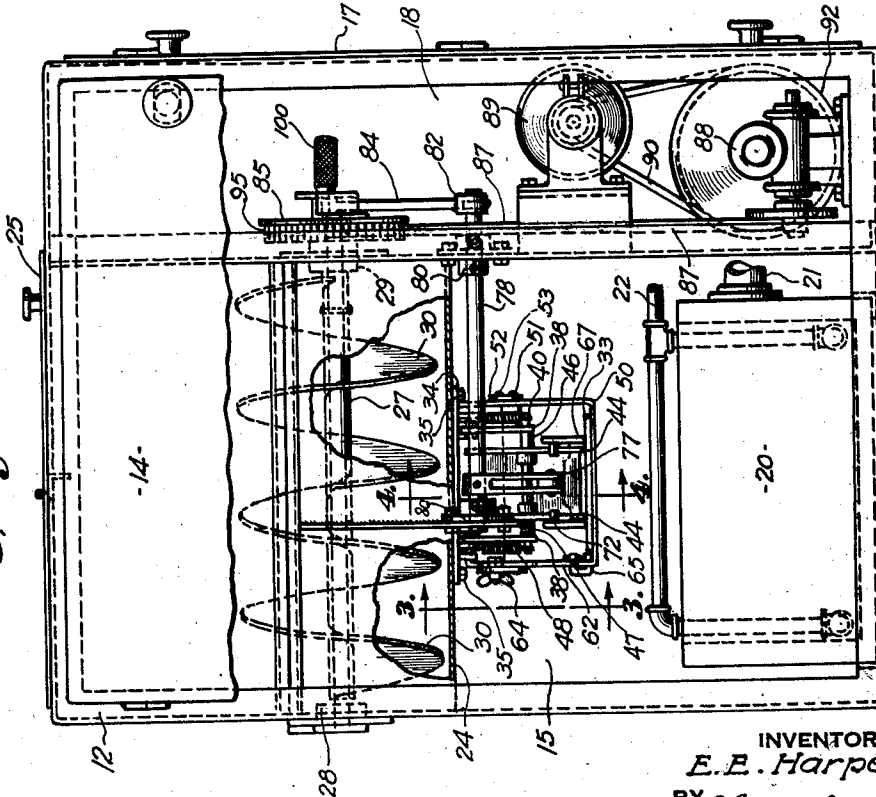


Fig. 1.



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2 Sheets-Sheet 2

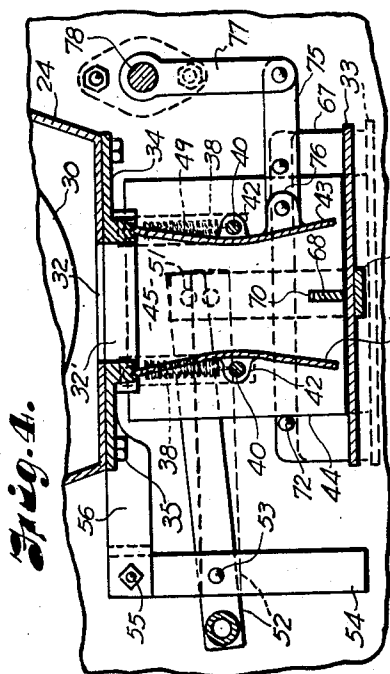


Fig. 4.

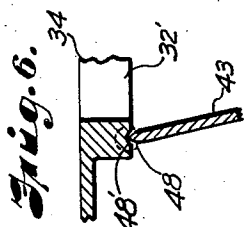


Fig. 6.

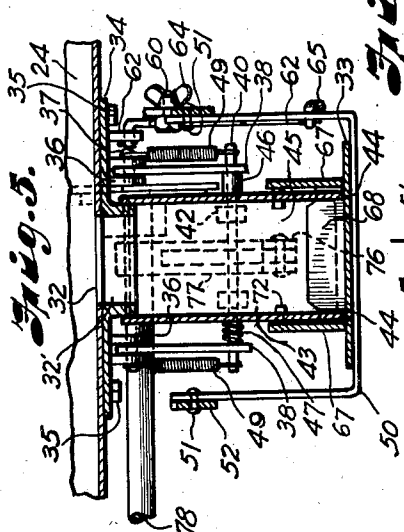


Fig. 5.

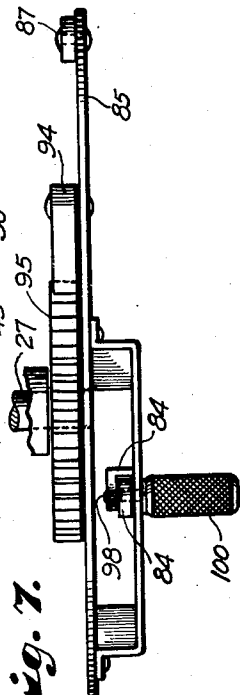


Fig. 7.

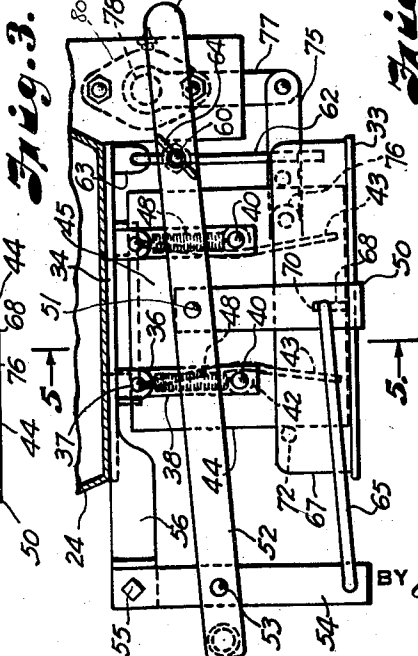


Fig. 3.

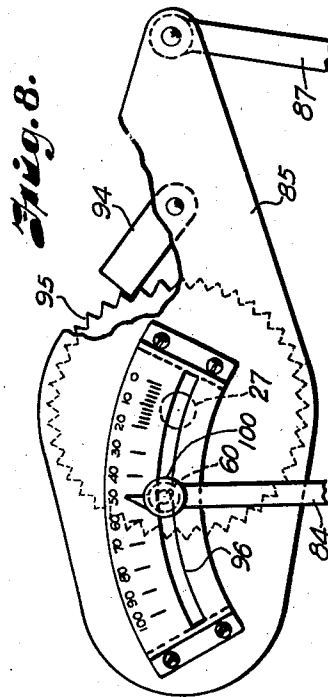


Fig. 8.

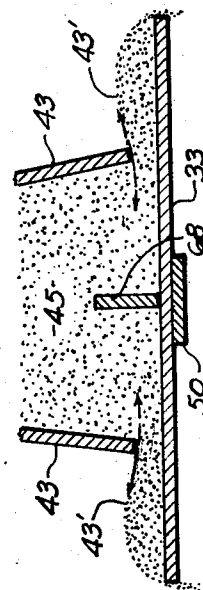


Fig. 9.

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METERING AND FEEDING MECHANISM FOR DRY MATERIALS

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11 Claims. (Cl. 221-118)

This invention relates to apparatus designed for operation in the metering and feeding of dry pulverized or granular materials, such as dry chemicals required for water-treating purposes, as in softening and purifying operations.

Accordingly, one of the objects in view is to provide improved apparatus which is adapted to maintain a supply of the material in an efficiently agitated state for feeding purposes, and which is provided with metering and feeding means of an improved construction especially adapted for effectively feeding materials of the character stated and including materials having fluffy characteristics, such as kieselguhr and the like.

Accordingly, I have devised improved apparatus comprising a storage or supply compartment for the dry material and having an outlet passage with which is associated the improved metering and feeding appliance into which the material settles by gravity, and in which the operation of the feeding appliance imparts a feeding motion adapted to effect proper settling of the material into a mass of uniform density, as well as an even and uniform rate of delivery or discharge of the material from the appliance.

One method of accomplishing this result, as herein shown, is by means of a sidewise feeding motion, transverse to the direction of the feed flow, which operates to produce a combined settling action of the material and also an intermittent discharge of the material, in substantially equal amounts or discharge increments of a uniform, homogeneous character.

The method of mounting and operating the feeding appliance is furthermore designed not only to effect proper agitation of the material within the appliance itself, but also to cooperate with appropriate agitating means within the supply compartment in maintaining an agitated state of the material throughout the discharge flow thereof from points well within the said compartment and on down to the final points of discharge.

Other features of improvement and advantage will be found to characterize the improved machine, as referred to hereinafter.

In the drawings:

Figure 1 is a front elevation showing a complete apparatus embodying feeding means constructed in accordance with the invention, a portion of the cabinet being broken away to disclose the interior mechanism;

Figure 2 is an end elevation of the apparatus, also having a part of the cabinet broken away;

Figures 3 and 4 are enlarged detail sectional

views of the feeding unit or assembly, representing sections taken on the lines 3-3 and 4-4, respectively, of Figure 1;

Figure 5 is a detail sectional view of said feeding unit or assembly, representing a section taken on the line 5-5 of Figure 3;

Figure 6 is an enlarged sectional detail view, showing the fulcrum arrangement of one of the oscillatory plates of the feed mechanism;

Figure 7 is an enlarged plan view of the adjusting means for the drive connections to the feeding mechanisms;

Figure 8 is a side view thereof, with a portion of the main oscillating drive member partly broken away; and

Figure 9 is an enlarged sectional detail view of a portion of the feeding device, representing the path or flow of material in the feeding action.

Among the materials which are required to be fed in a measured even flow, in material feeding operations for which the present improvements are designed, are such materials as carbon, hydrated lime, kieselguhr, etc., which possess more or less fluffy characteristics, and hence have clinging properties that render it difficult to produce anything like a flowing consistency of the material. Accordingly, it proves necessary not only to maintain an effective stirring or agitating action throughout the discharge zone of the material, but also a dividing or separating treatment of the mass at the discharge points, to the end of producing discharge increments at a uniform and even rate, for effecting as nearly as possible a uniform rate of discharge for the purpose in view. Having these objects in mind I have devised apparatus especially well adapted for efficient operation in the feeding of materials presenting these difficulties, as well as other more freely-flowing granular materials.

Referring to the drawings in detail, and more particularly to Figures 1 and 2, these illustrate the apparatus as adapted to be enclosed within a suitable cabinet structure 12, including a door 14 affording access to a compartment 15 enclosing the improved feeding mechanism, and also a door 17 to a smaller compartment 18 for the drive assembly and adjusting means therefor.

In the base of the compartment 15 are located the usual mixing chamber 20 and its connections, such as the outlet 21 and water-feed pipe 22 for the mixing jets or sprays.

Above the mixing chamber, or in the upper portion of the compartment 15, is located a trough-shaped hopper 24 for receiving a supply of the material to be fed into the mixing cham-

ber, a top door or cover 25 providing access to the interior of said hopper.

Mounted symmetrically and longitudinally of the hopper chamber is a horizontal shaft 27 journaled in bearings 28 and 29 at opposite ends of said chamber and provided with two opposed helical ribbon agitating devices 30, the relation of these devices being such as to maintain constant agitation of the material within the hopper and also to urge said material from both ends and toward the middle of the hopper (see Figure 1) where an opening 32 (Figure 4) is provided in the bottom of the hopper for passage of the material into the improved feeding device, now to be described.

Referring now more particularly to Figures 3, 4 and 5, the feeding mechanism comprises what may be termed a spout assembly operating in conjunction with a horizontally fixed, but adjustable plate or tray 33, in position for intercepting and temporarily supporting the material after passing through said spout assembly.

This assembly is made up of a plate 34 suitably secured, as by bolts 35, to the base of the hopper 24, and having an opening 32' registering with the hopper outlet 32 (Figures 4 and 5). The bottom face of this plate 34 is formed with sets of lugs 36 for mounting pins 37 for pivotally suspending a set of parallel-motion links 38, the lower ends of which are pivotally connected with the ends of rods 40 (Figure 5) extending through lugs 42 upon the outer faces of a pair of oscillating plates 43 and also through a pair of vertical plates 44 engaging the side edges of the plates 43, and forming therewith a spout or feed passage 45 between the opening 32' and the plate 33. Spacing collars 46 and coil springs 47 are interposed between the links 38 and plates 44 for maintaining the latter in continuous engagement with the sides of the plates 43 (see Figure 5).

The upper edges of the plates 43 are beveled, as indicated at 48, to provide knife-edge bearings within suitable grooves 48' (see Figure 6) at opposite sides of the opening 32'; and coil springs 49 may also be provided, connecting the pins 37 and the ends of the rods 40, with sufficient play allowed between the latter and the links 38 to maintain continuous fulcruming engagement of the upper edges of the plates 43 within the grooves 48'.

The plates 43 are shaped to produce a throat or spout passage 45 having a constricted portion about midway of said passage, as clearly represented in Figure 4, although these plates may be of any design for varying the contour of the feed passage according to the particular conditions as to material or operation.

The plate 33 is mounted within a yoke 50, the ends of which are pivotally connected, at 51, to the arms of a U-shaped lever 52, the sides of which are pivoted, at 53, to a pair of upright frame pieces 54 rigidly secured at 55 to a pair of arms 56 formed as projections from the plate 34 (see Figure 4). One arm of the lever frame 52 is extended to provide an operating handle portion 58 which is fitted with a bolt 60 having a sliding connection with a rod or link 62 pivotally suspended from a lug 63 on the under face of the plate 34, said bolt 60 also having a clamp nut 64 to secure the lever 52 in any adjusted position. To retain the plate 33 in continuously horizontal position, a parallel-motion link 65 is provided, connecting the yoke 50 with one of the upright pieces 54.

Obviously by adjustment of the lever 52 the plate or tray member 33 may be set at different elevations with relation to the lower end of the spout assembly, for varying the outlet space beneath the lower edges of the plates 43 and thus varying the rate of feed of the material. In order, however, to maintain the sides of the spout passage closed, an automatically adjustable shoe is provided, comprising side plates 67 supported on the upper face of the plate 33 and connected by a cross-bar 68 fitting in vertical slots 70 in the lower edges of the plates 44; in addition, the plates 67 are also provided with pins 72 which slidably engage the front and rear edges of said plates 44, whereby the plates 67 are slidably actuated by the movement of the spout assembly while resting upon the upper face of the plate 33.

Oscillating motion is imparted to the spout assembly by means of a connecting rod 75 pivoted to a lug 76 on the outer face of one of the plates 43 (Figure 4) and also pivotally connected with one end of a crank arm 77 which is attached to a transverse shaft 78 (Figures 1 and 2). This shaft is journaled in bearings 80 and carries another crank arm 82 (in the compartment 18) to which arm 82 is connected a link 84 adapted to make adjustable operating connection with a rocker frame 85 which is axially mounted on one end of the agitator shaft 27.

The rocker frame 85 is oscillated by a drive consisting of a connecting rod 87 actuated from a speed changer unit 88, which in turn is driven from a suitable motor 89 from which a belt 90 is trained over a pulley 92 to drive the unit 88.

The rocker member 85 carries a pawl 94 for engaging a ratchet wheel 95 secured to the shaft 27, whereby the latter is intermittently actuated for operating said shaft and the agitating means within the hopper chamber 24. This rocker member is also provided with an arcuate slot 96 which is suitably graduated, as indicated in Figures 2 and 8, as a guide for the adjustment of the link connection 84, the upper end of which is provided with a pin or bolt 98 and clamping handle element 100 for securing said connection at any desired point along said slot 96, thereby correspondingly adjusting the reciprocating drive action to the spout assembly and hence the extent of movement imparted thereto.

For any given size of hopper and rate of drive from the motor, the feeding action may also be varied by adjustment of the plate or tray member 33 by means of the handle extension 58 to secure the proper elevation of this tray member with reference to the lower edges of the plates 43, i. e., to obtain the desired size of feed apertures between said plates and the tray 33, and this adjustment is secured by tightening of the nut 64 to clamp the lever frame 52 to the rod or link 62.

The design of hopper 24 is that best adapted to provide a maximum capacity in a minimum of space, and having vertical ends to prevent clinging of the material thereto, and sides of sufficiently steep slope to direct the material to the operating zone of the agitating device. The type of agitating means shown effects movement from both ends of the hopper toward the middle, so that the material is continuously fed into the space over the feed spout, and the thrusts thus produced by the agitating means upon the material are thereby balanced. Any form or shape of hopper, as well as specific type of agitating devices, may of course be used insofar as the improved action of the metering and feeding means is concerned. Naturally, also the provision for

any agitating means may not be necessary in the feeding of some free-flowing granular materials.

At the start of the feeding operation, the space 45 within the feed hopper is filled, the material therein being supported by the tray 33. The spout movement produces a wiping action of the material within the spout (at the level of the lower edges of the plates 43) upon the material supported by the tray 33, resulting in some material being discharged from the spout beneath the edge of one of the plates 43 at the end of each stroke of the spout. At the same time each stroke of the spout produces some agitation of the material therein, and hence the combined action of the spiral agitating means and the motion of the spout results in complete agitation of the material from points well up within the hopper and continuously on down to the discharge points of the spout.

Referring to Figure 9, it will be noted that the material passing through the spout is supported by the tray 33, and the reciprocation of the spout, moving its lower edges through the paths indicated by the arrows, gradually discharges material at the points 43', thereby loading the ends of the tray 33 as shown, and resulting in gradually crowding the material off the ends of the tray as the feeding action of the spout continues. As the feeding operation thus becomes established, the action of the material within the spout as it is swept over the material on the tray may be likened to the action taking place between a multiple-layer-structure, such as the leaves of a book lying flat upon a table, when given a sidewise thrust, thereby producing a gliding action of the leaves upon each other; i. e., in a somewhat similar fashion the layers of material below the lower edges of the feed plates 43 are pushed alternately to and fro with gradually diminishing effect from top to bottom of the layers, and the material thereby smoothed out into a uniform state or consistency while it is at the same time crowded in the direction of the ends of the tray and finally off the end edges in substantially equal increments as effected by the uniform feeding movement of the spout, which is continuously producing a stream or ribbon of the material of substantially uniform consistency or density.

By this method of continuous agitation of the material, as well as continuous smoothing of the same into layers of substantially uniform consistency as it approaches the discharge point, it is apparent that soft, tenacious or fluffy materials may be efficiently handled in such a manner as to produce an even, regular, and uniform discharge flow which is not possible with the usual methods of feeding materials having the clinging properties of carbon, hydrated lime, etc.

It is, of course, obvious that any desired change in the feed rate, for any given installation, may be readily made by either adjusting the elevation of the tray 33, or by re-setting the adjustment of the link 84 along the graduated slot 96 by means of the handle clamp 100, whereby the feed rate may be either increased or diminished.

It may be noted that the arrangement of the spout assembly is adapted to maintain its fulcrum points sufficiently tight for proper operating purposes, without corrosion as in ordinary hinged joints, a substantially constant knife-edge relation being maintained by the spring supporting means as shown.

It may also be noted that the illustrated assembly, including the type of hopper shown, is adapted not only for ample storage capacity at low

height, but also for providing a multiple feed outlet arrangement to afford increased delivery capacity for a given installation, and this also provides a desirable safety factor under some conditions of operation.

Many minor changes are, of course, possible and desirable for adapting the improved construction to meet varying conditions of operation, and while I have herein shown and described one practical and efficient form of apparatus for embodying the various features of improvement, I desire to be understood as reserving the right to make all the changes and modifications falling within the spirit and scope of the appended claims.

What I claim, and desire to secure by Letters Patent, is:

1. Apparatus for feeding dry materials comprising a container for holding a supply of the material and having a discharge passage, fixed supporting means, a material supporting member carried by said fixed supporting means below said passage in the path of the material flow, feeding means operative to produce horizontal reciprocating movement of said flow with reference to the material lodged on said supporting member and thereby effecting intermittent discharge of the material off the edges thereof, and means including parallel motion linkage connected with said fixed supporting means and also operatively connected with said material supporting member for varying the elevation of said supporting member while maintaining the same in continuously horizontal position and thereby varying the discharge rate of the material.

2. Apparatus for feeding dry materials comprising a container for holding a supply of the material and having a discharge passage, a material supporting member below said passage in the path of the material flow, feeding means operative to produce a horizontal reciprocating movement of said flow with reference to the material lodged on said supporting member and thereby effecting intermittent discharge of the material off the opposite edges of said member, and an automatically adjustable shoe device confining the discharge of the material from the feeding means to movements in the direction of said opposite edges of the supporting member.

3. In apparatus for feeding dry materials, a feeding device comprising a pair of oscillatory plates provided with means for pivotally supporting the plates in spaced relation for passage of the material between them, a material supporting member below said plates, knife-edge bearing structures for the upper edges of said plates, yielding supporting means for maintaining said plate edges in engaged relation to said structures, and means for oscillating said plates in unison and substantially parallel relation for effecting the material-feeding operation.

4. In apparatus for feeding dry materials, a feeding device comprising a pair of oscillatory plates provided with means for pivotally supporting the plates in spaced relation for passage of the material between them, a material supporting member below said plates, means for oscillating said plates in unison and substantially parallel relation for effecting the material-feeding operation, and plate members maintained in sliding engagement with the side edges of said first plates and reciprocated in unison therewith for confining said material to the passage between said plates.

5. In apparatus for feeding dry materials, a feeding device comprising a pair of vertical oscillatory plates provided with means for pivotally supporting the plates in spaced relation for passage of the material between them, means for oscillating said plates in unison and substantially parallel relation for effecting the material-feeding operation, fixed supporting means, an adjustable supporting member carried by said fixed supporting means for intercepting the material below said plates, means including parallel motion linkage connected with said fixed supporting means and also operatively connected with said adjustable supporting member for varying the elevation of said supporting member while maintaining the same in continuously horizontal position and thereby also varying the discharge rate of the material, and means reciprocated in unison with said oscillating motion for confining said material to the passage between said plates.

6. Apparatus for feeding dry materials, comprising a container for holding a supply of the material and having a bottom discharge outlet, a pair of oscillatory plates having their upper edges pivotally engaged with opposite sides of said outlet, plate members maintained in yielding engagement with the side edges of said first plates, means for imparting oscillating movement to said first plates for producing a feeding movement of the material through the passage between said plates and material receiving and supporting means beneath said passage.

7. Apparatus for feeding dry materials, comprising a container for holding a supply of the material and having a bottom discharge outlet, a pair of oscillatory plates having their upper edges in pivotal engagement with opposite sides of said outlet, plate members engaging the side edges of said first plates, means connecting said oscillatory plates in pivotal relation to said plate members and also maintaining the latter in yielding sliding engagement with said oscillatory plates, means for oscillating said first plates for producing a feeding movement of the material through the passage between said plates and material receiving and supporting means beneath said passage.

8. Apparatus for feeding dry materials, comprising a container for holding a supply of the material and having a bottom discharge outlet, a pair of oscillatory plates having their upper edges in pivotal engagement with opposite sides of said outlet, plate members engaging the side edges of said first plates, suspension means pivotally connecting said plate members and said oscillatory plates and supporting the latter in pivotal relation to said outlet, and also having means for maintaining said plate members in

yielding sliding engagement with said oscillatory plates, means for imparting oscillating movement to said first plates for effecting a feeding movement of the material through the passage between said plates and material receiving and supporting means beneath said passage.

9. Apparatus for feeding dry materials, comprising a container for holding a supply of the material and having a bottom discharge outlet, a material-supporting member below said outlet in the path of the material flow, feeding means operative to produce a horizontal reciprocating movement of the material flow with reference to the material lodged on said supporting member and thereby effecting intermittent discharge of the material off the opposite ends of said member, and a shoe device slidably supported by said supporting member in automatically telescoping relation to said feeding means for confining the discharge of the material therefrom to movements in the direction of the opposite ends of the supporting member.

10. Apparatus for feeding dry materials, comprising a container for holding a supply of the material and having a bottom discharge outlet, a vertically adjustable material-supporting member below said outlet in the path of the material flow, feeding means operative to produce a horizontal reciprocating movement of the material flow with reference to the material lodged on said supporting member and thereby producing intermittent discharge of the material off the opposite ends of said member, and a shoe device carried by said supporting member and acting to confine the discharge of the material therefrom to movements in the direction of the opposite ends of said supporting member.

11. Apparatus for feeding dry materials, comprising a container for holding a supply of the material and having a bottom discharge outlet, means comprising a pair of spaced oscillatory plates having side plates in sliding engagement with the side edges of said first plates and forming a spout structure in discharge relation to said outlet, means for oscillating said spout structure to effect feeding movement of the material therethrough, a horizontal plate for intercepting the material below said spout structure, and a shoe device carried by said horizontal plate in telescoping relation to said spout structure for confining the material on said horizontal plate to discharge movements in the direction of the opposite ends of the horizontal plate, said shoe device having a transverse bar in sliding engagement with said side plates and forming a partition across the lower end of said spout structure.

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