

[54] FEEDER AND ORIENTER

[75] Inventor: Dennis E. Mead, Cazenovia, N.Y.

[73] Assignee: Lipe Rollway Corporation,
Liverpool, N.Y.

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Related U.S. Application Data

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[58] Field of Search ... 198/33 AA, 220 BA, 220 BC

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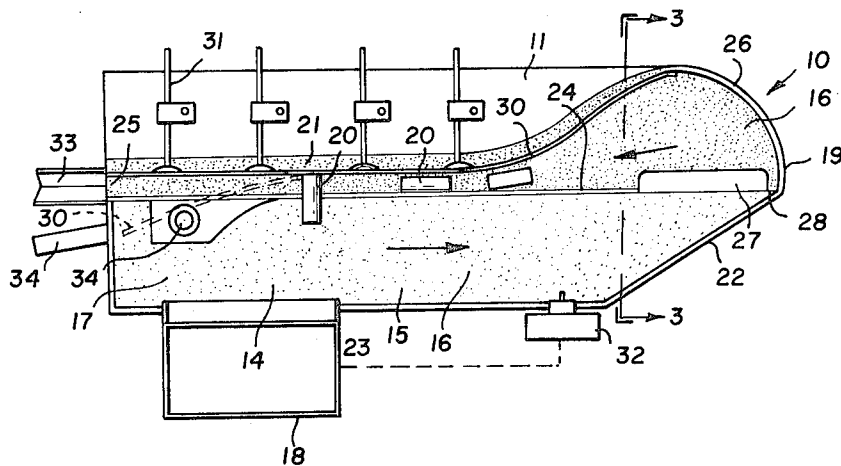
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Primary Examiner—Edward A. Sroka
Attorney, Agent, or Firm—Cumpston, Shaw &
Stephens

[57] ABSTRACT

A vibratory feeder has a feed surface that is inclined upward and doubled back so that objects falling from the upper level drop to the lower, input level. The feed surface is covered with a pile material that has filaments inclined from the vertical toward the direction of feed up the incline, and the filaments have a size, density and resilience for flexibly supporting objects on the filament tips for movement up the incline. The lower and upper levels of the feed surface are preferably driven by separate vibrators in the respective general directions of the pile inclinations.

10 Claims, 9 Drawing Figures



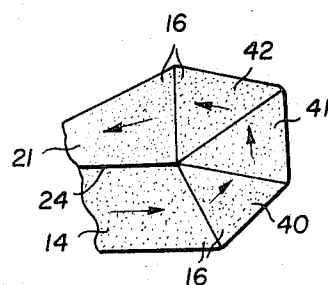
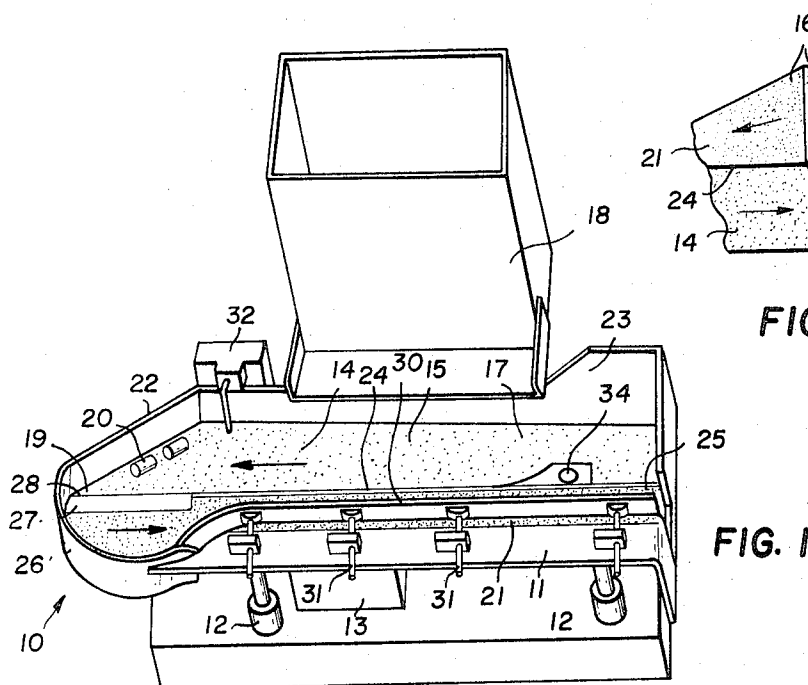


FIG. 5

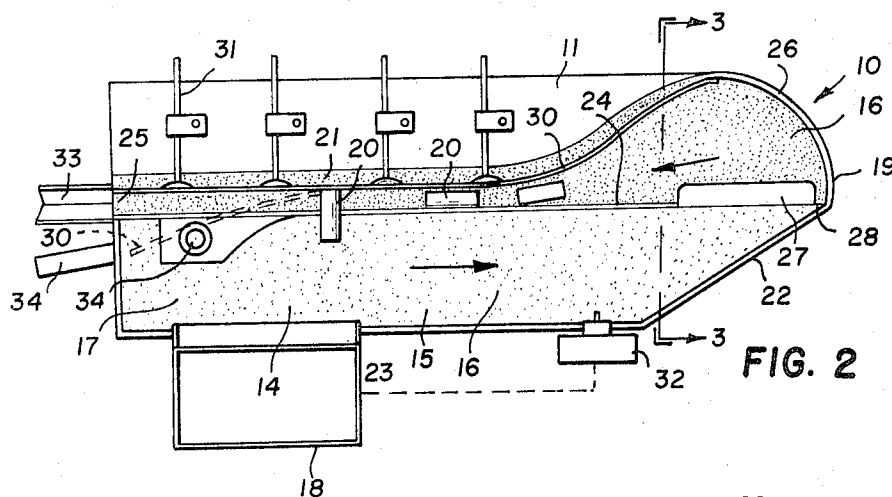


FIG. 2

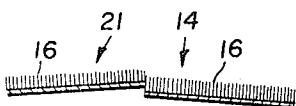


FIG. 3

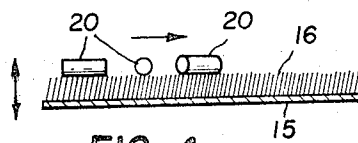


FIG. 4

INVENTOR.
DENNIS E. MEAD
BY *Cumpton, Shaw*
and Stephens
ATTORNEYS

FEEDER AND ORIENTER

RELATED APPLICATIONS

This application is a continuation-in-part of my previous application Ser. No. 137,884, filed Apr. 27, 1971, and abandoned upon the filing of this application.

THE INVENTIVE IMPROVEMENT

The invention involves recognition of the many disadvantages of present vibratory bowl feeders. For example, present feeder bowls are generally large, heavy, and have a relatively long track winding in a helix up the side of the bowl. Their size and mass is required for durability and feeding speed, but this also requires a vibrator of substantial size and power to drive the bowl in the desired motion. The result is noisy, space-consuming, very expensive, relatively slow, and difficult to adapt to different jobs.

The invention seeks to overcome these deficiencies of present vibratory feeder bowls, and the invention recognizes ways that a feed surface covered with inclined pile filaments can be used in a simplified and improved feeder. The invention also includes some specific structures that feed and orient objects in a much simpler and efficient manner.

SUMMARY OF THE INVENTION

The inventive feeder and orienter has a first feed surface inclined upward from an input region and a second feed surface leading from the output end of the first surface to a discharge region disposed so objects falling from the second feed surface drop to the first feed surface. Each of the feed surfaces is covered with a pile material having flexible filaments uniformly inclined by about 5° to 25° from the vertical toward the direction of movement of objects along the feed surfaces. The filaments have uniform length and thickness and a sufficient density so that only the tips of the filaments support the objects to be fed. Each of the feed surfaces is vibrated in a generally reciprocal motion in the general direction of the inclination of the filaments, and the filaments are sufficiently resilient to flex under the objects during upward movement of the feed surfaces to increase the feeding speed and force.

DRAWINGS

FIG. 1 is a perspective view of a preferred embodiment of the inventive feeder;

FIG. 2 is a partially schematic, plan view of the feeder of FIG. 1;

FIG. 3 is a schematic, fragmentary, cross-sectional view of a feed path of FIG. 2 taken on the line 3 — 3 thereof;

FIG. 4 is a schematic, fragmentary, elevational view of the operation of the feed surface of FIG. 3;

FIG. 5 is schematic, fragmentary, plan view of an alternative feed path;

FIG. 6 is a partially schematic plan view of another preferred embodiment of the inventive feeder;

FIGS. 7 and 8 are cross-sectional views of the feeder of FIG. 6 taken respectively along the lines 7 — 7 and 8 — 8 thereof; and

FIG. 9 is a diagram of the preferred angles for pile filaments and vibration.

DETAILED DESCRIPTION

The inventive feeder 10 includes a base 11 preferably supported on spring-suspension isolator feet 12 and carrying a preferably suspended vibrator 13. Vibrator 13 drives base 11 in a predominantly vertical motion that can be vertical reciprocation or a circular or orbital path in the vertical plane so that base 11 rises and falls vertically with each vibration cycle. Suitable vibrators are available for accomplishing this, including electrical, mechanical, and pneumatic vibrators. Also vibrator 13 can be mounted on a fixed surface to drive base 11 with or without support feet 12.

Base 11 has a feed surface 15 covered with a pile material 16 that functions as best shown in FIG. 4. The filaments of pile material 16 are inclined from the vertical toward the direction of feed along feed surface 15. The arrows in FIGS. 2 — 4 show the feed direction of objects 20, which for illustrative purposes are cylindrical roller bearings. The filaments of pile 16 are uniform and of an appropriate size, density, and resilience for flexibly supporting objects 20 on the tips of the filaments which lie in a common plane as illustrated.

Resilience of the filaments of pile 16 is preferably related to the size and mass of objects 20, with greater filament resilience used for lighter objects. Denser filaments have greater supporting capacity, and resilience is a function of filament material, diameter, length and density. One preferred pile material 16 is formed of polypropylene monofilaments .012 inches in diameter and three-quarter inch long, angled 20° from the vertical toward the direction of feed. However, other materials are satisfactory for the filaments of pile 16, many different filament sizes and lengths are usable, and the filaments can be set at different angles from the vertical. The preferred inclination of 5° to 25° from the vertical covers the optimum range for speedy and forceful feeding of objects 20.

The vibration amplitude and frequency is suited to the mass and shape of objects 20 and the characteristics of pile material 16 so that objects 20 are supported on the tips of the pile filaments and flex the filaments slightly with each vibration cycle to advance objects 20 in the direction of inclination as shown by arrows. The result is a relatively quiet but forceful and fast feeding of objects 20 along surface 15 with a relatively large feeding capacity for size, mass, expense, and energy used, and with no marring of objects 20.

Feed surface 15 includes a lower level 14 having an input region 17 for receiving objects 20 dropped from a supply bin 18. Feed surface 15 is inclined and bent back on itself at turn 19 so that an upper level 21 of feed surface 15 is disposed adjacent and above input region 17. Turn 19 is preferably about 180° as illustrated, so that the doubling back of feed surface 15 allows objects 20 falling from upper region 21 to drop back onto lower level 14 and input region 17.

On lower level 14, the filaments of pile 16 are inclined from the vertical toward turn 19 as represented by arrows, so that objects 20 move up the incline from input region 17 to turn 19. A wall 23 around the outside of the lower level 14 keeps objects 20 on feed surface 15, and a wall 22 extends obliquely inward toward turn 19 to guide objects 20 into turn 19. This allows the lower level 14 to be covered with one piece of pile material 16 having its filaments oriented toward turn 19 to drive objects 20 upward and into turn 19.

The incline of feed surface 15 is preferably less than 5°, and preferably about 3 ½° so that objects 20 move readily and easily up the incline and through turn 19. A vertical wall 24 extends from the inward edge of upper region 21 downward to lower level 14. The upper edge of wall 24 is just below the tips of filaments 16 along the edge of upper region 21 to keep such filaments from being bent over or matted down by parts 20 falling from upper region 21 down to lower level 14. Wall 24 also keeps objects 20 from falling off the inside of lower level 14. Also, as best shown in FIG. 3, lower level 14 is preferably inclined slightly downward and outward toward walls 23 and 22 so that objects 20 move along the outside of surface 15 and toward the outside of turn 19.

Upper level 21 of feed path 15 is covered with preferably the same pile material 16 with the filaments inclined from the vertical away from turn 19 as shown by the arrows to drive objects 20 toward the discharge end 25 of feed path 15. A plate 27, preferably secured to wall 24, covers a junction line 28 between the pieces of pile material 16 on the upper and lower levels of feed path 15 at turn 19. Objects 20 are pushed across plate 24 in rounding turn 19, and plate 24 eliminates any barrier step between the upper and lower levels of feed path 15 at turn 19.

A curved wall 26 guides objects 20 around turn 19 and toward discharge region 25, and a flexible guide 30 extends from wall 26 for guiding objects 20 along upper level 21. Guide 30 is variably positioned by adjustable clamps 31 to determine the width of the feed path along upper level 21. This allows upper level 21 to be narrowed sufficiently so that improperly oriented objects 20 topple off the edge of upper level 21 and drop to input region 17 as illustrated. Flexible guide 30 thus allows easy adjustment of the inventive feeder for different dimensions of objects 20.

A sensor 32 is preferably positioned as shown in FIG. 2 for sensing any clogging of objects 20 approaching turn 19, and sensor 32 is preferably connected with supply bin 18 to stop the input of objects 20 to region 17 if such clogging occurs. Obstructions, guides, etc. can be arranged along upper level 21 in a generally known manner to topple off any improperly oriented objects 20, such as objects standing upright on one end.

Discharge region 25 preferably provides two different discharge routes from feeder 10. For objects 20 that have a length greater than their diameter, a guide trough 33 is arranged in alignment with guide 30 for receiving objects 20 in end-to-end orientation for discharge from feeder 10. Any such objects that are not so oriented either fall or are toppled off of upper path 21 to recycle through feeder 10. For objects 20 that are approximately equal in length and diameter, flexible guide 30 is moved to the broken-line position shown in FIG. 2 to guide objects 20 to discharge tube 34 which has a central opening that is circular in cross-section and sized to accommodate objects 20. Tube 34 leads vertically downward from discharge region 25 and out of feeder 10 as illustrated. Cylindrical objects 20 having about equal lengths and diameters will tip and fall endwise into tube 34 in end-to-end orientation, and will not fit into tube 34 in any crosswise orientation. Improperly oriented objects are forced to pass over and beyond tube 34 and fall back to input region 17, and only those

objects that tip endwise into tube 34 are accepted for discharge from feeder 10.

FIG. 5 schematically shows an alternative curve arrangement for the feed path of the inventive feeder. Sectors 40, 41, and 42 are arranged around a curve as illustrated, with their pile filaments 16 oriented as shown by the arrows to follow cords of the curve. Objects are then fed in the direction of the arrows across each of the sectors 40 - 42 as they round the curve from lower level 14 to upper region 21. This gives the objects more feeding force in rounding the curve.

Compared to a vibratory bowl feeder for the same job, the inventive feeder is far smaller and lighter and can be driven by one small vibrator. The inventive feeder is faster in feeding objects, is more quiet and does not mar the objects being fed, and is not unduly impaired by liquid on the feed surface. Although cylindrical roller bearings have been illustrated as the feed objects, many objects and parts can be fed with feeder 10. The bent-back feed path 15 can have its upper level spaced from its lower level and connected by a downwardly inclined ramp, and the bent-back path allows return of improperly oriented objects back into the input region without the feed path having undue length. Two strips of pile material can be used as described to drive objects around corner 19, or the pile material can be bent or shaped so that the pile filaments follow the curvature of the feed path with the filament inclination angle turning around the corner with the objects.

The feed path can have many different shapes and can be inclined at many different angles. One preferred arrangement is an incline that is flatter near the discharge region to ensure full speed and force for objects entering the discharge region. Also, the feed surface can be covered with many pile materials having filaments properly inclined to accomplish the desired feeding.

Experience with the invention since the parent application was filed has led to several improvements schematically shown in FIGS. 6 - 8. Feeder and orienter 50 is similar to feeder 10 with an input chute 51, and an adjustable guide rail 52 leading to a discharge chute 53. A first feed surface 54 extends from input region 55 under chute 51 and is inclined upward to the right as illustrated in FIGS. 6 and 7. Its pile filaments 56 are also inclined toward the right as shown by the arrow and illustrated in FIG. 7 to move objects up the slope.

A second feed surface 58 is adjacent the output end 57 of the first feed surface 54 and inclines upward to discharge region 59. Pile filaments 60 on second feed surface 58 are inclined to the left as shown by the arrow and illustrated in FIGS. 7 and 8 to move objects up the slope and toward discharge region 59.

A piece of pile material 61 is inlaid into the output region 57 of the first feed surface 54 and has pile filaments 62 inclined from feed surface 54 toward feed surface 58 as shown by the arrow to move objects from the first to the second feed surfaces. Pile filaments 62 are preferably blended with pile filaments 56 and pile filaments 60 along the intersections with surfaces 54 and 58 to move parts smoothly over the junction. Pile inlay material 61 can be supported on either first surface 54 or second surface 58 as desired.

Preferably separate vibrators are used for surfaces 54 and 58 as best shown in FIGS. 7 and 8. A vibrator 63 drives feed surface 54 in a reciprocal motion in the gen-

eral direction of the inclination of pile filaments 56 as shown by the arrows. Vibrator 63 can be mounted on support base 64 as illustrated, or can be suspended from feed surface 54. Surface 54 is also supported on spring-suspension isolator feet 65.

Vibrator 66 drives feed surface 58 in a reciprocal motion in the general direction of the inclination of pile filaments 60 as shown by the arrows, and feed surface 58 is also supported by spring-suspension isolator feet 67. Vibrator 66 is preferably in phase with vibrator 63 so that the reciprocal motion produced by both vibrators rises and falls in unison. The different vibration angle for feed surfaces 54 and 58 improves the feeding speed and force of objects along each feed surface to increase the efficiency of feeder 50.

FIG. 9 is a diagram of preferred angles of inclination for pile and vibration as evolved during experience with the invention. The optimum pile filament angles lie between 5° and 25° as illustrated, with the preferred range for most applications falling between 10° and 20°. Generally, the smaller angles produce greater speed at a sacrifice of feeding force, and the larger angles have a somewhat slower feed with greater force. Vibration angles are successful throughout a wider range as illustrated, from vertical to 75° from the vertical. The optimum vibration angle tends to align generally with the pile angle, particularly at angles closer to vertical, but the vibration angle can incline further from the vertical and still be quite successful. The vibration angle should not be transverse to the pile angle, and should stay in the same quadrant and the diametrically opposite quadrant as the pile inclination.

With the proper pile angle and vibration angle within the suggested ranges, the filaments are flexed slightly on each vibrational upstroke and their flexure moves objects in the feed direction for a forceful and rapid feed compared to vibration of a hard surface on a surface covered with soft or matted down pile.

Persons wishing to practice the invention should remember that other embodiments and variations can be adapted to particular circumstances. Even though one point of view is necessarily chosen in describing and defining the invention, this should not inhibit broader or related embodiments going beyond the semantic orientation of this application but falling within the spirit of the invention. For example, those skilled in the art will appreciate the ways that the inventive feeder can be adapted to particular feeding jobs and used in association with other equipment to which or from which objects are fed.

I claim:

1. A feeder and orienter comprising:

- a. a first feed surface inclined upward from an input region for receiving objects to be fed;
- b. a second feed surface leading from the output end of said first feed surface to a discharge region disposed so said objects falling from said second feed surface drop to said first feed surface;

c. each of said feed surfaces being covered with a pile material having flexible filaments uniformly inclined by about 5° to 25° from the vertical toward the direction of movement of said objects along said feed surfaces;

d. said filaments having uniform length and thickness and a sufficient density so that only the tips of said filaments support said objects to be fed;

e. means for vibrating each of said feed surfaces in a generally reciprocal motion in the general direction of the inclination of said filaments; and

f. said filaments being sufficiently resilient to flex under said objects during upward movement of said feed surfaces in said reciprocal motion to increase the feeding speed and force of said feed surfaces in moving said objects.

2. The feeder and orienter of claim 1 wherein said vibrating means includes a separate vibrator for each of said first and second feed surfaces.

3. The feeder and orienter of claim 2 wherein said separate vibrators operate in phase with each other and have respective reciprocal motions in the general direction of the inclination of said filaments for said respective first and second feed surfaces.

4. The feeder and orienter of claim 2 wherein said direction of said reciprocal motion of said vibrators is from vertical to 75° from vertical in the plane of said inclination of said filaments.

5. The feeder and orienter of claim 1 wherein a laterally adjustable guide rail extends along said second feed surface for adjusting the width of said second feed surface so improperly oriented objects fall to said first feed surface.

6. The feeder of claim 1 wherein said objects are generally cylindrical with approximately equal length and diameter, and said discharge region includes a tube leading vertically downward from said discharge region.

7. The feeder and orienter of claim 1 wherein said objects are generally cylindrical with greater length than diameter, and said discharge region includes a guide trough leading horizontally from said discharge region.

8. The feeder and orienter of claim 1 including pile material arranged in the region of the junction between said first feed surface and said second feed surface and having flexible filaments uniformly inclined from said first feed surface toward said second feed surface.

9. The feeder and orienter of claim 8 wherein said vibrating means includes a separate vibrator for each of said first and second surfaces, and said separate vibrators operate in phase with each other.

10. The feeder and orienter of claim 9 wherein said first and second feed surfaces are sloped to bias said objects toward the outside of said first and second feed surfaces.

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