United States Patent [19]

Lewis, Jr.

[11] **3,774,782**

[45] **Nov. 27, 1973**

[54] **MACHINERY FOR HANDLING SYNTHETIC FILAMENT**

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[73] Assignee: **Tucel Industries, Inc.**, Middleburg, Vt.

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[21] Appl. No.: **193,855**

[52] **U.S. Cl.** ..... **214/6 D**, 53/236, 193/43 R, 214/6.5, 221/163

[51] **Int. Cl.** **B65g 57/18**

[58] **Field of Search** ..... 214/6 D, 6 H, 6 M, 6 S, 6.5; 53/236; 193/43 R, 43 D; 221/163 214/6 N,

[56] **References Cited**

UNITED STATES PATENTS

2,214,814	9/1940	Hambleton	214/6 D
2,853,170	9/1958	Logden et al.	193/43 R
3,217,461	11/1965	Wheelock	214/6 D X

Primary Examiner—Robert J. Spar
Attorney—Robert E. LeBlanc et al.

[57] **ABSTRACT**

A method and apparatus are presented for aligning and orienting cut-to-length synthetic filaments or the like in parallel relationship for use directly in brush-making or tufting machines, or for packaging or bundling. The apparatus of this invention includes a housing through which nonaligned filaments are allowed to fall. A conduit extending diagonally into a central portion of the housing selects oriented filaments and conveys them to an aligning groove. In the aligning groove the filaments are aligned longitudinally in parallel relationship and allowed to settle into a straightening section. In the straightening section the filaments surround a plurality of pins extending from a trim plate disposed perpendicularly to the longitudinal axes of the filaments. Vibrating means vibrates the trim plate and the pins mounted thereon to further align the filaments in parallel relationship and to align the ends thereof in a common plane. The straightening section may feed directly to a stock box for use in a brush-making or tufting machine, or to conventional bundling or packaging apparatus.

16 Claims, 7 Drawing Figures

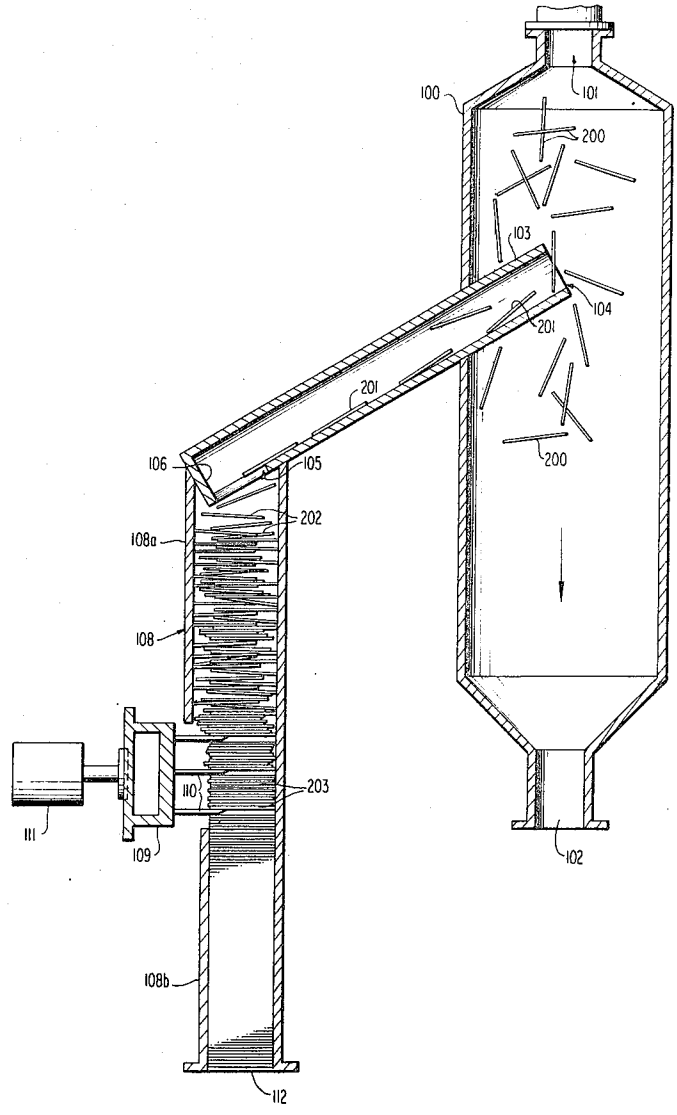


FIG.1

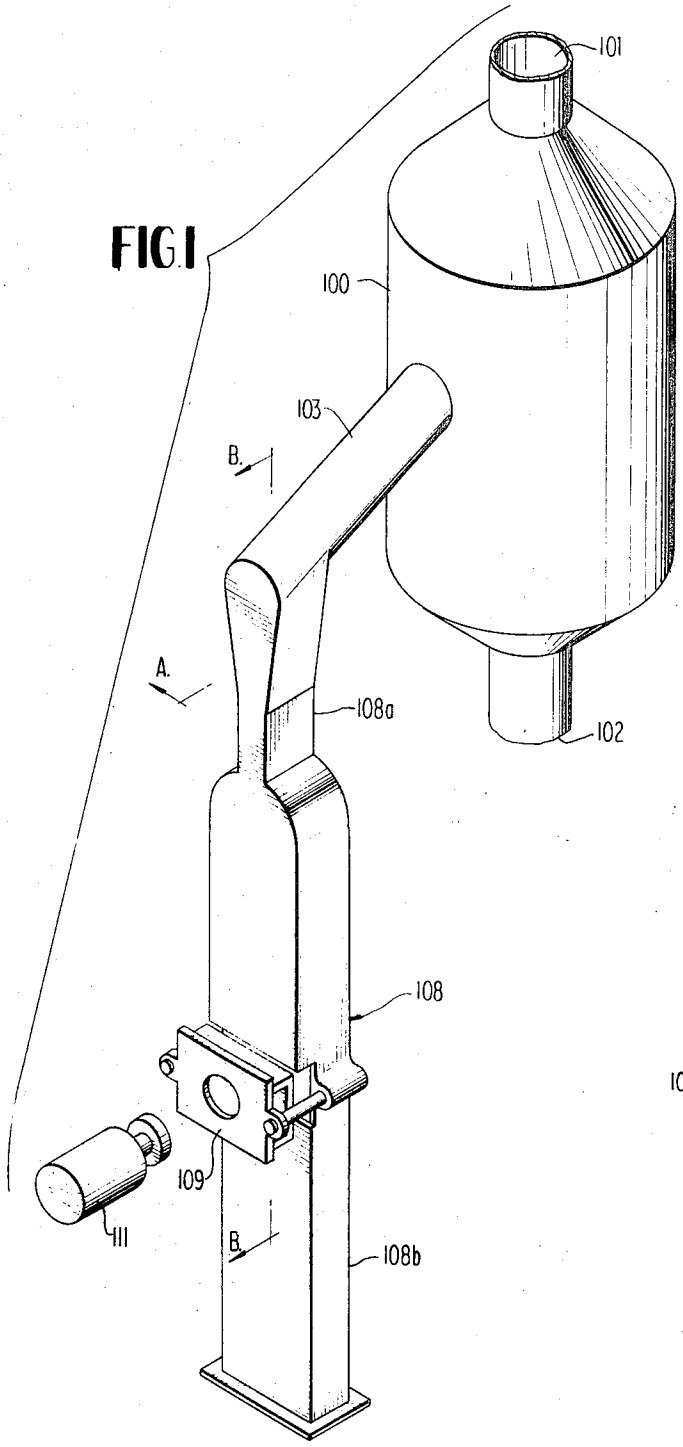

101
100
103
B.
A.
108a
102
108
109
111
B.
108b

FIG.3

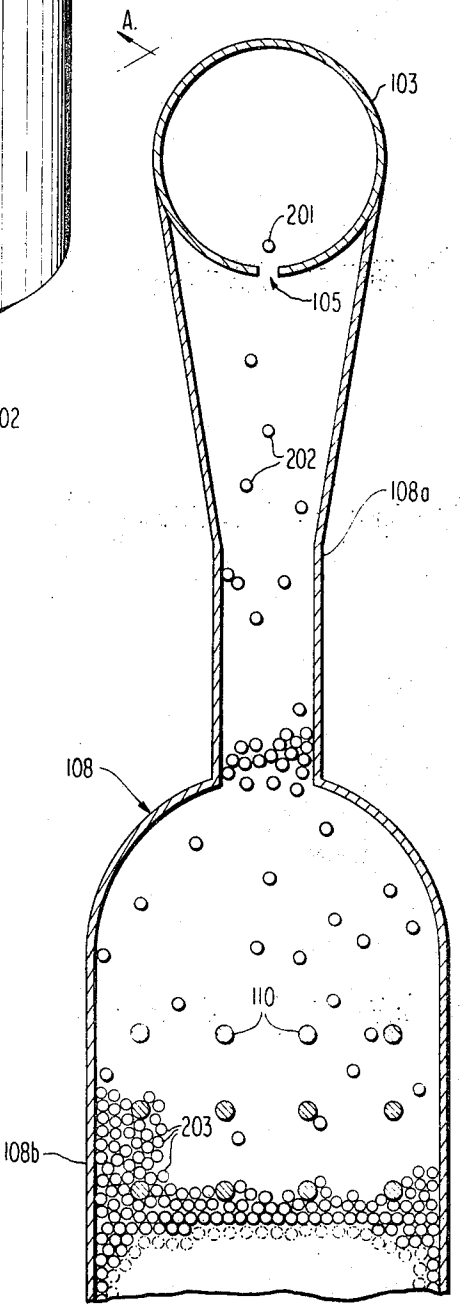

A.
103
201
105
202
108a
108
110
203
108b

FIG.2

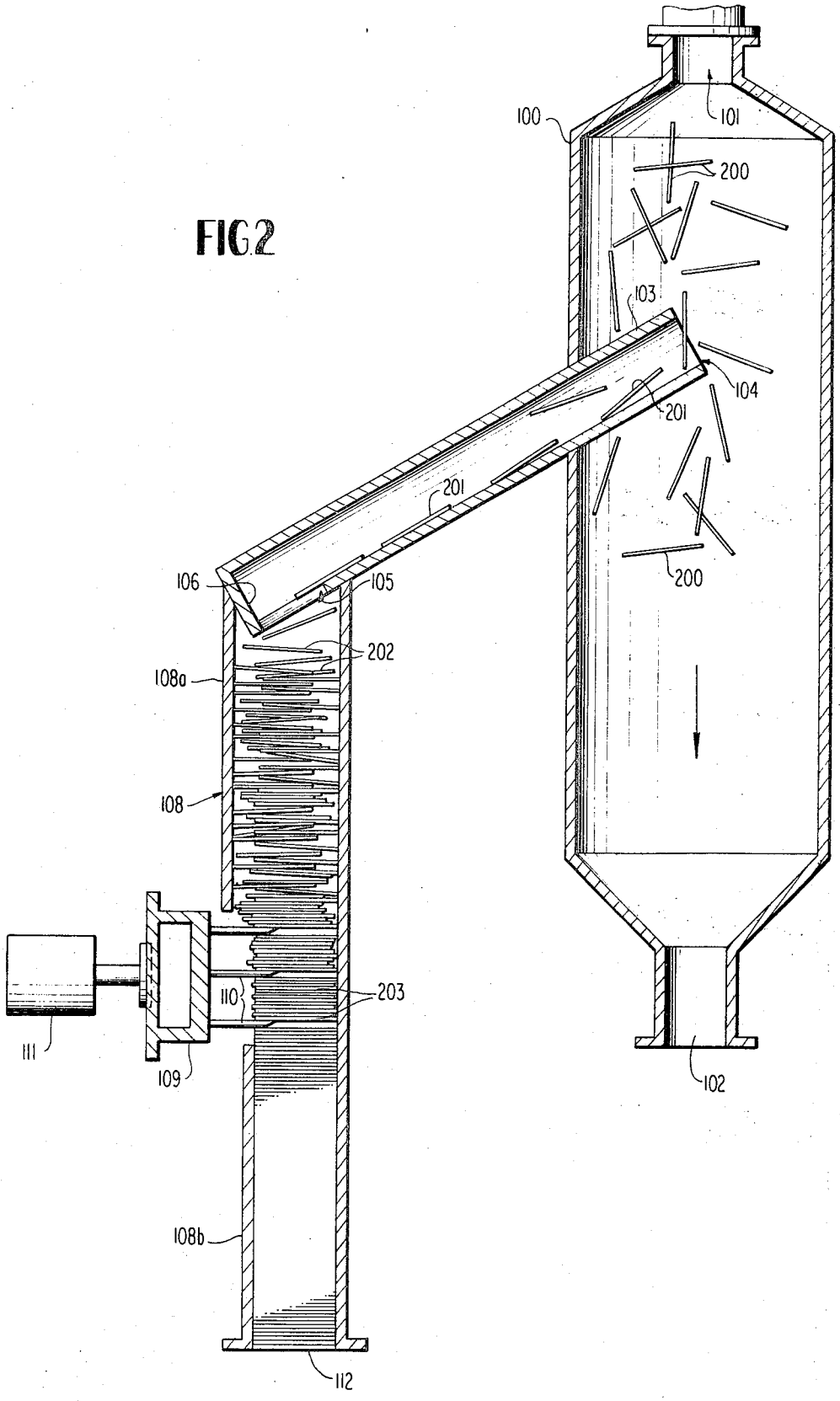

100
101
200
103
104
201
201
200
106
105
202
108a
108
110
203
111
109
102
108b
112

FIG. 4A

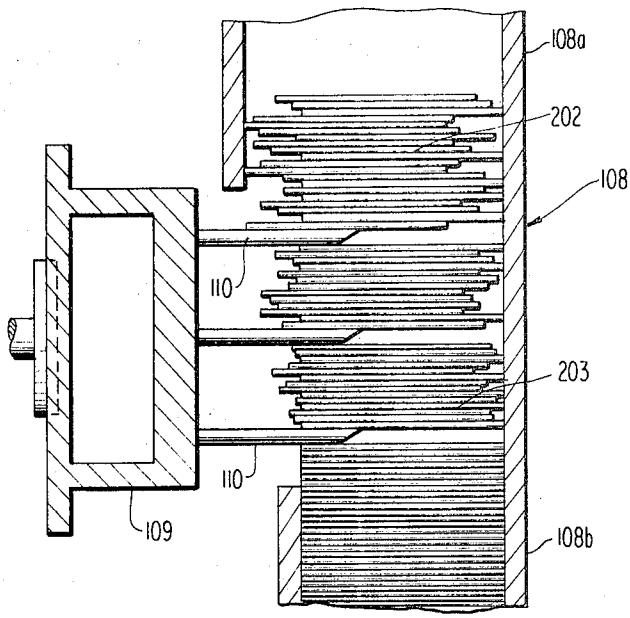


FIG. 4B

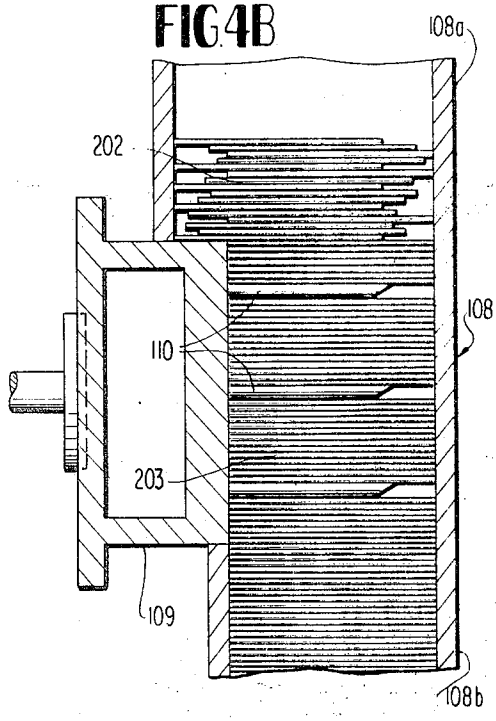
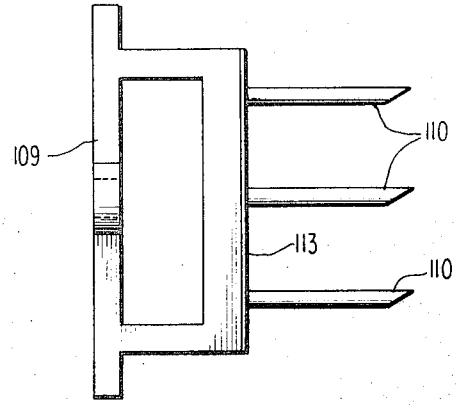


FIG. 5A



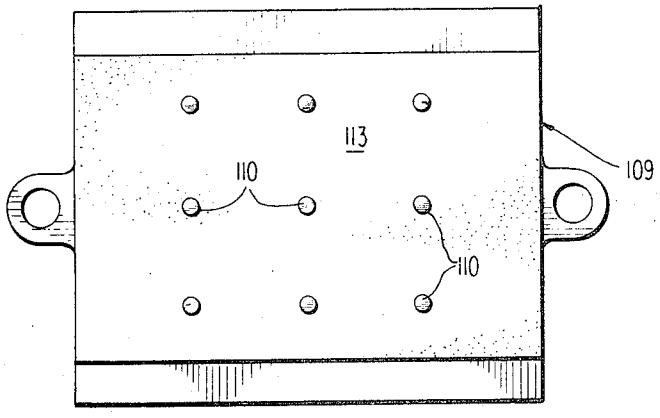


FIG. 5B

MACHINERY FOR HANDLING SYNTHETIC FILAMENT

This invention relates to new and useful machinery for loading cut-to-length synthetic filaments into stock boxes for use on tufting machines. More specifically, it is concerned with loading and aligning non-oriented short length filaments into a brush machine stock box in parallel relationship in order that the filaments may subsequently be picked with single-tuft stapling equipment or with multiple picking fixtures.

Synthetic filaments, when used to produce brushes and related articles, must first be loaded into a stock box or magazine in parallel relationship with all longitudinal axes of the filaments in the same plane or parallel thereto.

Filaments are supplied in different packages, but always must be wrapped or contained in some type of bundle in order to keep the short filaments aligned prior to loading the stock box. Methods of packing filament have been set forth in U.S. Pat. Nos. 2,581,561 and 3,589,409. However, in each instance, filaments must be contained in their package by first cutting said filaments from a group of longer filaments held together in parallel relationship. After the filaments are cut to a specific length, they must be contained, for if they are allowed to become mis-aligned, they can not be packaged.

This invention is concerned with orienting filaments cut from a plurality of long parallel aligned synthetic filaments into short pieces without the aid of containing means, and specifically this invention is directed to subsequently orienting the loose and mis-aligned filaments in parallel relationship within a filament stock box or other container.

With the new and improved methods and machines for tufting brushes and other tufted products it has become necessary to load filament stock boxes three, four and sometimes five times faster than was necessary with conventional tufting machines. Within the time rrequired it is impossible for an operator to load small, two and three inch diameter cuts of filaments, one bundle at a time, into a stock box. Also, it is not desirable to employ bulk packages of cut filaments, because of the time required for the operations of opening, loading and removing the container in order to fill a stock box. This invention, however, eliminates the need for hand loading of filaments, and for having the operator constantly check the level of filaments within the stock box.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom or may be learned by practice with the invention, the same being realized and attained by means of the combinations, compositions and improvements pointed out in the appended claims.

The invention resides in the novel steps, methods, apparatus, and improvements thereof hereinafter shown and described.

While this invention is primarily concerned with new and novel filament aligning machinery for loading stock boxes, it should be realized that this invention is applicable to aligning filament for bundling or wrapping. The principles of this invention are attained through the novel combination of isolating individual cut-to-length filament pieces, allowing each piece to align itself by means of gravity, and the employement

of a vibrating pin means along the longitudinal axis of the filament within the stock box.

It is therefore an object of this invention to provide a filament container for dispensing cut-to-length synthetic filaments having automatic filament aligning elements. Another object of this invention is to provide machinery for loading cut-to-length filaments automatically into filament stock boxes, wherein the machinery is an integral part of the stock box. A still further object of the invention is to provide a mechanical loading device wherein loose, mis-aligned cut-to-length synthetic filaments may be automatically loaded into a filament-retaining stock box, thus providing the brush maker and other manufacturers with means for eliminating hand loading of said filament.

A still further object of this invention is to provide a loading device capable of loading automatically, loose cut-to-length synthetic filaments from a bulk storage bin, and combining more than one type of filament in a predetermined ratio, in order to arrive at a mixture of filament, into a filament package or filament retaining stock box. Yet another object of this invention is to provide a filament-dispensing stock box having means for aligning and positioning filaments into the proper attitude for subsequent tuft formation.

Another object of this invention is to provide a new and improved method and apparatus for loading and retaining loose, cut-to-length synthetic filaments into filament stock boxes.

The term "filament" as used hereinafter is to apply to those synthetic monofilaments which are formed from linear thermoplastic polymers from the group consisting of polystyrene and polystyrene co-polymers, polyvinyl chloride and polyvinyl chloride-acetate co-polymers, polyethylene, polypropylene, polyethylene-polypropylene co-polymers, polyamides, polyimides, polyesters and polyurethane. Both oriented and unoriented monofilaments may be employed.

Also, various cross-sectional shapes may be imparted to the monofilaments, such as circular, lobular, trifoil, X and Y cross-sections, triangular, polygonal, star, etc. Mixtures of synthetic monofilaments may be employed in cases where the compositions of the monofilaments are compatible during any fusing or stapling operations, i.e. heat fusing the non-working ends of the filaments in order to form a filament tuft. Such filament may have suitable crimp imparted to its length or a portion thereof.

Filaments to be automatically loaded into a stock box according to this invention may have lengths of from about 0.50 inches up to and including lengths of about 15 inches. The diameter of the filaments may range from about 0.0050 inches to about 0.50 inches.

The term "picking" refers to the picking of a filament tuft from a storage container or filament stock box. The picking can be the conventional type employed on a stapling brush machine or can be the type referred to in my U.S. Pat. No. 3,471,202 where more than one filament tuft may be picked simultaneously. In both instances, filaments are removed from the filament stock boxes.

The term "filament stock box" refers to any type of container employed for holding cut-to-length synthetic filament in a parallel disposition longitudinally, with the ends thereof lying in a common plane, prior to picking or advancement of said filament into a brush making operation. An example thereof is described and

claimed in my U.S. Pat. No. 3,563,609. Such stock boxes may be employed in machinery consisting of staple-setting, strip-brush making, paint-brush equipment, etc.

The term "aligning pins" refers to rigid longitudinal elements employed within the filament stock box proper. These pins engage the filaments along each filament's longitudinal axis and align the filament by contact therewith. Each filament along the pins' sides as well as the adjacent filaments are thereby kept in parallel disposition. The pins are also vibrated according to this invention in order to facilitate alingment of adjacent filaments.

To load the filament in a stock box, loose filament is fed into the top of a housing by means of a conveyor, or other suitable means, such as forced air, and subsequently allowed to cascade downward by forces of gravity. As the falling filament begins to twist and tumble, it engages the open end of a hollow conduit. The hollow conduit leads to a constricted aligning groove. If the filament is oriented in a position which will allow it to enter the conduit, it continues to fall but follows the path through the conduit leading to the stock box or packing apparatus.

If the falling filaments are unable to enter the hollow conduit, or if entry is averted by other falling filaments, they simply continue to fall to the bottom of the housing, where they are collected and returned to the conveying means for another pass through the housing unit. The filaments which enter the hollow conduit pass therethrough into the groove. The groove provides a means for aligning the filament longitudinally, and for stacking the filaments on the preceding filaments therein. As the aligned, parallel filaments move downward, they are vibrated by aligning pins, which continue to align and settle the filaments. The pins are carried by a vibrating plate which aligns the ends thereof in a common plane. The filaments, after passing this point are disposed in a proper aligment for subsequent usage, or can be bulk packaged for future use in separate container.

The accompanying drawings referred to herein and constituting a part hereof illustrate a preferred embodiment of the appratus and together with the following description serve to explain the principles of this invention.

IN THE DRAWINGS

FIG. 1 is a perspective view in partial section of the automatic filament loading device of this invention.

FIG. 2 is a cross-sectional view of the filament loading device of FIG. 1 taken along line A—A.

FIG. 3 is a cross-sectional view of a portion of the filament loading device of FIG. 1 taken along lines B—B of FIG. 1.

FIG. 4A is a cross-sectional view of alignment pins and alignment trim plate of this invention in an open position.

FIG. 4B is a cross-sectional view of alignment pins and alignment trim plate in a closed position.

FIG. 5A is a cross-sectional view of a trim plate of this invention showing the alignment pins.

FIG. 5B is a front view of FIG. 5A showing one arrangement of the alignment pins.

Referring now to the drawings, the filament housing **100** shown in FIGS. **1** and **2** may be of any general shape, but is preferably circular in cross-section, and of a length of at least 12 inches. The further filaments **200** fall, the more each filament will tend to separate and orient itself in a desirable attitude for entering the selection tube **103** extending into housing **100.** Tube **103** conveys filaments to the aligning frame **108** wherein the filaments are aligned primarily by trim plate unit **109** and mounting pins **110,** which are vibrated by means **111.**

FIG. **3** illustrates the aligning area **108***a* and straightening section **108***b* within frame **108.** Aligning area **108***a*, as shown in FIG. **2,** must be no wider than one-half of the length of the filament passing therethrough.

FIGS. **4A** and **4B** illustrate how the vibrating trim plate **109** and pins **110** transfer vibrating forces to align the filaments within frame **108,** and how the filaments **203** are therein oriented in parallel disposition.

FIG. **5A** and **5B** illustrate one specific pattern in which the alignment pins **110** may be positioned on the trim plate **109.** This invention comtemplates any desired pattern for pins **110,** and other cross-sectional shapes therefor may be employed.

In order to describe the invention more fully, reference is now made to specific embodiment illustrated in FIGS. **1–3** of the drawings. The invention is directed specifically to a method and apparatus for orienting cut-to-length synthetic monofilaments, however, the apparatus and method are equally adaptable to situations wherein such items as match sticks, straws, and the like may be oriented in parallel attitudes, and subsequently packaged.

Cut-to-length filaments **200** are conveyed by any well known, suitable means to the filament housing portion **100** of this invention, entering at opening **101.** The filaments **200** are then allowed to free-fall through the interior of the housing **100,**from top to bottom. The opening **101** may be located at or near the top of housing **100,** and should be large enough to allow easy passage of filaments **200** therethrough. Suitable forced air blast apparatus and/or mechanical paddles (not shown) may be located at the opening **101** to insure proper movement of the filaments **200** through opening **101,** as well as to serve to spread the loose filaments **200** evenly across the interior housing **100.** Under normal circumstances, the filament **200** will fall downward in random fashion toward the opening **102** at the bottom of the housing. However, in the apparatus of this invention, there is located within housing **100** a selection tube **103** which has an open end **104** projecting diagonally into housing **100.** Tube **103** serves as the means to select and convey properly oriented filaments **201** from the bulk filament **200** which constantly circulates through housing **100.** As filaments **200** fall, if properly oriented, they engage the selection tube **103** at its open end **104** and fall or slide down the tube. Filaments **201** are illustrative thereof. FIG. **2** shows the filaments' movement through tube **103** toward the tube's end **106,** where there is located an opening **105,** which serves to further orient the filament.

The end **106** of the tube **103** acts as a stop for slowing and stopping the filaments **201** prior to the exit thereof through the opening **105.** Filaments **201** then fall onto the filaments **202** contained in the aligning groove area **108***a*.

Filaments **202** in this section of frame **108** are aligned in parallel and restrained from twisting by the design of of the aligning groove area **108***a*.

The filaments **202** then enter straightening section **108***b*, wherein the vibrating aligning pins **110** and trimming plate **109** serve to subject the filaments **202** to forces sufficient to align the ends of the parallel filaments **203** while retaining lengthwise alignment so that all adjacent filaments **203** in section **108***b* have the same trim. In other words, if 1 inch length filaments are used, after the filaments pass through the apparatus, the trim of all the filaments aligned would be one inch. At this section within frame **108**, the filaments **203** may be further processed, either packaged or picked directly from within.

With attention to FIG. 2 the trim plate assembly **109** having pins **110** extending perpendicularly from a face thereof preferably is attached to a conventional vibrator **111**. Although any conventional vibrating apparatus may be utilized within the scope of this invention a preferred type which may be utilized is an electromagnetic vibrator having a one-half inch stroke displacement and operating at approximately 3,000 cycles per minute.

The oriented and aligned filaments **203** exit the straightening section **108***b* and opening **112**. It will be obvious to those skilled in the art that a brush machine stock box (not shown) may be attached at opening **112** and filled directly and automatically by the apparatus of this invention. In addition, a plurality of the machines of this invention may be utilized to automatically fill a single stock box, each machine orienting and aligning a different colored filament with the opening **112** of each machine adapted to feed a common stock box.

In addition, a conventional packaging or bundling machine may be mounted at opening **112** to bundle or package the filaments **203** exiting therefrom, automatically.

Furthermore, as noted, above, the apparatus of this invention may be utilized for aligning and orienting a variety of other cylindrical or tubular elements such as match sticks or straws for packaging, if desired.

With reference to FIGS. **5A** and **5B**, the face **113** of trim plate assembly **109** mounting pins **110** is adapted to vibrate against the ends of filaments **203**. Although the face **113** may be smooth, in the preferred embodiment of this invention the face is roughened to frictionally hold the ends of said filament against the opposite wall of frame member **108**. If the assembly is constructed of metal the face **113** may be sandblasted to achieve a mat finish, or the face may be covered with emory paper or sand paper, as desired.

The following examples describe operation of the apparatus of this invention to align and orient cut-to-length synthetic filaments.

EXAMPLE 1

Cut-to-length polypropylene filaments having an average diameter of 0.012 inch and a length of one and one-half inches were allowed to fall loosely through the housing **100**. Certain filaments fell into the opening **104** of the selection tube **103**, and subsequently travelled by gravity along the tube until they passed through the bottom opening **105** therein. The filaments continued to move downward within the frame member **108**, and aligned filaments were removed from the bottom opening **112**. Within frame **108** the filaments moved through the vibrating aligning pins **110** and trim plate **109**, and were subsequently contained within a stock box. The filaments were then picked from the bottom of the stock box and processed into brush filament tufts.

EXAMPLE II

Cut-to-length nylon filaments having an average diameter of 0.020 inch and a length of three and one-half inches were allowed to fall loosely with housing **100** having a selecting tube **103** with an opening **104** of about one and one-half inches in diameter. After the filaments passed through the tube, they entered frame **108** for alignment, and were then processed in the same manner as described in Example I. The only difference is that the dimension of the stock box and straightening section **108***b* corresponded to the specific filament length desired.

If two or more conveying systems are employed for feeding filaments into the housing, a mixture of different colors or types of filaments may be obtained, whereby a suitable ratio of each results at opening **112** of the apparatus of this invention.

EXAMPLE III

Equal parts of loose red polypropylene filaments, 0.012 inches in diameter, one and one-half inches in length, were circulated simultaneously through the apparatus of this invention with white polypropylene filaments of the same diameter and length. As the aligned filaments were removed from the opening **112** of frame **108**, an analysis showed that the filaments were mixed approximately in equal amounts.

As noted above, more than one unit may be employed to fill a stock box, for instance, two, three or four units placed over one large filament stock box when more than one filament tuft is removed. This would facilitate the removal of large quantities of filament in the form of tufts when high speed tufting equipment is used.

From the foregoing it will be apparent to those skilled in the art that this instant invention provides a very simple and effective filament orientation method and apparatus for accomplishing the object of the invention.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. An apparatus for orienting and stacking randomly disposed, cut-to-length synthetic filaments or the like comprising: an upstanding housing having an entrance port in the upper portion thereof and an exit port at the bottom thereof; means disposed at the entrance port for conveying randomly disposed, cut-to-length synthetic filaments therethrough whereby said filaments will be allowed to free-fall through said housing toward the bottom thereof; selection means disposed within a central portion of said housing for selecting only a portion of those randomly disposed filaments falling therethrough, having longitudinal axes oriented approximately parallel to the vertical axis of said housing; a vertical stacking frame having front, back and side

walls disposed externally to said housing, said frame adapted to confine a plurality of oriented, cut-to-length filaments disposed longitudinally between the front and back walls thereof; means connecting said selection means and said stacking frame for conveying the selected, oriented filaments from said selection means through said housing to said stacking frame and for stacking the selected filaments in said frame.

2. The device of claim **1** further comprising means disposed at the exit port of said housing for collecting the randomly disposed filaments falling therethrough and for conveying said filaments to the entrance port for readmittance to said housing through said entrance port.

3. The device of claim **1** wherein the distance between the entrance port and the exit port of said housing is at least twelve inches.

4. The device of claim **1** wherein the internal distance between the front and back walls of said stacking frame is no more than one and one-half the length of the cut-to-length filaments to be stacked therein.

5. The device of claim **1** wherein said means for conveying the selected filaments comprises a conduit extending upwardly from the upper portion of said stacking frame and into a central portion of said housing, the longitudinal axis of the terminal portion of said conduit extending into said housing at an angle to the vertical axis thereof.

6. The device of claim **5** wherein said conduit is a tube and a terminal portion of the walls thereof describe an entrance opening substantially perpendicular to the longitudinal axis thereof, said opening adapted to receive only those randomly disposed filaments falling through said housing which are oriented longitudinally parallel to the vertical axis of said housing.

7. The device of claim **5** wherein the terminal portion of the conduit distal to said housing has a closed end and an elongated exit opening in the lower portion of the conduit wall adjacent said closed end, the exit opening and the longitudinal axis of the terminal portion of said conduit surrounding the opening being aligned over said stacking frame between the front and back walls thereof so that filaments passing through said conduit will encounter the closed end thereof and drop through the exit opening therein into said frame, oriented between the front and back walls thereof.

8. The device of claim **7** wherein the elongated exit opening is a slit extending longitudinally along the lower portion of the wall of said tube from the closed end thereof toward said housing a distance greater than the length of the filament passing therethrough, but less than one and one-half times the length of said filament.

9. The device of claim **7** wherein the lower portion of said conduit is mounted on the upper portion of said stacking frame, the interior of said conduit in communication with the interior of said frame through an elongated exit opening in a wall thereof, the side walls of said frame converging at a central portion thereof to form a constricted filament aligning section, and diverging at a lower portion thereof to form a filament stacking section.

10. The device of claim **4** wherein the side walls of said frame converge at a central portion thereof to form a filament aligning section and diverge at a lower portion thereof to form a filament stacking section.

11. An apparatus for orienting, stacking and aligning randomly disposed cut-to-length synthetic filaments or the like comprising: an upstanding housing having an entrance port in the upper portion thereof and an exit port at the bottom thereof; means disposed at the entrance port for conveying randomly disposed cut-to-length filaments therethrough whereby said filaments will be allowed to free-fall through said housing toward the bottom thereof; selection means disposed within a central portion of said housing for selecting only a portion of those randomly disposed filaments falling therethrough which have longitudinal axes oriented approximately parallel to the vertical axis of said housing; a vertical stacking frame having front, back, and side walls disposed externally to said housing, the front wall of said frame having an opening therein in a central portion thereof, said frame adapted to confine a plurality of oriented, cut-to-length filaments disposed longitudinally between the front and back walls thereof; means connecting said selection means and said frame for conveying the selected filaments from said selection means through said housing to said frame, said means adapted to stack said filaments in said frame longitudinally between the front and back walls thereof; means disposed within said frame for orienting said filaments longitudinally between the front and back wall thereof with the longitudinal axes of said filaments in parallel relationship at a central portion of said frame adjacent the opening in the front wall thereof; vibrating means disposed at the opening in the front wall of said frame for vibrating said filaments against the back wall thereof until the ends adjacent said back wall are aligned in a common vertical plane.

12. The device of claim **11** wherein the internal distance from the front wall of said frame to the back wall thereof above the opening in the front wall is no greater than one and one-half the length of the cut-to-length synthetic filaments to be aligned therein.

13. The device of claim **12** wherein the internal distance from the front wall of said frame to the back wall thereof below said opening is approximately equal to the length of the cut-to-length filaments to be aligned therein for retaining said aligned and oriented filaments.

14. The device of claim **11** wherein the opening in the front wall of said frame extends from one side wall to an opposite side wall thereof.

15. The device of claim **11** wherein said vibrating means comprises a trim plate assembly having a face adapted to be disposed at the opening in the front wall of said frame, perpendicular to the longitudinal axes of the filaments to be aligned therein; electromagnetic vibrator means coupled to said assembly for causing said face to vibrate toward the back wall of said frame.

16. The device of claim **15** wherein the face of said plate assembly mounts a plurality of mutually spaced probes extending perpendicularly therefrom toward said back plate, said probes adapted to vibrate with said assembly and to transmit vibratory motion thereof to the longitudinal surfaces of filaments adjacent thereto when said filaments are received in said frame.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,774,782 Dated November 27, 1973

Inventor(s) John C. Lewis, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page 1, under "Assignee", "Middleburg" should read --Middlebury--.

Col. 1, line 40, "rrequired" should read --required--.

Signed and sealed this 9th day of April 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents