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Sterling

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[54] SEPARATING AND SORTING APPARATUS

[75] Inventor: **Walter S. Sterling,** Quincy, Mass.

[73] Assignee: **Pneumatic Scale Corporation,** Quincy, Mass.

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[52] **U.S. Cl.** **209/73,** 198/53, 209/76, 221/165

[51] **Int. Cl.**.....**B07c 1/04**

[58] **Field of Search** 209/76, 73; 221/165; 198/53

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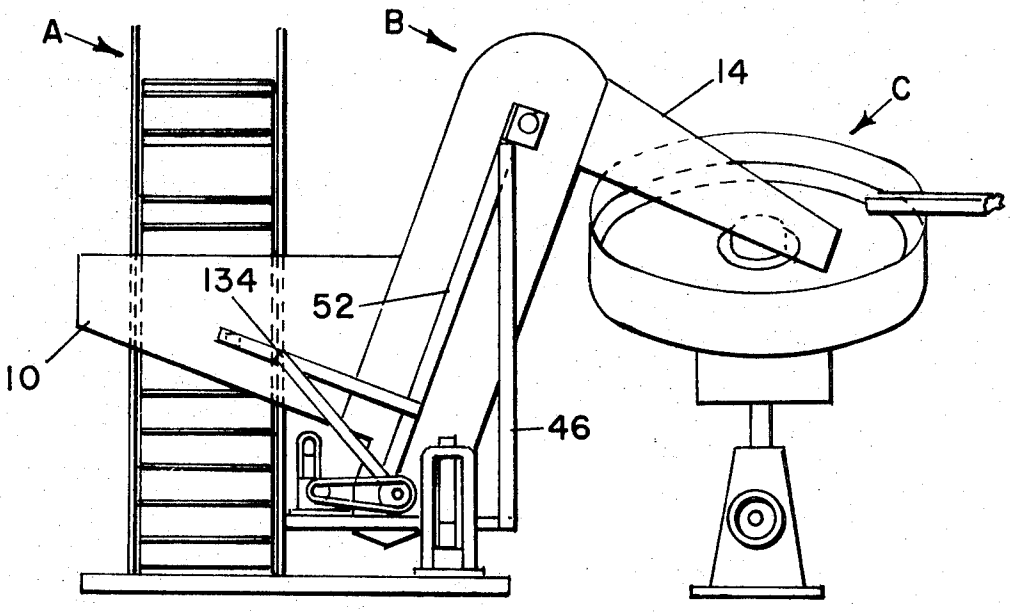
Primary Examiner—Richard A. Schacher

Attorney—Sewall P. Bronstein, John D. Woodberry, Robert T. Gammons, Donald Brown, Robert L. Goldberg and Robert F. O'Connell

[57] **ABSTRACT**

Apparatus for sequentially separating and distributing items from a mixed relatively compact mass of items having appendages so intertwined as to make separation difficult, comprising tandemly arranged separators for successively operating on the mass. Each separator apparatus has a hopper and an elevator. The elevator in the first separator loosens items from the initially compact mass and transfers random complements to the hopper of the second separator where they collect in the form of a loose mat. The elevator of the second separator loosens the items in the mat and transfers continuous complements to the hopper of a sorting apparatus. The hopper of each apparatus has a sloping bottom so that the mass gravitates toward its lower end and the elevator of each separator comprises a conveyor situated at the lower end of the hopper which extends upwardly relative to the bottom and has fixed to it a plurality of spaced parallel flights operable by movement upwardly relative to the bottom of the hopper to effect oscillation of the mass so as to loosen items in the mass. Eccentrics are mounted in engagement with the bottoms of the hoppers for effecting vibration thereof.

32 Claims, 10 Drawing Figures



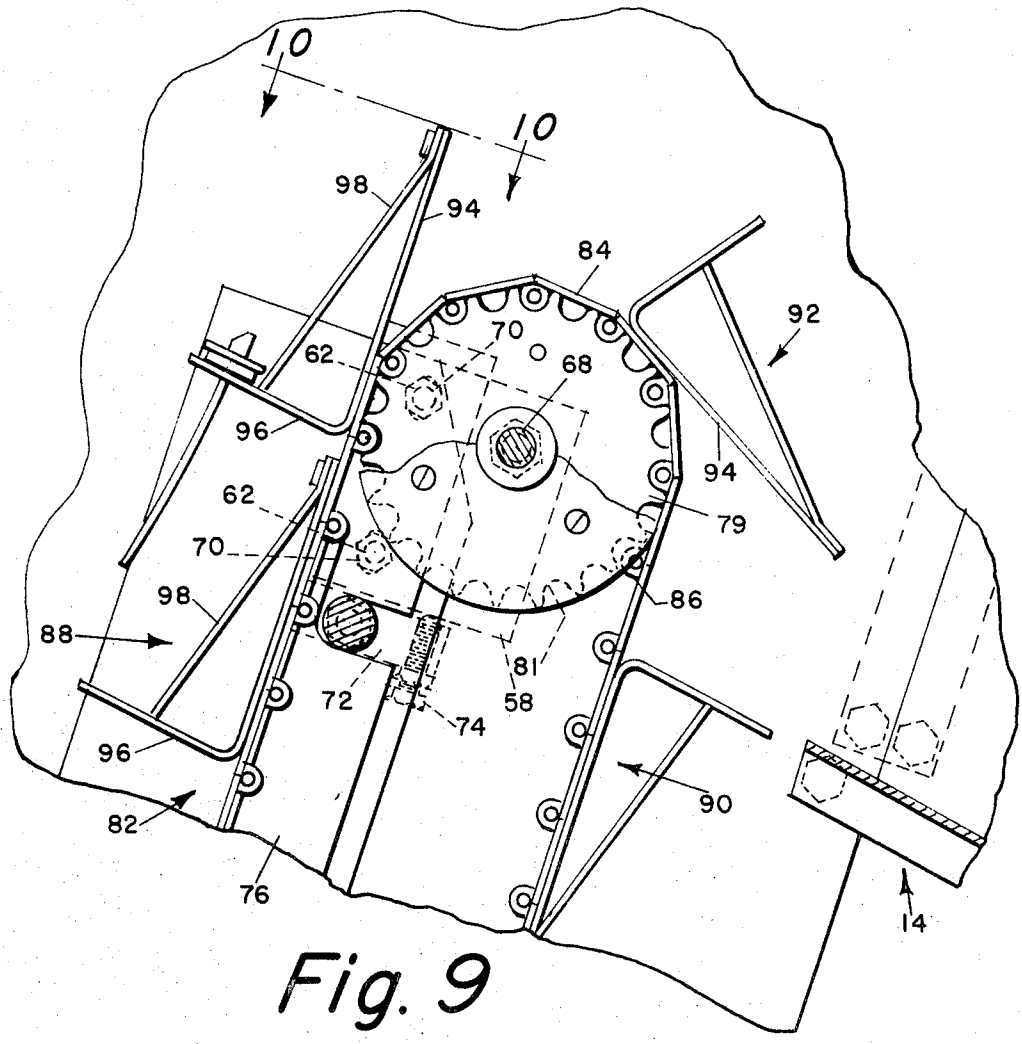


Fig. 9

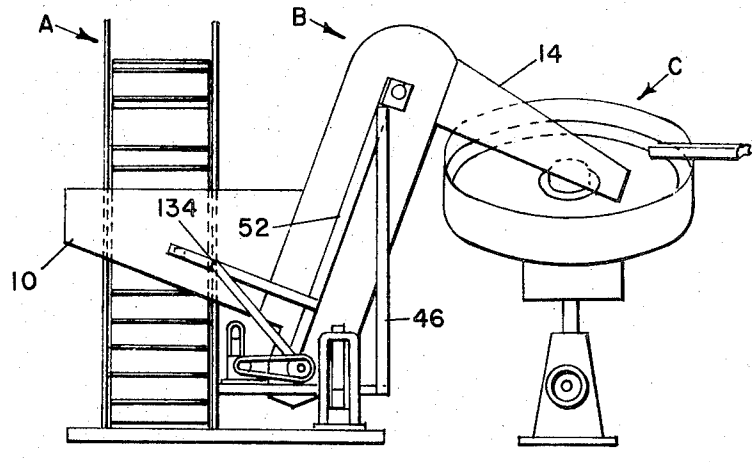


Fig. 1

INVENTOR
Walter S. Sterling
BY
Robert T. Simmons
ATTORNEY

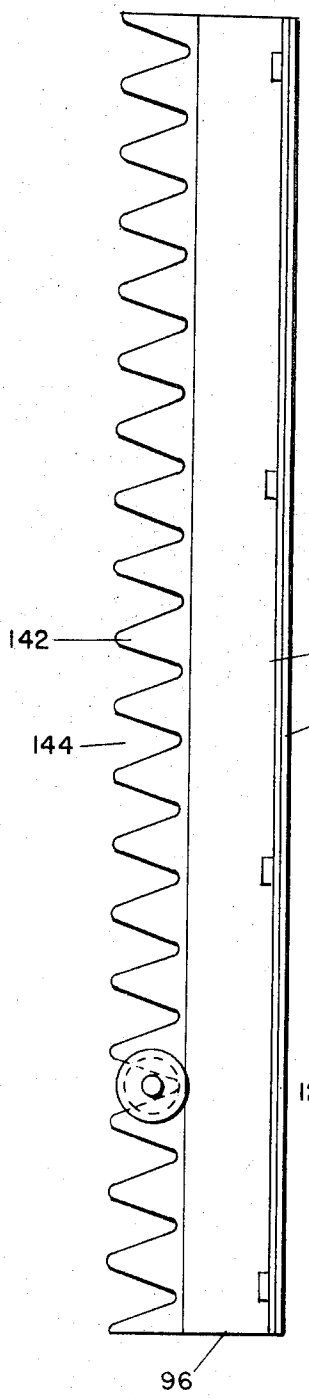


Fig. 10

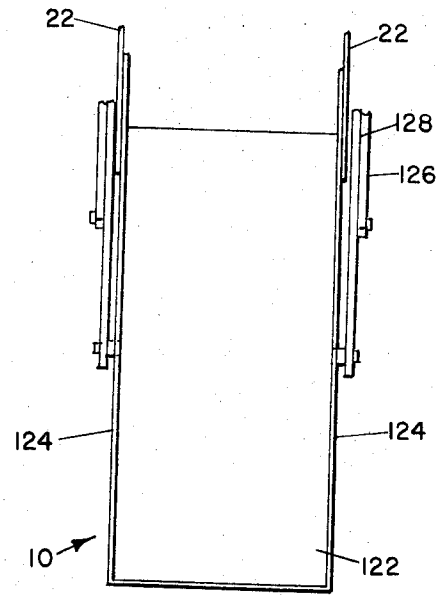


Fig. 5

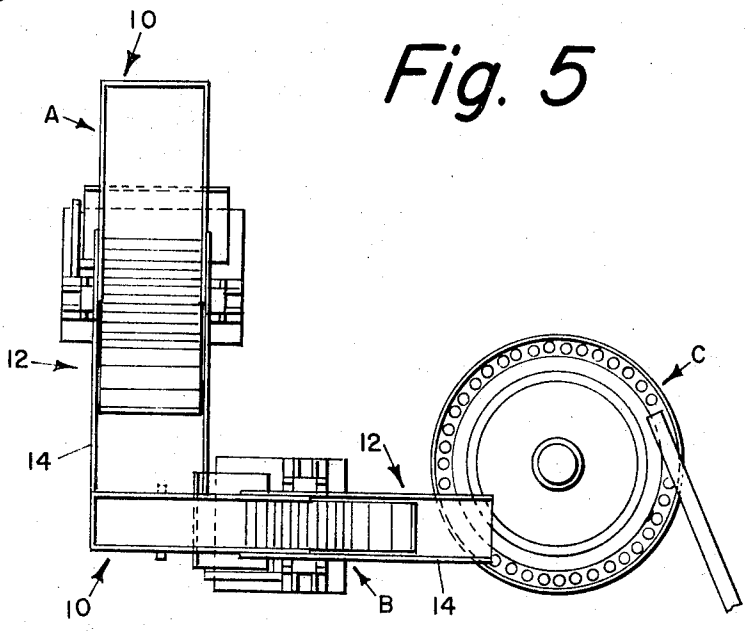


Fig. 2

INVENTOR
Walter S. Sterling

BY
Robert T. Gammon

ATTORNEY

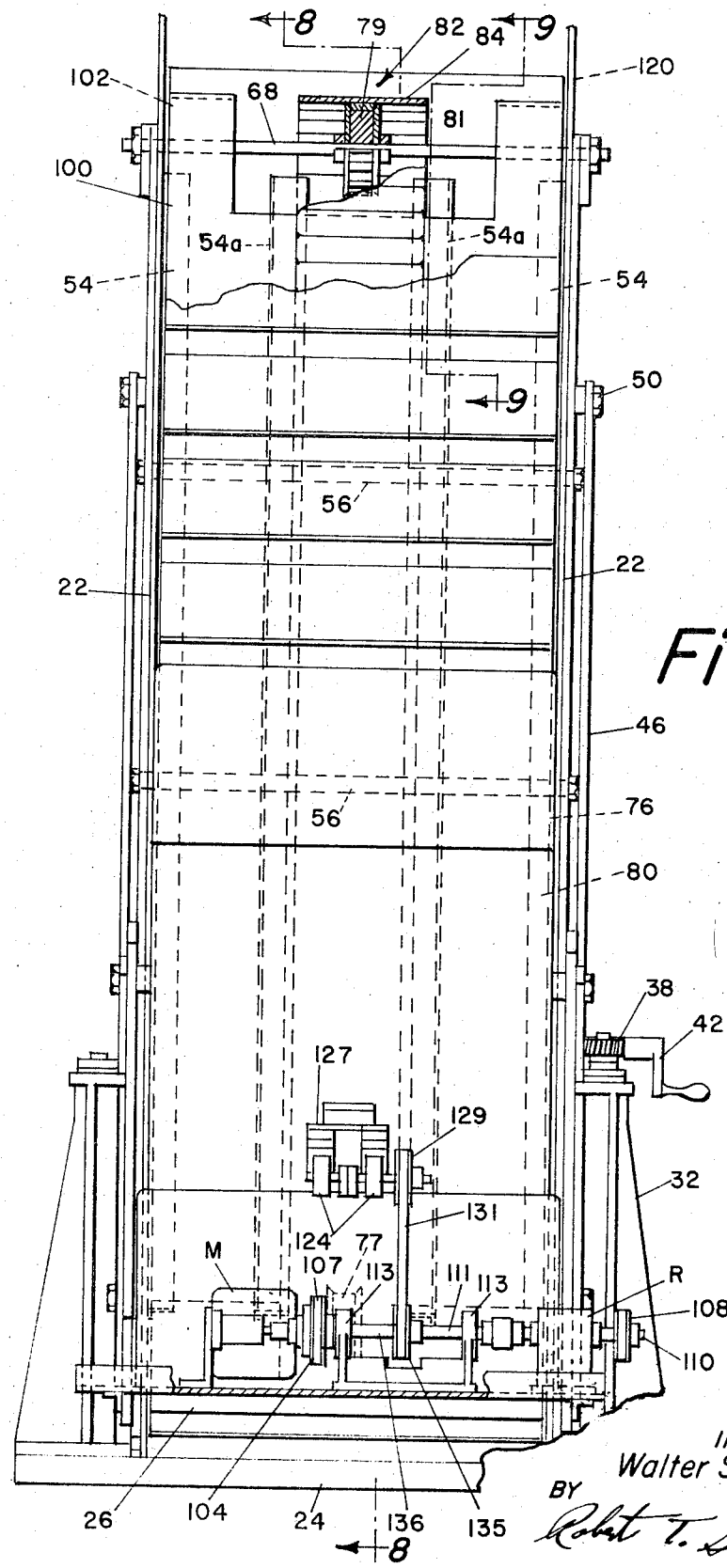


Fig. 3

INVENTOR
Walter S. Sterling

BY
Robert T. Hammond

ATTORNEY

Fig. 4

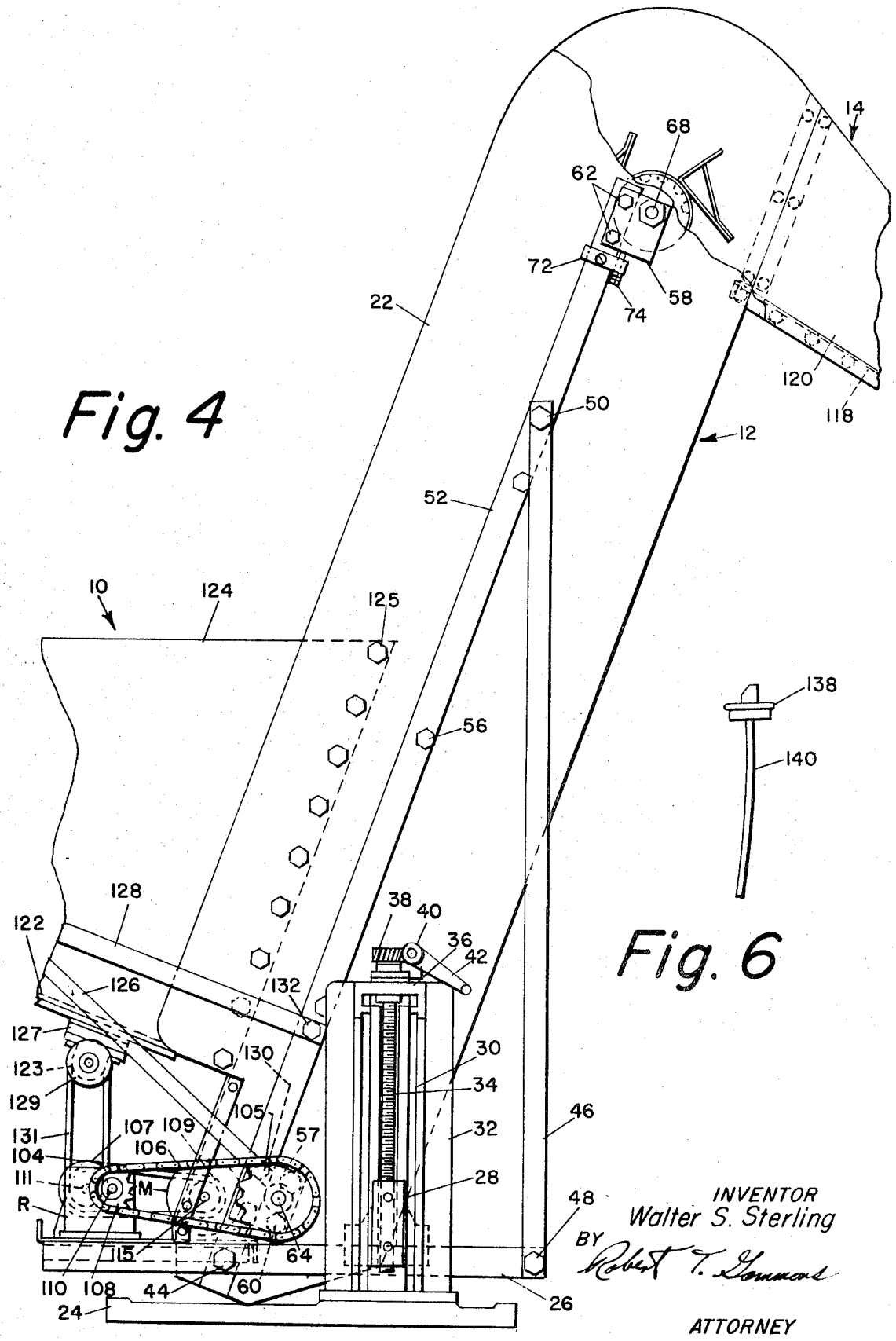
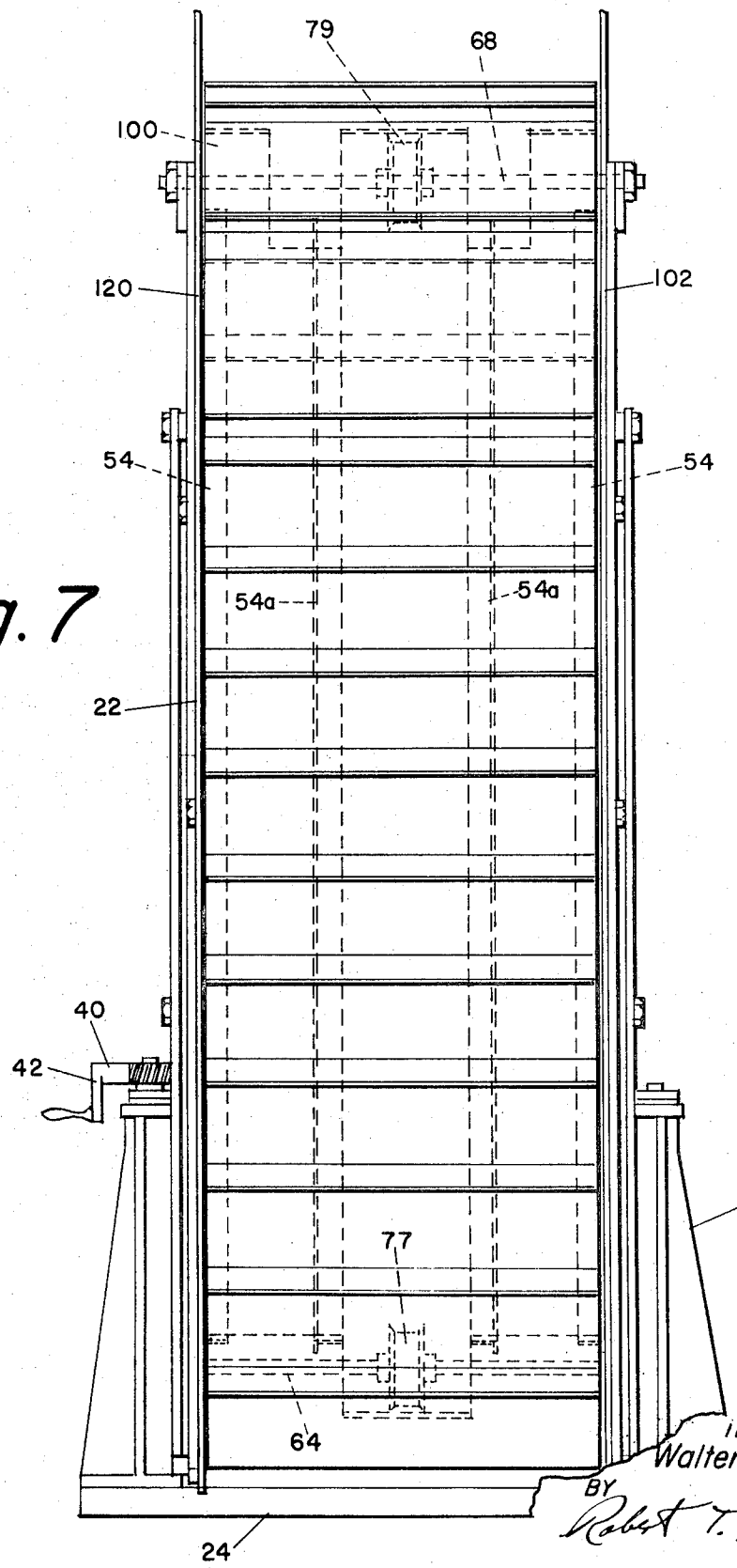


Fig. 6

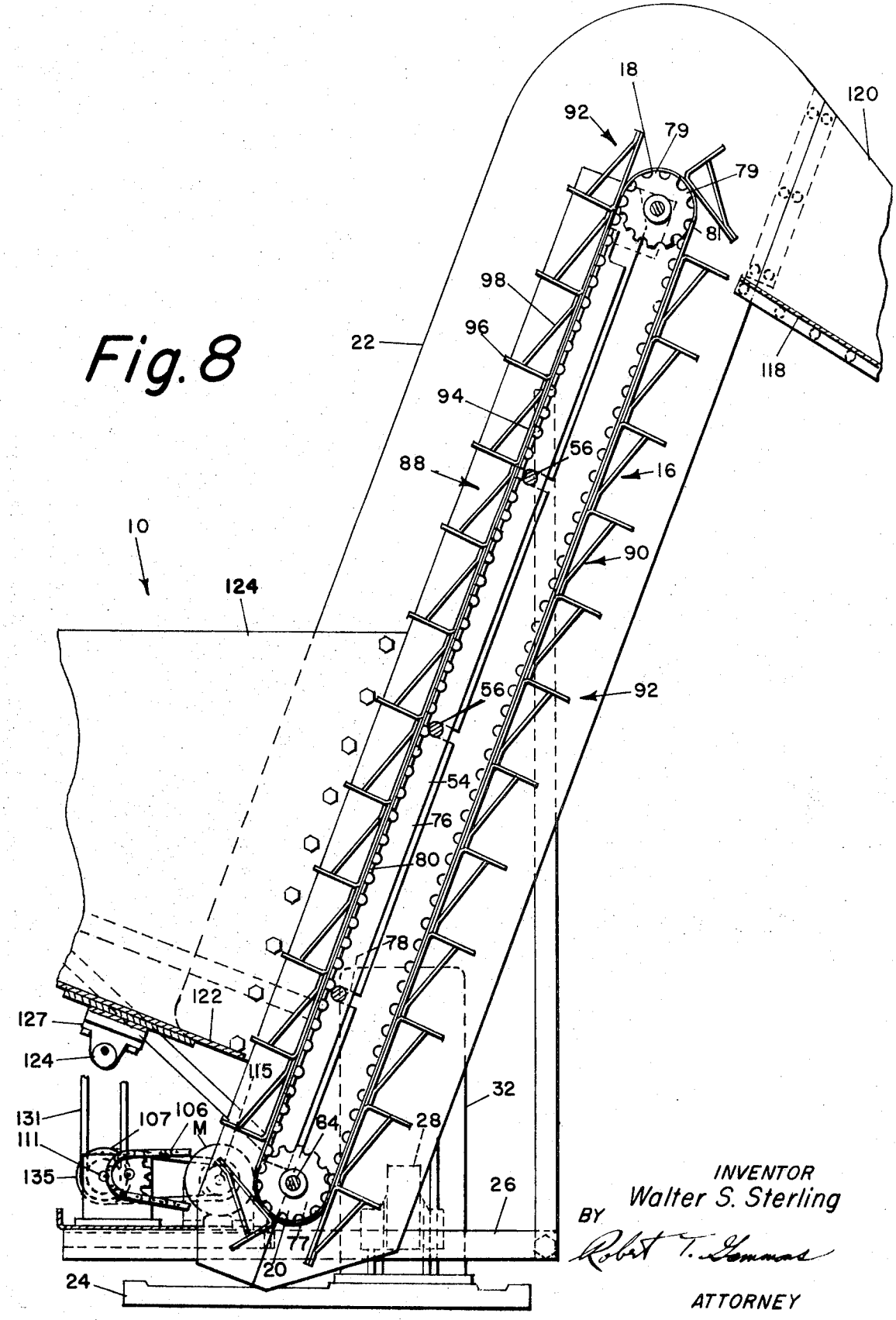
INVENTOR
Walter S. Sterling
BY
Robert T. Gammons
ATTORNEY

Fig. 7



INVENTOR
Walter S. Sterling
BY
Robert T. Hammond
ATTORNEY

Fig. 8



INVENTOR
Walter S. Sterling

BY
Robert T. Hammas

ATTORNEY

SEPARATING AND SORTING APPARATUS

BACKGROUND OF THE INVENTION

Apparatus for separating articles from each other for use is not new; however, the separation problems generally encountered are not particularly difficult especially where the items are more or less uniform in shape so that there is no matting or intertangling of the items of the mass. A single processing of a mixed mass of items which are not matted usually suffices to provide for a uniform delivery of items to the place where they are to be used. A problem arises, however, with respect to items of irregular shape, particularly such items as have appendages, such as aerosol caps. The caps are delivered to the user in cartons in an entangled intertwined mass which is very difficult to loosen to an extent to enable removing from the mass a uniform complement of caps and so using a single separating apparatus for effecting separation and distribution of the caps to, for example, a sorting machine is inadequate. In accordance with this invention two separators are employed, the first to separate the caps from the initial relatively solid mass from which it is difficult to remove more than a few at a time, deposit them in a second apparatus in the form of a loose mat and separate them from the loose mat in which a sufficient quantity may be accumulated to enable separating them from the mat continuously and uniformly for supply to the sorting apparatus.

SUMMARY

Apparatus for sequentially separating and distributing items from a mixed relatively compact mass of items having appendages so intertwined as to make separation difficult comprising providing tandemly arranged separators for successively operating on the mass, the first of which comprises a hopper having a sloping bottom onto which the compact mass is deposited, means at the lower end of the hopper against which the mass gravitates, said means being operable to effect oscillation of the mass so as to loosen the mass and means movable into engagement with said end to extract therefrom random complements of items and transfer them from the mass, the second of which comprises a hopper having a sloping bottom onto which the items transferred from the mass in the first hopper are deposited in the form of a loose mat, and means at the lower end of said second hopper against which the mat gravitates operable to extract therefrom a full complement of items and transfer them from the mat into the hopper of a sorting apparatus. The means for effecting oscillation and transfer of items from the hopper in each apparatus comprises a conveyor situated at the lower end of the hopper on which there are spaced parallel flights movable by the conveyor upwardly from the bottom of the hopper and which in succession repeatedly push, lift and release the mass at the lower end. The means for extracting loose items comprises combs carried by the flights movable upwardly from the bottom of the hopper. There is also means for vibrating the bottoms of the hoppers to assist in effecting loosening of the items from the mass in the first hopper and from the mat in the second hopper.

The invention will now be described in greater detail with reference to the accompanying drawings wherein:

FIG. 1 is a front elevation of the separating apparatus herein disclosed comprising tandemly arranged first and second separators and a sorting apparatus;

FIG. 2 is a plan view of FIG. 1;

FIG. 3 is a front elevation of the first separator;

FIG. 4 is a side elevation of FIG. 3 with portions broken away;

FIG. 5 is a plan view of the hopper of the first separator showing a portion of the conveyor apparatus to which it is attached;

FIG. 6 is an elevation of an item of the kind adapted to be processed by the apparatus;

FIG. 7 is a rear elevation of the separator shown in FIG. 3;

FIG. 8 is an elevation, taken on the line 8—8 of FIG. 3, with parts in section and other parts broken away;

FIG. 9 is a fragmentary elevation at the upper part of the separator shown in FIG. 3, to much larger scale, taken on the line 9—9 of FIG. 3; and

FIG. 10 is a plan view of one of the flights on the conveyor taken on the line 10—10 of FIG. 9.

Referring to the drawings (FIGS. 1 and 2), the apparatus comprises two separators A and B, identical except as to size, each comprising (FIG. 4) a hopper 10 supported at the lower end of an elevator 12 for receiving a mass of entangled items which are to be separated. Separator A is provided with means which will be described hereinafter for lifting a plurality of items upwardly from the hopper and discharging them in a condition of partial separation through an inclined discharge chute 14 into the hopper of the separator B for further separation and delivery to a sorting apparatus C.

Referring to FIGS. 4 to 9, the elevator 12 of the separator A comprises an endless conveyor 16 mounted on vertically and laterally offset upper and lower sheaves 18 and 20 within an upwardly inclined housing comprising spaced parallel plates 22—22 supported at their lower ends on a base 24 for a limited amount of vertical adjustment perpendicular to the base. Vertical adjustment is provided for by a horizontally disposed frame 26 which is secured at its opposite sides to guide blocks 28—28, the latter being vertically movable in vertically disposed openings 30—30 of a pair of spaced parallel stanchions 32—32 fixed at their lower ends to the base 24. A screw 34 is fixed to each of the blocks 28 at its lower end, extends upwardly through a bearing 36 at the top of the stanchion and through a threaded nut 38 rotatably secured to the upper side of the bearing 36. The nut 38 is internally threaded to receive the screw and externally toothed for engagement with a worm 40 adapted to be rotated by a handle 42 to in turn rotate the nut and hence raise or depress the screw according to the direction of rotation.

The frame 26 supports the lower ends of the plates 22—22 which are fastened thereto by bolts 44. Additional support is provided for by a pair of transversely spaced braces 46—46 fastened at their lower ends by bolts 48 to the frame 26 and at their upper ends by bolts 50 to the outer sides of the plates 22—22.

Substantially midway between the opposite edges of the side plates 22—22 there are fastened to the outer and inner sides supporting members 52—52 and 54—54, respectively, by means of transverse rods 56, the

ends of which extend through holes in the members 52—52, through holes in the plates 22—22 and through holes in the inner members 54—54. The supporting members 52—52 extend from the lower ends of the side plates to substantially the upper ends and provide means to which shaft bearing plates 57—57 and 58—58 are secured by bolts 60 and 62. The bearing plates 57—57 and 58—58 contain horizontally aligned openings within which are supported the end portions of transversely disposed, horizontally extending shafts 64 and 68. The bearing plates 58—58 (FIG. 9) contain elongate openings 70—70 so that the plates are adjustable rectilinearly on the bolts 62. A bracket member 72 is fastened to each of the supports 52 below each of the bearing plates 58 and supports an adjusting screw 74 with its upper end bearing against the lower edge of the bearing plate 58 so that by rotation of the screw 74 the bearing plate 58 may be moved to increase or decrease the distance between it and the bearing plate 57 at the lower end in which the shaft 64 is journaled. The supporting members 54—54 at the inner sides of the plates 22—22 are right-angular in section, having flanges 76—76 containing the holes for accommodating rods 56, which flanges 76—76 are parallel to and have contact with the inner side of the plate 22—22 and flanges 80—80 which project inwardly from the side plates 22—22 toward each other and which form spaced parallel supporting tracks.

A sprocket 77 is mounted on the lower shaft 64 and a sprocket 79 on the upper shaft 68, the sprockets being secured substantially midway between the opposite ends of the shafts. Each sprocket contains peripherally thereof a plurality of uniformly spaced, substantially cylindrical recesses 81 (FIG. 9). An endless conveyor 82 (FIG. 9) comprised of a plurality of flat parallel bars 84 connected at their adjacent ends by hinge elements 86 dimensioned to fit into the recesses 81 is entrained about the sprockets 77 and 79 so as to be movable continuously about the sprockets and to have an upwardly moving run 88 at the forward side which moves upwardly from the lower sprocket over the upper sprocket and a downwardly moving run 90 at the rear side which moves downwardly from the upper sprocket beneath the lower sprocket. A flight 92 (FIG. 9) comprising a combination agitator and elevator is fastened to every fifth one of the bars 84, each flight comprising a transversely elongate supporting plate 94 corresponding substantially in length to the distance between the side plates 22—22, at one end of which there is a right-angularly disposed flange plate 96 of corresponding transverse length and extending from one to the other across the angle of intersection is an angle plate 98. The flights are wedge-shaped and each is fastened to its bar by means of the supporting plate 94 with its base lowermost with respect to the direction of movement at the upwardly moving side of the conveyor, with the supporting plate 94 parallel to the bar and the flange plate 96 perpendicular thereto and substantially coinciding with the lower edge of the bar 84 to which the structure is attached. The opposite ends of the flights 92 are slidably supported by the tracks 54—54 and are carried upwardly on the one side with the apices formed by the convergence of the supporting plates 94 with the angle plates 98 moving in advance of the flange plates 96. Support for the flights at the upper end of the housing as they pass over the top of the sprocket 79 is provided for by a curved plate 100 (FIG. 3) having a portion adjacent the upper ends of the tracks 54—54 from which extend upward and rearward portions 102—102 which are concentric with the sprocket 79. At the rear side the downwardly moving run 90 of the conveyor requires no support. As shown in FIGS. 8 and 9 movement of the flights 92 over the upper sprocket 79 inverts them so that they travel downwardly in inverted positions and movement beneath the lower sprocket 77 toward the forward side restores them to their original upright position. Tracks 54*a*—54are provided intermediate the tracks 54—54 for supporting the opposite ends of the bars 84 and contain longitudinally thereof open notches for receiving the transverse rods by means of which the tracks 54—54 are secured to the side walls.

The conveyor is driven by means of a sprocket 105 fixed to the shaft 64 about which one end of a belt 106 is entrained, the other end of the belt being entrained about a sprocket 108 fixed to the shaft 110 of a gear reducer R mounted on the platform 26. The gear reducer R is driven by a shaft 111 mounted in bearings 113—113. The shaft 111 is adapted to be clutched to a shaft 115 on which there is a sheave 109. A belt 107 entrained about the sheave 104 and sheave 109 fixed to the shaft of a motor M drives the shaft 115 and hence the shaft 111 when the latter is clutched thereto.

At the top of the conveyor and at the rear side there is secured the discharge chute 14 which comprises a downwardly inclined flat bottom plate 118, the upper end of which is located in a position to receive an item dumped from a flight 92 as it moves toward its inverted position, as shown in FIG. 9, and guide it downwardly away from the apparatus. Spaced parallel side walls 120—120 are secured to the opposite edges of the plate 118 to contain the items as they travel down the chute.

The hopper 10 (FIGS. 4 and 5) has a flat, downwardly inclined bottom wall 122 and transversely spaced side walls 124—124. The lower ends of the side walls are disposed at the inner sides of the plates 22—22 and secured thereto by bolts 125. Additional support for the hopper is provided for by supporting bars 126—126 and 128—128 fastened, respectively, at one end by bolts 130 and 132 to the supporting members 52—52 and at their other ends to the side walls 124—124. The lower end of the bottom wall 122 terminates close to and parallel to the outer edges of the angle plates 96, sufficiently close so that items in the hopper cannot fall through and yet with sufficient clearance to permit the flights 92 moving upwardly from below the hopper through the bottom. As arranged the bottom wall 122 of the hopper is substantially at right angles to the path along which the flights 92 travel, the latter travelling along a path which is rectilinear throughout their movement from the bottom of the hopper to the top and comprising as they travel from bottom to top end portions of the hopper. Eccentrics 123—123 (FIGS. 2, 3 and 7) are mounted by means of a bracket 127 to the underside of the bottom wall 122 substantially midway between the opposite sides of the bottom wall and are driven by a sheave 129 fixed to the eccentric shaft, a belt 131 and a sheave 135 fixed to the shaft 111, the latter being driven by the gear reducer R. The eccentrics operate to vibrate the bottom wall 122 and

such vibration is transmitted to a considerable degree through supporting members supporting members **126—126** and **128—128** to the lower end of the conveyor.

The apparatus as thus described is designed especially for the purpose of separating compactly entangled articles such as aerosol caps. These caps, as shown in FIG. **6**, have a rigid head **138** of circular configuration from one side of which extends a long flexible stem **140**. The caps are manufactured and supplied by manufacturers to customers in quantity packed in cartons and when removed from the cartons for use are so interentangled that the entire mass is difficult to break down into individual units. The separator A thus far described herein is adapted to shake the mass loose so that individual components are freed and deliver them in relatively dispersed relation to each other to the separator B for further dispersion and delivery to the sorting apparatus C. The cartons in which the items are delivered are generally of a standard size and so the hopper **10** of the separator A is made somewhat wider in transverse dimensions than the carton in which the caps are delivered so that when the mass is dumped into the hopper it will be permitted to spread out to a certain extent and because of the inclination of the bottom and vibration imparted to the bottom gravitationally settle toward the lower end of the hopper and come to rest against one of the flights **92**. The flights **92** are moved upwardly by the conveyor at a relatively high speed and as each flight enters the bottom of the hopper the leading end which comprises an entering wedge and the angle plate **98** rearwardly thereof pushes the mass rearwardly, that is, upwardly along the downwardly inclined bottom of the hopper. Rearward movement is accompanied by an upward movement perpendicular to the bottom imparted thereto by the flange plates **96** which are moving at right angles to the bottom and this combined rearward and upward movement at such a rapid rate jostles the mass sufficiently to loosen individual caps from the mass. The distal edges of the flanged plates **94** are toothed and as they move upwardly through the lower end of the mass they comb individual caps from the loosened mass carrying them upwardly. The teeth **142** are uniformly distributed lengthwise of the flanged plates **96** (FIG. **9**) and have V-shaped spaces **144** between them. The lower edges of the angle plates **98** intersect the flange plates **96** close to the base line of the teeth so that the heads **138** of the caps, by engagement with the angle plates, are held in positions such that the stems **140** are not permitted to become wedged at the bottoms of the V-shaped spaces between teeth. Some caps are lifted without being captured between the teeth by entanglement with caps that are captured between teeth but these are ultimately discarded both by the angle plate **98** which fends them off, preventing them from settling into secure positions and by the vibration transmitted from the hopper to the elevator. By the time the items trapped between teeth reach the top of the conveyor most of the loose untrapped caps have fallen back into the hopper. The caps that are retained are randomly distributed so that there is seldom any intertwining of the stems depending at the underside. As the flights pass over the upper sprocket and are inverted the caps are dumped onto the inclined bottom wall **118** of the discharge chute **14** and slide downwardly into the hopper of the separator B where a second processing takes plate. Because of the compaction of the initial mass relatively few caps are extracted by the upwardly moving flights and sometimes none, so that delivery of caps to the hopper of the separator B is spasmodic. The separator B is provided with a hopper approximately half the size of the separator A and the flights therein are about half the width. Consequently, the caps dumped into the hopper of the separator B collect in a relatively uniform loose mat in contrast to the solid mass in the hopper of the separator A. Oscillation and combing action provided by the separator B is accordingly much more effective and instead of removing random complements of caps the elevator of the separator B removes relatively uniform complements of caps from the mat for delivery to the hopper of the sorting apparatus.

The provision of two separators in tandem enables a uniform and continuous supply of caps to the sorting apparatus which would not otherwise be possible for the reason that a single separator is not capable of separating the caps from the compacted mass fast enough to provide for continuity of delivery. In other words, relatively few caps are disentangled from the solid mass by each flight of the separator A and sometimes none at all and so a continuous delivery of caps directly to a sorting machine could not be hoped for — the delivery at most being somewhat sporadic. By employing the second separator the somewhat random delivery of caps from the first separator accumulate in the form of a loose mat in sufficient quantity so that the second separator operates to deliver a full complement of caps to each flight of the conveyor so that the latter is capable of delivering a continuous supply of caps to the hopper of the sorting apparatus.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents falling within the scope of the appended claims.

I claim:

1. Apparatus for sequentially separating and distributing items from a mixed, relatively compact mass of items having appendages so intertwined as to make separation difficult, comprising providing tandemly arranged separators, the first separator comprising a hopper having a downwardly sloping bottom wall onto which the compact mass is adapted to be deposited, and spaced parallel side walls for retaining the mass on said bottom wall, means at the lower end of the hopper against which the entire mass gravitates and is supported, said means comprising an upwardly inclined conveyor extending upwardly from the lower end of the bottom wall between the side walls beyond the top, the portion the conveyor travelling upwardly in the hopper at any time comprising a closure at the lower end of the hopper and the portion of the conveyor above the hopper operating to carry items separated from the mass upwardly away from the hopper to a place of discharge, said conveyor extending entirely across the hopper from side wall to side wall and spaced parallel flights on the conveyor disposed transversely thereof from side wall to side wall and extending forwardly from that portion of the conveyor travelling upwardly in the lower end of the hopper, and means for effecting

movement of the conveyor to cause the flights to travel upwardly from the bottom against the mass resting against the portion of the conveyor at the lower end of the hopper to effect repeated oscillation of the mass, said flights embodying means for scraping items from said ends of the mass and for entraining random items scraped from said end and carrying them upwardly out of the hopper for discharge into the hopper of said second separator, and said second separator comprising a hopper having a downwardly sloping bottom onto which items transferred thereto from the first separator are deposited in the form of a loose mat, and means at the lower end of the second hopper against which the mat gravitates operable to remove therefrom uniform complements of items and transfer them to the hopper of a sorting apparatus.

2. Apparatus according to claim 1, wherein the means for entraining random items from the mass are combs carried by the flights upwardly through the mass.

3. Apparatus according to claim 1, comprising means vibrating the bottom of the hopper of the first separator.

4. Apparatus according to claim 1, wherein the hopper of the first separator is adapted to receive an unbroken mass of predetermined dimensions and the hopper of the second separator is approximately half the volume of the first.

5. Apparatus for sequentially separating and distributing items from a mixed, relatively compact mass of items having appendages so intertwined as to make separation difficult, comprising providing tandemly arranged separators, the first separator comprising a hopper having a sloping bottom onto which the compact mass is adapted to be deposited, means at the lower end of the hopper against which the mass gravitates, said means being operable to effect oscillation of the mass so as to loosen items from the mass, and means movable in engagement with said end to remove therefrom random complements of items and transfer the same to the second separator; said second separator comprising a hopper having a sloping bottom onto which the items transferred thereto from the first separator are deposited in the form of a loose mat, and means at the lower end of the second hopper against which the mat gravitates operable to remove therefrom uniform complements of items and transfer them to the hopper of the sorting apparatus, said means at the lower end of each hopper comprising an endless conveyor supported with one run adjacent the lower end of the hopper for movement upwardly relative to the bottom of the hopper and transversely disposed flights mounted on the conveyor movable thereby upwardly relative to the bottom of the hopper, each flight embodying a flat plate having a transverse flight corresponding substantially to the width of the hopper at the lower end, and inclined downwardly and away from the hopper with respect to the direction of movement.

6. Apparatus according to claim 5, wherein there is a comb at the distal edge of each plate substantially perpendicular to the direction of movement.

7. Apparatus for separating items from a mixed mass of entangled items comprising a hopper having a sloping bottom such that the mass gravitates to the lower end, means adapted successively to become an end portion of the hopper at the lower end, said means comprising an endless conveyor, supported with one run adjacent the lower end of the hopper for movement upwardly relative to the bottom, said conveyor comprising transversely disposed flights, mounted on the conveyor movable thereby upwardly relative to the bottom of the hopper, each flight embodying a flat deflector plate having a transverse length corresponding substantially to the width of the hopper, and inclined downwardly and away from the conveyor with respect to the direction of movement, which pushes the mass upwardly on the bottom, and means associated with the deflector plate for catching such items as from time to time occupy a predetermined position in the loosened mass to lift said items from the mass.

8. Apparatus according to claim 7, wherein the last means is adapted to retain items which occupy said predetermined position when intercepted and to reject items not so positioned.

9. Apparatus according to claim 7, wherein the last means embodies transversely spaced combs adapted to intercept items which occupy said predetermined positions to extract them from the mass.

10. Apparatus according to claim 7, wherein the movement of the parts while constituting end portions of the hopper is rectilinear.

11. Apparatus according to claim 7, wherein there are elevator plates at the lower edges of the deflector plates disposed at right angles to the direction of movement of the conveyor, and wherein said means for catching items to lift them from the mass comprise transversely disposed spaced notches at the distal edges of the elevator plates.

12. Apparatus according to claim 7, wherein the conveyor is supported on spaced parallel sheaves for continuous movement of one run upwardly relative to the hopper and the other run downwardly relative to the hopper, and wherein the line of centers of the sheaves is situated at an angle to the bottom of the hopper such that the upwardly moving run is substantially at right angles to said bottom.

13. Apparatus according to claim 7, wherein the deflector which forces the mass away from the lower end comprises a flat plate disposed at an angle of approximately 30° to the upwardly moving run of the conveyor and the elevator which lifts the mass is a flat plate disposed at right angles to said upwardly moving run of the conveyor.

14. Apparatus according to claim 7, wherein the conveyor comprises pivotally connected links to which are fixed the flights and wherein as each flight passes over the upper sheave to the downgoing side it is inverted so as to dump the items caught thereby.

15. Apparatus for separating items from a mixed, relatively solid mass of items, wherein the items comprise rigid parts from which extend elongate, flexible appendages, and wherein the appendages are so entangles within the mass as to require loosening of the mass to separate individual items therefrom; comprising a hopper having a flat sloping bottom such that a mass of entangled items deposited in the hopper will gravitate toward the lower end, means at the lower end of the hopper adapted successively to become an end portion of the hopper, said means comprising a plurality of flights movable rectilinearly at said lower end in a

direction from the bottom upwardly into engagement with the mass, each flight embodying a transversely disposed plate situated substantially at right angles to the direction of movement of the conveyor while comprising an end portion of the hopper, said plate having a toothed edge, the distances between the teeth being less than the major dimension of the rigid part of the item and greater than the flexible appendage, such that said toothed plate will hold items in suspension with their rigid parts resting against its upper side and with the flexible appendages descending therefrom, and each flight operating to push the mass away from the lower end of the sloping bottom and to lift the mass upwardly from the bottom, and means for effecting said movement of the flights in such a way as to jostle items loose from the end of the mass resting against said flights.

16. Apparatus according to claim 15, wherein the spaces between teeth are dimensioned to accommodate but a single item.

17. Apparatus according to claim 15, comprising a part situated along the root line of the teeth for limiting the entrance of items into the spaces between teeth to a position such that the flexible appendages are held away from the bottoms of the tooth spaces and so remain loose in said spaces.

18. Apparatus according to claim 15, wherein the distance between successive flights is greater than the length of the flexible appendages.

19. Apparatus according to claim 15, comprising means for effecting vibration of the bottom of the hopper at its lower end.

20. Apparatus according to claim 15, comprising an eccentric operably associated with the bottom of the hopper at its lower end, and means for effecting rotation of the eccentric to effect vibration of the bottom.

21. Apparatus according to claim 15, comprising means for effecting vibration of the lower end of the conveyor.

22. Apparatus according to claim 15, comprising eccentric means operably connected with the bottom of the hopper at the lower end, means for effecting rotation of the eccentric and hence vibration of the bottom at the lower end of the hopper, and means connecting the eccentric to the lower end of the conveyor for effecting vibration of the conveyor simultaneously with the vibration of the hopper.

23. Apparatus according to claim 15, wherein the distance between the side walls of the hopper is greater than that of the compacted mass to allow an initial expansion of the mass.

24. The method of separating from a relatively solid mass of items for deposit in the hopper of a sorting apparatus, comprising effecting an initial separation by depositing the mass in a hopper of larger dimension than the mass to permit an initial spreading of the mass, subjecting an end of the mass to repeated oscillation to effect loosening, successively combing from said end random complements of loosened items, transferring the items combed from the mass to a second hopper of small dimension in the form of a continuous mat, subjecting an end of the mat to repeated oscillations to effect loosening, successively combing from said end continuous complements of items and transferring said items to the hopper of a sorting apparatus.

25. The method of separating from a relatively solid mass of items embodying appendages intertwined with each other comprising effecting an initial separation by depositing the mass in a hopper of larger dimensions than the mass to permit initial spreading of the mass, subjecting an end of the mass to repeated oscillations to effect loosening, successively combing from said end random complements of loosened items, forming a continuous mat of the random complements of items, successively combing from said mat uniform complements of items and transferring the uniform complements of items to a sorting apparatus.

26. The method of separating items from a relatively solid mass of items embodying appendages intertwined with each other in the mass, comprising reducing a compact mass of such items to its component items by repeatedly shaking the mass to loosen items in the mass, successively combing random complements of items from the mass, forming a continuous mat of the items randomly combed from the mass, successively combing uniform complements of items from the mat and transferring the uniform complements of items to a sorting apparatus.

27. The method of sequentially separating and distributing items from a mixed relatively compact mass of items having appendages so intertwined as to make separation difficult, comprising subjecting the mass to repeated oscillations and vibrations such as to loosen some of the items from the mass, successively combing from an end of the mass random complements of items, forming a continuous mat of the random complements of items, successively combing from the mat full complements of items and transferring the items combed from the mat to a sorting apparatus.

28. The method of separating from a relatively solid mass of items embodying appendages intertwined with each other in the mass comprising depositing the mass in a hopper of larger dimension than the mass to permit an initial spreading of the mass to the larger dimension of the hopper, oscillating the mass in the hopper to loosen items in the mass, and successively combing loosened items from the mass until the mass is completely disseminated.

29. The method of separating from a relatively solid mass of items embodying appendages intertwined with each other in the mass comprising depositing the mass in a hopper of larger dimension than the mass to permit an initial spreading of the mass to the larger dimension of the hopper, oscillating the mass in the hopper to loosen items within the mass, successively combing random complements of items from the mass, transferring the random complements to a hopper of smaller dimensions to form a continuous mat therein, oscillating the mat in the hopper, successively combing uniform complements of items from the mat, and transferring the uniform complements from the mat to the hopper of a sorting apparatus.

30. A method according to claim 29, comprising depositing the mass in a hopper having an inclined bottom such that the mass gravitates toward the lower end, effecting oscillation of the mass by repeatedly pushing the mass away from the lower end and releasing it, and successively removing random complements of loose items from the lower end by combing upwardly through the mass from the bottom.

31. A method according to claim 29, comprising transferring the randomly combed complements to a second hopper in the form of a continuous mat, effecting oscillation of the mat, and successively removing uniform complements of items from the mat by combing upwardly through the mat.

32. A method according to claim 29, comprising vibrating the mass and the mat.

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