Nov. 5, 1963 J. R. ROSENLEAF 3,109,560

LIVE BOTTOM HOPPER FEEDER

Filed July 3, 1961 2 Sheets-Sheet 1

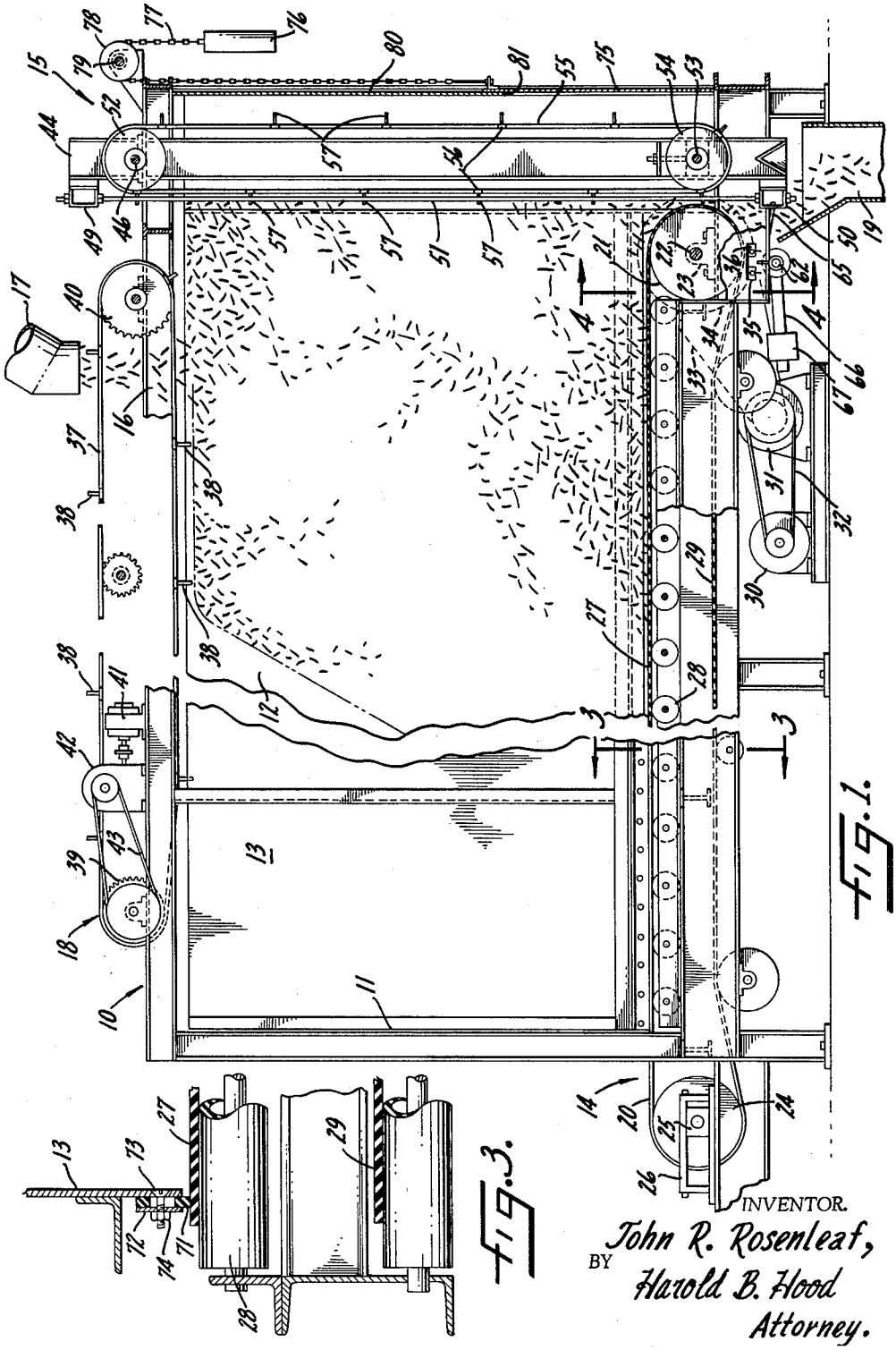


FIG. 1.

FIG. 3.

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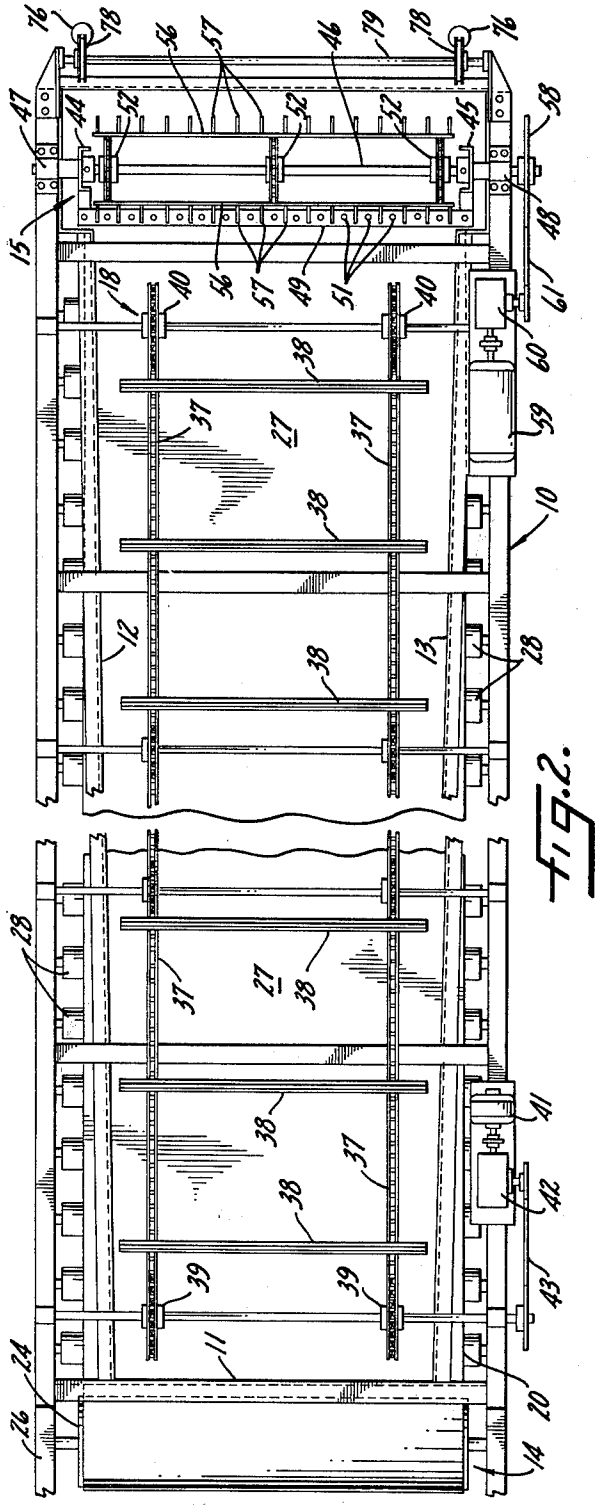


FIG. 2.

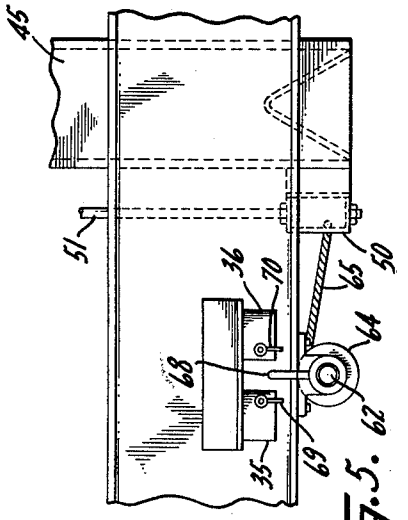


FIG. 5.

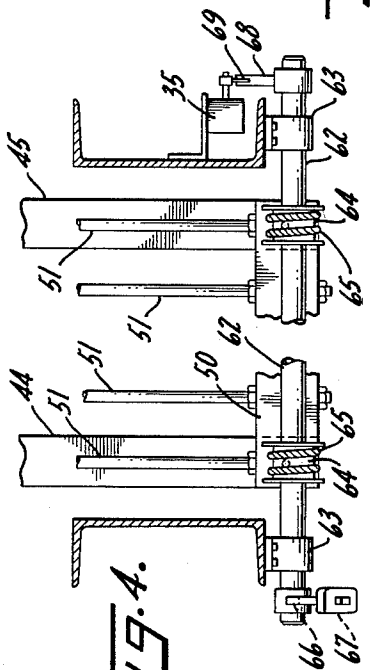


FIG. 4.

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LIVE BOTTOM HOPPER FEEDER

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16 Claims. (Cl. 222—63)

The present invention relates to a live bottom hopper feeder, and is particularly concerned with the provision of a device for establishing a smooth, uniform flow of compactable material to a point of use. The primary object of the invention is to provide a device which will act in the nature of a surge tank in a feed line between a point of supply and a point of use, so that granular, fibrous or other similar discrete material which may have a tendency to accumulate into bunches, rolls or clumps of varying density, thickness and composition, may be delivered to the point of use in a uniform and homogeneous condition.

A further object of the invention is to provide mechanism which will receive compactable, discrete material at varying rates and which will discharge that material at a substantially uniform rate. Another object of the invention is to provide, in a device of the character under consideration, means whereby self-grading of material fed to a stock pile will be inhibited and homogeneity of such material, when delivered from the mechanism of the present disclosure, will be quite well maintained.

A further object of the invention is to provide, in a live bottom hopper, means responsive to the rate of flow of material from the hopper to control the rate of operation of the live-bottom conveyor.

Still further objects of the invention will appear as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

FIG. 1 is a vertical section through a hopper constructed in accordance with the present invention;

FIG. 2 is a top plan view thereof;

FIG. 3 is an enlarged section taken substantially on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged section taken substantially on the line 4—4 of FIG. 1; and

FIG. 5 is an enlarged, fragmentary elevation of a portion of the control mechanism.

Referring more particularly to the drawings, the reference numeral 10 indicates generally a receiver comprising a rear end wall 11 and upstanding side walls 12 and 13 which preferably flare somewhat from the rear wall 11 toward the opposite end of the receiver. Conveyor means, indicated generally by the reference numeral 14, constitutes the floor of the receiver 10; and barrier means indicated generally by the reference numeral 15 constitutes the front end wall of the receiver. At its top, and near the barrier means 15, the receiver is formed with a charging port 16 for receiving discrete material from a spout 17, or the like. In many installations, the top of the receiver may be open from end to end.

The device of the present disclosure is intended primarily for handling fibrous material such as shredded paper, wood pulp, shavings, chips, bagasse, chopped grain stalks or the like; but it may be used advantageously with other materials such as grains or minerals which may have a tendency to compact when subjected to pressure. When any such material is delivered to a receiver at a closely localized point, it tends to pile into a cone

whose lateral surfaces are inclined from the vertical at an angle which depends upon the character of the material. In a situation like that illustrated, of course, the material will tend to build vertically against the side walls and against the end wall adjacent the port 16, and to form a mass whose face remote from the barrier means 15 assumes the angle of repose of the particular material. However, in the absence of means for leveling the top of the pile, the material would tend to build, at the point of delivery from the spout 17, to a level above the upper edges of the side walls; and for that reason, among others which will appear hereinafter, I provide leveler means indicated generally by the reference numeral 18 which is disposed adjacent the top of the receiver and which acts continually to move past the point of delivery of material to the receiver and to carry that material rearwardly toward the wall 11.

The barrier means 15 is so arranged as to provide a relatively narrow space at the discharge end of the conveyor means 14, through which material may be discharged to a carry-away chute 19 whence it will be delivered to a point of use.

The conveyor means 14 comprises an endless belt 20 of any conventional form trained over a drum 21 mounted upon a shaft 22 supported in bearings 23 fixed to the receiver frame, and trained also over a drum 24 suitably supported in bearings 25 which may desirably be adjustably mounted in ways 26 whereby the tension of the belt may be adjusted. The upper or active run 27 of the belt is suitably supported upon closely-spaced idler rolls 28, whereby cupping of the belt run 27 is obviated; and said belt run 27 comprises the floor of the receiver 10 and supports the material contained within the receiver. The lower or return run 29 of the belt 20 will preferably be supported upon suitable idler rolls, for instance, as shown.

An electric motor 30 is connected to drive suitable transmission means 31 through a belt or chain 32, and said transmission means, in turn, is connected by a belt or chain 33 to a sheave or sprocket 34 fixed to the shaft 22. Thereby, the motor 30, when energized, will drive the drum 21 in a direction to move the upper run 27 of the belt 20 continuously toward the front end wall of the receiver. As has been stated, that end wall is, at its lower end, somewhat spaced from the conveyor means so that material may fall between the drum 21 and the end wall into the chute. Operation of the conveyor means 14 is dominated by control means 35 and 36 as will be explained in further detail.

In a conventional hopper, as it is being filled, the material tends to fill only a sloping section from the top to the bottom, filling to the full depth at the front end only, and sloping to the rear at an inclination depending upon the angle of repose of the material being handled. Also due to the self-grading of material rolling down a slope, the rear section of the hopptr would tend to fill up with the larger pieces while the smaller and finer particles would be concentrated toward the front end of the hopper. Under those circumstances, of course, it is impossible to maintain reasonable homogeneity in the material discharged at the front end of the hopper.

To obviate this condition, I provide the leveler means 18 which, as shown, may comprise two or more endless chains 37, 37 carrying flights or scrapers 38 at spaced intervals in their lengths. Each chain is trained over a sprocket 39 near the rear end of the receiver and over a sprocket 40 located between the spout 17 and the front wall of the receiver, the sprockets being carried on separate shafts journalled in suitable bearings supported on the receiver frame. A motor 41 continuously drives the chains 37 through a reducer 42 which is drivingly connected, through a belt or chain 43 to a sheave or sprocket on one of the above-mentioned shafts. The leveler means

is so arranged that the distal edges of the scrapers 38, as they move on the lower runs of the chains 37, extend to a level just below the tops of the receiver side walls. Thus, when the material delivered through the spout 17 reaches a level near the top of the receiver, it is engaged by the flights 38 as they move past the spout toward the rear wall 11 of the receiver, and said flights move the upper layers of the material toward the rear, leveling the pile and inhibiting self-grading and keeping the material in a uniform mixture as to size. The specific character of the flights 38 will depend upon the material being handled.

Now, even though the leveler means tends to maintain uniform distribution of the material in the receiver, it is found to be a very difficult matter to secure a uniform discharge by means of a conveyor belt or the like at the bottom of the receiver. Many materials will tend to roll or pack and to pass over the discharge end of the belt in chunks or lumps, interspersed with spaces of little or no material, particularly when there is a substantial depth of material in the receiver. To overcome such erratic discharge, I provide the barrier means 15 which includes the agitator means now to be described.

The barrier means 15 comprises a pair of upright frame members 44 and 45 oscillably suspended from a shaft 46 carried in bearings 47, 48 above the top of the receiver and supported from the receiver frame. The members 44 and 45 are joined at their tops by a beam 49 and are similarly joined at their bottoms by a beam 50. Uniformly spaced, substantially vertical rods 51 extend between the beams 49 and 50 to constitute the end wall of the receiver. The rods 51 thus define substantially vertical slots opening into the interior of the receiver 10; and, particularly under the influence of the conveyor means 14, the material in the receiver will build up and pack against the slotted front wall defined by the rods 51.

A shaft 53 is journalled in the members 44 and 45 near the lower ends thereof. Two or more sheaves or sprockets 52 are fixed to the shaft 46 and a corresponding number of sheaves or sprockets 54 will be mounted on the shaft 53. Endless belts or chains 55 are trained over each pair of sheaves or sprockets 52 and 54; and a series of longitudinally spaced, transversely arranged bars 56 spans the several belts or chains. Each bar 56 carries a plurality of outwardly-projecting fingers 57, and such fingers are so proportioned and arranged that when they are on the run of the belts or chains adjacent the bars 51, said fingers will register with, and extend through, the slots between the bars 51 to engage the front face of the mass of material within the receiver 10.

As is shown in FIG. 2, the shaft 46 carries at one end a sheave or sprocket 58 which is continuously driven from a motor 59 and reducer 60 through a belt or chain 61. The direction of rotation of the shaft 46, of course, is such that the run of the belts or chains 55 adjacent the bars 51 moves upwardly.

A rock shaft 62 is supported in suitable bearings 63 from the frame of the machine upon an axis which is spaced to the left, as viewed in FIG. 1, from the discharge end of the conveyor means 14. Drum means is secured to the shaft 62 and, in the illustrated embodiment of the invention, that means comprises a drum 64 adjacent each lateral side of the machine frame. A cable 65 is wrapped on each drum and extends to, and is secured to, the beam 50 at the lower end of the barrier means 15. A lever 66 is secured to the rock shaft 62 and carries an adjustable counterweight 67 which yieldably urges counterclockwise turning movement of the shaft 62, as viewed in FIG. 1. Thus, the lower end of the barrier means 15 is yieldably urged toward the discharge end of the conveyor means 14.

In the illustrated embodiment of the invention, the switch 35 is a start switch for the motor 30 and the switch 36 is a stop switch therefor. It will be obvious, particularly from a consideration of FIG. 5, that the finger 68 secured to the rock shaft 62 will engage the arm 70 of the switch 36 to actuate that switch to stop the motor 30 whenever the lower end of the barrier means 15 moves to a predetermined distance away from the discharge end of the conveyor means; and that, when the lower end of the barrier means moves to a predetermined degree of proximity to the discharge end of said conveyor means, the finger 68 will engage the switch arm 69 to actuate the switch 35 to restart the motor 30.

In FIG. 3, I have shown a felt, rubber or composition strip 71 backed by a metal strip 72 and secured to the lower edge of the receiver wall 13 by means of a series of bolts 73 and nuts 74. Such a strip is carried by each side wall of the receiver, and each such strip bears, at its lower edge, upon the upper run 27 of the belt 20 to provide a seal against lateral escape of material from the receiver.

Preferably, the traveler means comprising the belts or chains 55 is enclosed by a rear wall 80 formed with an access port 81 which is normally closed by a sliding gate 75. Counterweights 76 carried by chains 77 passing over pulleys or sprockets 78 on a shaft 79 supported at the top of the frame of the machine, facilitate operation of the gate 75.

Now, it will be understood that the motor 41 operates continually to drive the leveler means 18 and that the motor 59 operates continually to drive the traveler means comprising the belts or chains 55 and the fingers 57. The capacity of the receiver 10 is such that it will never be completely filled, but the leveler means maintains the top of the mass of material in the receiver at a uniform level and, as explained above inhibits self-grading and tends to maintain homogeneity of the mass. Operation of the conveyor means 14 continually tends to move the mass of material in the receiver bodily toward the barrier means 15, thus maintaining a pressure against the bars 51 tending to swing the barrier means in a counterclockwise direction as viewed in FIG. 1. This tendency is yieldably resisted by the counterweight 67 in the manner above described, and the degree of resistance is adjustable by positioning the counterweight at will along the lever 66. The traveler means, operating continually, scrapes against and digs into the front face of the mass of material in the receiver, dislodging the material at a uniform rate and allowing a free fall thereof downward into the chute 19. If, for any reason, the pressure of the mass of material against the barrier means should rise beyond the preselected optimum value, the lower end of the barrier means will be moved toward the right as viewed in FIG. 1, thereby turning the rock shaft 62 in a clockwise direction until the finger 68 engages and actuates the switch arm 70 to stop the motor 30. Since the traveler means continues in operation, the front face of the mass of material in the receiver will continue to be "shaved" and material will continue to be fed downwardly to the chute 19 at the predetermined rate. The front face of the mass in the receiver will thus be torn away gradually and, under the influence of the weight 67, the drum means 64 and the cable means 65, the lower end of the barrier means 15 will gradually move toward the left as viewed in FIG. 1. This movement will be accompanied by counterclockwise movement of the shaft 62 until the finger 68 engages the switch arm 69 to actuate the switch 35, thus restarting the motor 30.

Alternatively, the switches 35 and 36 may be arranged to control the speed of a variable speed electric motor or to control a speed-varying transmission interposed in the drive train between the motor 30 and the conveyor means 14, actuation of the switch 36 acting to reduce the speed of operation of the conveyor means 14 and actuation of the switch 35 acting to increase that speed. It will be seen, of course, that starting and stopping the motor 30 in response to actuation of the switches 35 and 36, respectively, constitutes a control of the rate at which the conveyor means 14 moves material toward the barrier means 15.

While satisfactory results can usually be obtained when the traveler means is driven at constant speed, it will be obvious that the motor **59** may be a variable speed motor or a speed-varying transmission may be introduced into the drive train between said motor and the shaft **46**.

I claim as my invention:

1. A device for uniformly delivering compactable, discrete material comprising a receiver having an upright end wall and a discharge port adjacent the bottom of said end wall, conveyor means constituting the floor of said receiver, means for driving said conveyor means unidirectionally toward said end wall to carry material in said receiver toward said discharge port, said end wall being formed to provide a plurality of vertical slots therethrough, endless traveler means arranged outside said end wall for upward travel in substantial parallelism with said end wall, finger means carried by said traveler means and arranged to penetrate said slots during such upward travel, and means for driving said traveler means.

2. A device for uniformly delivering compactable, discrete material comprising a receiver having an upright end wall and a discharge port adjacent the bottom of said end wall, means for delivering material to said receiver near the top of said end wall, conveyor means constituting the floor of said receiver, means for driving said conveyor means unidirectionally toward said end wall to carry material in said receiver toward said discharge port, scraper means arranged near the top of said receiver, means to drive said scraper means in a direction away from said end wall, said end wall being formed to provide a plurality of vertical slots therethrough, endless traveler means arranged outside said end wall for upward travel in substantial parallelism with said end wall, finger means carried by said traveler means and arranged to penetrate said slots during such upward travel, and means for driving said traveler means.

3. A device for uniformly delivering compactable, discrete material comprising a receiver, barrier means suspended to swing about an axis near the top of said receiver and constituting an end wall for said receiver, conveyor means constituting the floor of said receiver, means for driving said conveyor means to move material supported thereon toward said end wall for discharge from said receiver, said barrier means being provided with a plurality of substantially vertical slots therethrough opening to the interior of said receiver, endless traveler means supported to move bodily with said barrier means, finger means carried by said traveler means and arranged to penetrate said slots during upward travel relative to said barrier means, and means for driving said traveler means.

4. A device for uniformly delivering compactable, discrete material comprising a receiver, barrier means suspended to swing about an axis near the top of said receiver and constituting an end wall for said receiver, conveyor means constituting the floor of said receiver, means for driving said conveyor means to move material supported thereon toward said end wall for discharge from said receiver, said barrier means being provided with a plurality of substantially vertical slots therethrough opening to the interior of said receiver and the lower end of said barrier means being yieldably urged toward the discharge end of said conveyor means, endless traveler means supported to move bodily with said barrier means, finger means carried by said traveler means and arranged to penetrate said slots during upward travel relative to said barrier means, and means for driving said traveler means.

5. The device of claim 4 including means dominated by movement of the lower end of said barrier means to control the rate at which said conveyor means moves material toward said end wall.

6. The device of claim 4 including means actuated by movement of the lower end of said barrier means to a predetermined distance away from said conveyor means to reduce the rate of operation of said conveyor means, and means actuated by movement of the lower end of said barrier means to a predetermined proximity to said conveyor means to increase the rate of operation of said conveyor means.

7. The device of claim 4 in which said means for driving said conveyor means is an electric motor, an energizing circuit for said motor including a stop switch and a start switch, and means controlled by movement of the lower end of said barrier means to actuate said stop switch to stop said motor when said barrier means end reaches a predetermined distance away from said conveyor means and to actuate said start switch to start said motor when said barrier means end reaches a predetermined degree of proximity to said conveyor means.

8. In a device of the class described, a receiver, barrier means suspended to swing about an axis near the top of said receiver and constituting an end wall for said receiver, conveyor means constituting the floor of said receiver, an electric motor connected to drive said conveyor means, when energized, to move material supported thereon toward said barrier means for discharge from said receiver, an energizing circuit for said motor including a start switch and a stop switch, said barrier means being provided with a plurality of substantially vertical slots therethrough opening to the interior of said receiver, endless traveler means supported to move bodily with said barrier means, finger means carried by said traveler means and arranged to penetrate said slots during upward movement relative to said barrier means, means for driving said traveler means, rocker means mounted for oscillation about an axis fixed relative to said receiver and transverse relative to the direction of travel of said conveyor means, means providing an operative connection between said rocker means and said barrier means, means yieldably biasing said rocker means in a direction to urge the lower end of said barrier means toward said conveyor means, and means moving with said rocker means and engageable with said stop switch to stop said motor when said barrier means end reaches a predtermined distance away from said conveyor and engageable with said start switch to start said motor when said barrier means end reaches a predetermined degree of proximity to said conveyor.

9. In a device of the class described, a receiver, barrier means suspended to swing about an axis near the top of said receiver and constituting an end wall of said receiver, conveyor means constituting the floor of said receiver, an electric motor connected to drive said conveyor means, when energized, to move material supported thereon toward said barrier means for discharge from said receiver, an energizing circuit for said motor including a start switch and a stop switch, said barrier means being provided with a plurality of substantially vertical slots therethrough opening to the interior of said receiver, endless traveler means supported to move bodily with said barrier means, finger means carried by said traveler means and arranged to penetrate said slots during upward movement relative to said barrier means, means for driving said traveler means, drum means mounted on a fixed axis between the ends of said conveyor means and transverse relative to the direction of travel of material on said conveyor means, cable means wrapped on said drum means and secured to said barrier means near the lower end thereof, means yieldably urging said drum means in a direction to draw said barrier means end toward said conveyor means, and means connected to move oppositely in response to opposite rotational movement of said drum means to actuate said stop switch to stop said motor when said barrier means end reaches a predetermined distance away from said conveyor means and to actuate said start switch to start said motor when said barrier means end reaches a predetermined degree of proximity to said conveyor means.

10. In a device of the class described, a receiver, barrier means suspended to swing about an axis near the top of said receiver and constituting an end wall for

said receiver, conveyor means constituting the floor of said receiver, an electric motor connected to drive said conveyor means, when energized, to move material supported thereon toward said barrier means for discharge from said receiver, an energizing circuit for said motor including a start switch and a stop switch, said barrier means being provided with a plurality of substantially vertical slots therethrough opening to the interior of said barrier means, finger means carried by said traveler means and arranged to penetrate said slots during upward movement relative to said barrier means, means for driving said traveler means, a shaft mounted on a fixed axis between the ends of said conveyor means and transverse relative to the direction of travel of material on said conveyor means, drum means fixed on said shaft, cable means wrapped on said drum means and secured to said barrier means near the lower end thereof, a lever fixed to said shaft, a counterweight on said lever yieldably urging turning movement of said shaft in a direction to wind said cable means on said drum to draw said barrier means end toward said conveyor means, and a finger fixed to said shaft and engageable with said stop switch to stop said motor when said barrier means end reaches a predetermined distance away from said conveyor and engageable with said start switch to start said motor when said barrier means end reaches a predetermined degree of proximity to said conveyor means.

11. The combination with a receiver having an upright wall having a plurality of substantially vertical slots therein, of conveyor means at the bottom of said receiver urging material in said receiver toward said slotted wall for discharge from said receiver near the bottom of said wall, agitator means penetrating said slots to the interior of said receiver, and means for continually moving said agitator means upwardly.

12. The combination with a receiver having an upright wall having a plurality of substantially vertical slots therein and having a charging port near the upper end of said wall, of leveler means disposed near the top of said receiver, means for driving said leveler means continually past said charging port and away from said wall, conveyor means at the bottom of said receiver urging material in said receiver toward said slotted wall for discharge from said receiver near the bottom of said wall, agitator means penetrating said slots to the interior of said receiver, and means for continually moving said agitator means upwardly.

13. The combination of claim 11 in which said upright wall is suspended to swing about a substantially horizontal axis near the top of said receiver and said agitator means is supported to move bodily with said wall.

14. The combination of claim 13 including means actuated by movement of the lower end of said wall to a predetermined distance away from said conveyor means to reduce the rate of operation of said conveyor means, and means actuated by movement of the lower end of said wall to a predetermined proximity to said conveyor means to increase the rate of operation of said conveyor means.

15. The combination of claim 12 in which said upright wall is suspended to swing about a substantially horizontal axis near the top of said receiver and said agitator means is supported to move bodily with said wall.

16. The combination of claim 15 including means actuated by movement of the lower end of said wall to a predetermined distance away from said conveyor means to reduce the rate of operation of said conveyor means, and means actuated by movement of the lower end of said wall to a predetermined proximity to said conveyor means to increase the rate of operation of said conveyor means.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,109,560 November 5, 1963

John R. Rosenleaf

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 45, for "of", second occurrence, read -- for --; column 7, line 8, after "said" insert -- receiver, endless traveler means supported to move bodily with said --.

Signed and sealed this 21st day of April 1964.

(SEAL)
Attest:
ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents