United States Patent

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[54] **METHOD OF AND APPARATUS FOR PRODUCING CHOPPED FIBROUS STRANDS**
15 Claims, 3 Drawing Figs.

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[51] **Int. Cl.** **B02c 13/13,** B02c 18/06
[50] **Field of Search** 241/3, 4, 15, 16, 18, 24, 27, 28, 38, 41, 60, 79, 79.2, 80; 209/3, 11, 329, 244, 245; 210/243

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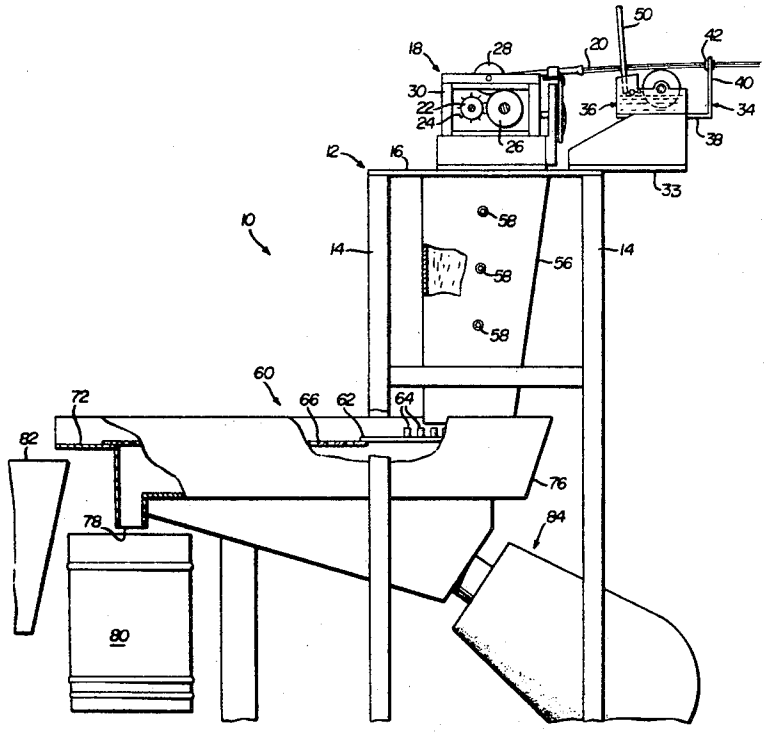
ABSTRACT: Production of chopped strands of fibers such as glass fibers is improved by removal of static charge and size classification. In one apparatus embodiment of the invention, size classification of chopped strands is accomplished by a vibrating screen through which chopped strands of desired size pass while oversize material such as clumps of fuzz, long fibers or other oversize material is screened out. In this embodiment, static removal is accomplished in stages by a charge dissipating structure, a liquid applicator and an ionized airstream. Method subject matter of the invention includes a step of screening chopped strands supplied from a cutter to pass chopped strands of desired sizes while screening out oversize material such as clumps of fuzz. Static is removed by contacting continuous fiber strands which are fed to a cutter with electrically conductive structure at a reference potential, and also by applying liquid to the continuous strands. After chopping of the strands, they may be further exposed to ionized flowing air to assist in reducing static charge.



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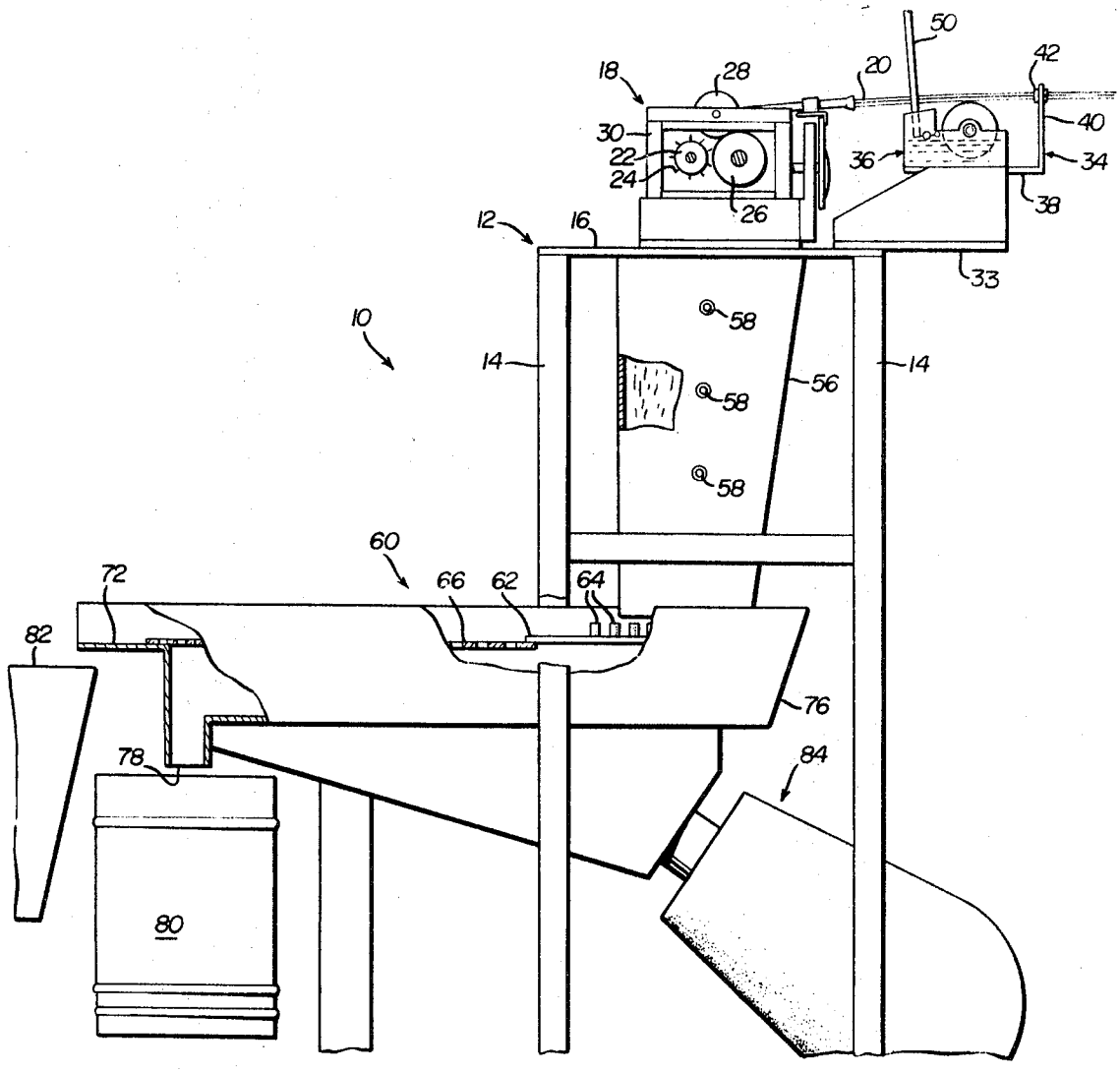

FIG. 1

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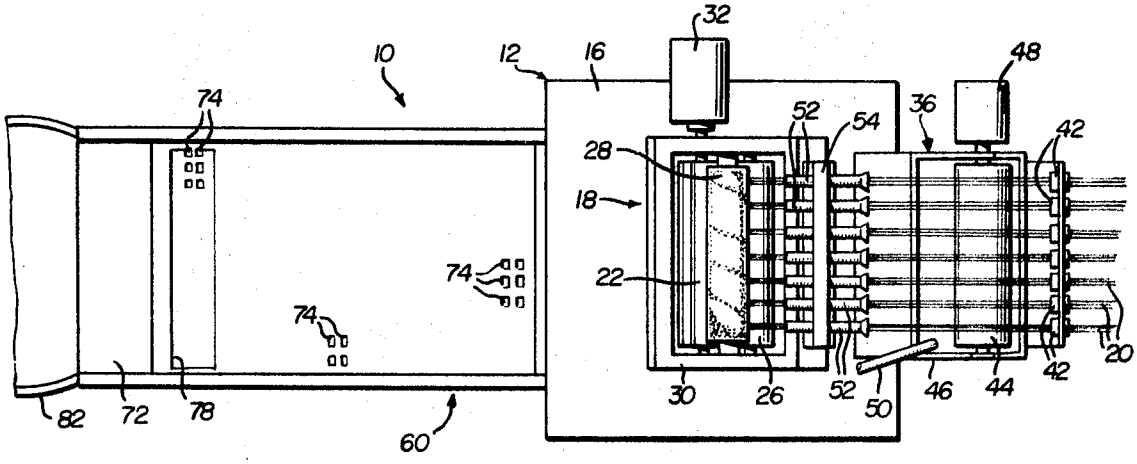

FIG. 2

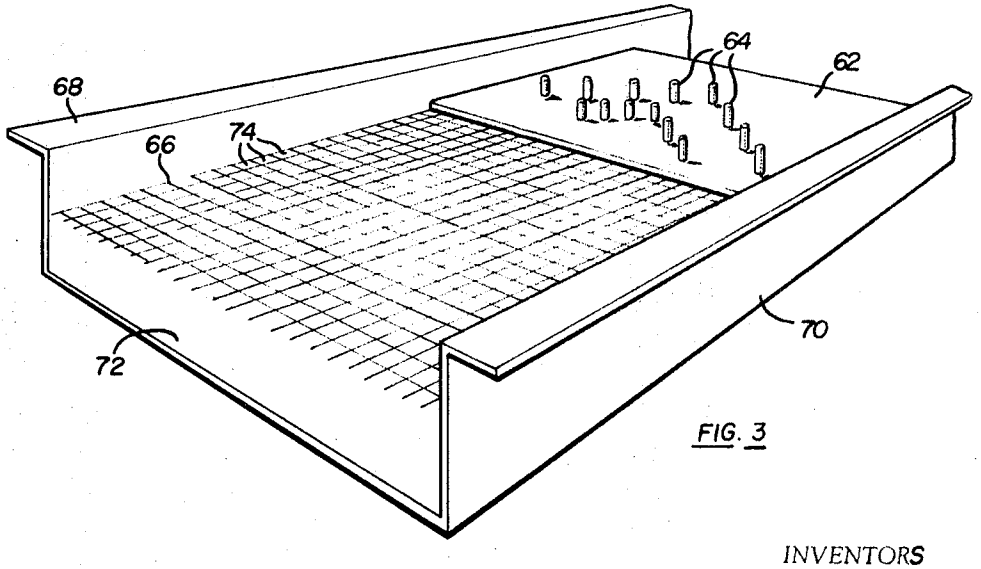

FIG. 3

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METHOD OF AND APPARATUS FOR PRODUCING CHOPPED FIBROUS STRANDS

BACKGROUND OF THE INVENTION

Chopped strands of mineral fibers, for example, glass fibers are sometimes used as reinforcement in plastic articles. Similarly, chopped strands of impregnated glass fibers are used as reinforcement in rubber products. A rapid growth in the demand for such chopped strands has caused a need for improvement in the methods and apparatus for producing such chopped strands. Specifically, it would be desirable to (1) increase the rate of production per machine, (2) decrease the labor required to operate each machine, and (3) improve the overall quality of the chopped strands by removing defects such as long fibers, fuzz clumps, cutter heat buildup and foreign objects.

SUMMARY OF THE INVENTION

The present invention provides a method and apparatus which accomplish the above-listed objectives. Most importantly, the operation of the apparatus and the performance of the method are independent of the number and sizes of the filaments in the continuous strands being processed. For example strands containing **204**, **408** and **816** filaments per strand have been chopped. An apparatus embodiment of the invention includes a high throughput cutter which increases the production rate. Continuous strands of fibers are fed to the cutter, and enroute to the cutter they are conditioned by an electrode structure and a liquid applicator to reduce static electrical charge on the continuous strands. Chopped strands pass from the cutter through a chute or chamber into which ionized flowing air is introduced to assist in reducing static electrical charge on the chopped strands. The chopped strands impinge on a vibratory screening means which allows chopped strands of desired size to pass to a discharge point while segregating out oversize material such as long fibers, fuzz clumps, cutter head buildup and foreign objects. The screening substantially improves the quality of the product, and screening is made effective by removal of static charge.

A method embodiment of the invention includes the step of screening chopped strands supplied from a cutter to pass chopped strands of desired sizes while screening out oversize material. The method subject mater also includes steps of static removal by contacting continuous strands as they are being fed to a cutter with an electrode structure, applying liquid to the continuous strands, and exposing the chopped strands discharged from the cutter to ionized flowing air.

The invention will be described with reference to the accompanying drawings in which:

FIG. **1** is an elevational view of apparatus forming one embodiment of the invention;

FIG. **2** is a plan view of the apparatus of FIG. **1**; and

FIG. **3** is a perspective view of a screening system included in the apparatus of FIGS. **1** and **2**.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

AS SHOWN ON THE DRAWINGS

The apparatus **10** of FIGS. **1** and **2** includes a frame **12** having floor-mounted vertical legs **14** supporting a platform **16**. Mounted on the platform **16** is a cutter **18** through which a plurality of continuous strands **20** are fed. The strands **20** are each composed of continuous fibers, either twisted or untwisted, and these fibers may be made of glass.

The cutter **18** illustrated in FIGS. **1** and **2** includes a cylindrical cutter head **22** having cutter blades **24** secured to head **22**. The blades **24** project radially from the head, extend longitudinally of the head, and are spaced equidistantly about the circumference of the head. Upon rotation of cylindrical head **22**, the blades **24** sequentially engage a cot roll **26**. Located just above the cot roll **26** is an idler roll **28** which contacts the cot roll **26**. Head **22** and rolls **26** and **28** are journaled for rotation in a frame **30** of the cutter. Cutter head **22** and cot roll **26** are rotated in opposite directions by a motor **32** through suitable gearing or other drive means (not shown). Rotation of cot roll **26** causes idler roll **28** to rotate.

The strands **20** pass between rolls **26** and **28** and from there downward between cutter head **22** and cot roll **26**. As the continuous strands pass between head **22** and roll **26**, they are chopped into relatively short lengths by the blades **24**.

A stand **33** is mounted on the platform **12**, and affixed to stand **33** is a grounding electrode **34** and a liquid applicator **36**. The electrode **34** includes a metal arm **38**. The stand **33** and frame **12** are also made of metal, and all of these metal structures are electrically grounded. Electrode arm **38** has a plurality of upwardly projecting legs **40** each of which carries an electrically conductive ceramic eyelet **42**. The strands **20** pass respectively through the eyelets **42** and contact the electrically conductive material thereof. Since the eyelets **42** are electrically grounded, and since they contact the strands **20**, static electrical charge is dissipated from the strands through the electrode structure **34**.

The liquid applicator **36** applies a liquid to the strands **20** that reduces static charge and also prevents filamentizing of strands. Liquid applicator **36** includes a roll **44** journaled for rotation in a container **46**. The roll **44** is rotated by a motor **48** connected thereto. A liquid such as water is provided in the container **46**, and the roll **44** is partially submerged in the liquid. As the roll rotates, it transfers liquid from the pan **46** to the strands **20** to moisture them. The amount of moisture pickup required is from about 0.04 percent to about 0.5 percent by weight of the strands. Liquids other than water may be used, examples being alcohols, ketones and other solvents. A constant liquid level control **50** may be provided for the application **36** if desired, but this is not essential. As alternatives to the roll-type liquid applicator **36**, a liquid may be applied to the strands with a spray system, and in conjunction with such a spray system a rag or sponge may be placed directly under the strands in contact therewith to aid in transferring liquid to strands. The sprayed liquid may be water or other suitable liquid as mentioned above.

From the liquid applicator **36**, the strands **20** pass through collection tubes **52** which are mounted on the frame **30**. The tubes **52** merely aid in directing the strands. The tubes **52** may be retained in a block **54** which may be oscillated horizontally perpendicular to the axes of tubes **52**. This oscillation moves the strands laterally of the rolls **26** and **28** and the cutter head **22** to equalize wear on these structures. The drive for oscillating block **54** may be taken from the motor **32** by means of a suitable linkage (not shown).

Chopped strands are discharged from the cutter **18** downwardly through an opening in platform **16** into a chute **56**. Nozzles **58** project through the wall of chute **56**. Ionized flowing air is introduced through the nozzles **58** into chute **56** to scatter the chopped strands and also, due to the ionization of the air, to reduce static electrical charge on the chopped strands. The air may be supplied from a source of compressed air. The moisturizing of the strands **20** in the liquid applicator **36** aids in removal of static charge from the chopped strands in chute **56**.

The chopped strands are discharged at the bottom of chute **56** onto a screening system **60**. This system includes a horizontal impingement plate **62** having a plurality of upwardly projecting pins **64** mounted on the top thereof, and a horizontal screening plate **66** adjacent to plate **62** and substantially in the plane thereof. Plates **62** and **66** are affixed to a frame including side members **68** and **70** and a crossmember **72**. Screening

plate 66 has a pattern of closely spaced square apertures 74 formed therein. These apertures are sized to pass chopped strands of desired size but screen out oversize material such as long fibers, fuzz clumps, cutter head buildup and foreign objects such as rubber cot cuttings, broken blades and the like. Apertures 74 of other shapes, e.g. rectangular, oval or round, may be ultilized if desired.

The frame including side members 68 and 70 and cross-member 72 with plates 66 and 62 mounted thereon is mounted in a trough 76 as shown in FIG. 1. Trough 76 has a downwardly directed discharge opening 78 for chopped strands. The chopped strands fall into a container 80 or onto a suitable conveyor or other transporting means. The cross-member 72 forms another separate discharge point at which oversize material is discharged into a container 82.

The entire screening system 60 is mounted on a vibrator 84. Such vibrators are commercially available, so the vibrator 84 is not shown in detail herein. The vibrator 84 vibrates the screening system 60 in directions at an acute angle to horizontal. Specifically, the screening system 60 as viewed in FIG. 1 moves downwardly to the left and upwardly to the right along a linear path which is at an angle to horizontal. As chopped strands fall from chute 56 onto impingement plate 62, the vibratory motion of the screening system causes the chopped strands to move to the left as viewed in FIG. 1 from plate 62 onto screening plate 66. The chopped strands may be accompanied by undesired material such as long fibers, fuzz clumps, cutter head buildup and foreign objects. This material moves with the chopped strands onto plate 66. The vibratory motion of the screening system as described above causes chopped strands which are smaller than the openings 74 to pass through these openings, and all other material larger than the openings is screened out. Since the undesired material mentioned above is ordinarily larger than the openings 74, it is all screened out. As a result of the vibratory motion, the oversize material travels to the left as viewed in FIG. 1 across screening plate 66 and is discharged from the left end of the screening system at cross arm 72 into the container 82. The chopped strands of desired sizes pass through the apertures 74 into the trough 76, and again due to the vibratory motion of the screening system as described above, these chopped strands move to the left as viewed in FIG. 1 to the discharge opening 78 where they fall into the container 80. The pins 64 help to direct the chopped strands in their motion from plate 62 to the screening plate 66. The scattering of the chopped strands in chute 56 spreads chopped strands evenly over the impingement plate 62. If the strands 20, and thus the chopped strands, have a length of one-eighth inch, the openings 74 in screening plate 72 are preferably made square with each side of an opening being about one-eighth inch long. It is apparent that strands of other sizes may be produced by the apparatus 10, and accordingly openings of appropriate size would be used for strands of different sizes.

In the method of the invention, chopped strands supplied from a cutter along with undesired material such as fuzz clumps, long fibers, cutter head buildup or foreign objects, is classified by a screening step to separate chopped strands of desired size from undesired material. In this screening step, the chopped strands and other material are directed from the cutter onto a generally horizontal screening means having apertures therein sized to pass only desired sizes of the chopped strands, and the screening means is vibrated to cause any oversize material in the chopped strands to travel across at least a portion of the screening means to a discharge point and to cause desired size chopped strands to pass through the apertures of the screening means to a separate discharge point. The method subject matter also includes steps of contacting the continuous strands which are fed to the cutter with electrically conductive structure at a reference potential to dissipate static electrical charge from the continuous strands, and applying liquid to the continuous strands to assist in reducing static electrical charge. Static removal may be further augmented by directing the chopped strands from a cutter through a chamber, and introducing ionized flowing air into the chamber.

It has been found that the method and apparatus are not limited to specific sizings applied to the strands. For example, strands sized with polyesters, epoxies, polyethylene and rubber have been successfully chopped. The sizing material utilized has been found to be significant only to the degree to which it causes or is affected by static buildup in the process. Some sizes which create less static or are affected less by static do not require maximum static removal effort.

The apparatus and method of the invention are suited to high production rates. The overall quality of the chopped strands is improved by segregating out defects such as long fibers, fuzz clumps, cutter head buildup and foreign objects. This segregation is accomplished by screening, and the screening is facilitated by removing static charge from the continuous strands as they are fed to the cutter and also from the chopped strands emerging from the cutter.

Having thus described our invention, we claim:

1. In an apparatus wherein continuous strands of fibers are fed to a cutter which chops them into relatively short strands, the improvement of a support made of electrically conductive material, a grounding electrode attached to said support and electrically conductive strand-guiding means positioned in front of said cutter to receive said continuous strands to contact the same for dissipating static electrical charge from said strands, and liquid applicator means positioned between said strand-guiding means and said cutter for applying a liquid to said strands to assist in further reducing static electric charge on said strands.

2. In an apparatus having a cutter in which continuous strands of fibers are chopped into relatively short strands of predetermined length, the combination with said cutter of screening means supported in a generally horizontal position below said cutter, said screening means having apertures therein sized to pass only individual ones of said predetermined length of the chopped strands, means for directing the chopped strands from said cutter to said screening means including strand separating means, means for vibrating said screening means to cause any oversize material in said chopped strands to travel across at least a portion of said screening means to a first discharge region and desired size chopped strands to pass through said apertures of said screening means to a second discharge region separate from said first discharge region.

3. Apparatus as claimed in claim 1 in which said vibrator means causes said screening means to vibrate in directions at an acute angle with respect to horizontal while said screening means remains horizontal.

4. The apparatus as claimed in claim 3 in which said screening means includes an impingement portion on which the chopped strands are initially received, said impingement portion having projections thereon for deflecting the chopped strands, and said screening means further including an apertured portion adjacent said impingement portion having apertures corresponding to the predetermined length of said fibers.

5. The apparatus as claimed in claim 4 in which said screening means further includes a trough under said apertured portion having a discharge opening at one end thereof providing said second discharge point.

6. In an apparatus having a cutter in which continuous strands of fibers are chopped into relatively short strands of predetermined length, the combination with said cutter of an impingement plate supported in a generally horizontal position, chute means for directing the chopped strands from said cutter to said impingement plate including means to introduce ionized air into the path of said chopped strands to separate said strands, a screener plate adjacent said impingement plate and in the plane thereof, said screener plate having apertures therein sized to pass only the predetermined lengths of chopped strands, and means for vibrating said plates in directions at an acute angle with respect to horizontal to cause oversize material to travel from said impingement plate over

said screener plate for discharge therefrom and predetermined lengths of material to pass through said screener plate for separate discharge.

7. In an apparatus having a cutter in which continuous strands of fibers are chopped into relatively short strands, the combination with said cutter of a support having a grounding electrode adapted to support electrically conductive means contacting said continuous strands ahead of said cutter for dissipating static electrical charge from said strands, means for applying a liquid to said continuous strands ahead of said cutter to assist in reducing static charge on said strands, screening means supported in a generally horizontal position below said cutter to receive chopped strands therefrom, said screening means having a plurality of apertures therein dimensioned to allow desired sizes of the chopped strands to pass through the same and to screen out oversize material such as long fibers and fuzz clumps, chute means extending between said cutter and said screening means, means for introducing ionized flowing air into said chute means to scatter chopped strands therein and to reduce static charge on such strands, and means for vibrating said screening means to cause material screened out by said screening means to travel across at least a portion of said screening means to a discharge region while material or desired size passes through said apertures of said screening means to be collected.

8. The apparatus as claimed in claim 7 and further including chute means leading from said cutter to receive the chopped strands therefrom, and means for forcibly introducing ionized flowing air into said chute means to scatter chopped strands therein and to further reduce static electric charge on such strands.

9. In a method of making chopped strands of fibers in which continuous strands of fibers are fed to a cutter which chops them into relatively short strands, the improvement comprising the steps of demagnetizing said continuous strands of fibers prior to being fed to said cutter, directing the chopped strands from said cutter into a chute, further demagnetizing said chopped strands in said chute, permitting said chopped strands to fall onto a generally horizontal screening means having apertures therein sized to pass only desired sizes of the chopped strands, and vibrating said screening means to cause any oversize material in said chopped strands to travel across at least a portion of said screening means to a first discharge region and to cause desired size chopped strands to pass through said apertures of said screening means to a second discharge region separate from said first discharge region.

10. The method as claimed in claim 9 in which said screening means is vibrated in directions at an acute angle to horizontal to cause said oversize material to travel in a horizontal component of one of said directions.

11. In a method of making chopped strands of fibers, the steps of (1) feeding continuous strands of fibers to a cutter, (2) contacting said continuous strands ahead of said cutter with electrically conductive structure to dissipate static electrical charge from said strands, (3) applying liquid to said strands ahead of said cutter to assist in reducing static electrical charge, (4) chopping said continuous strands in said cutter into shorter strands, (5) directing the chopped strands through a chamber onto a screening means having apertures therein sized to pass only desired sizes of the chopped strands, (6) introducing ionized flowing air into said chamber to scatter said chopped strands and to reduce static electrical charge on said chopped strands, (7) and vibrating said screening means to cause material screened out by said screening means to travel across at least a portion of said screening means to a discharge point while material of desired size passes through said screening means.

12. In a method of making chopped strands of fibers, the steps of (1) feeding continuous strands of fibers to a cutter, (2) contacting said continuous strands with electrically conductive structure at a reference potential to dissipate static electrical charge from said strands, (3) applying liquid to said continuous strands to assist in reducing static electrical charge and to reduce frizzing of said strands, and (4) chopping said continuous strands in said cutter into shorter strands.

13. The method as claimed in claim 12 including the further steps of directing the chopped strands from said cutter through a chamber, and introducing ionized flowing air into said chamber to scatter the chopped strands and to further assist in reducing static electrical charge on said strands.

14. The method as claimed in claim 12 including the further step of screening the chopped strands to remove foreign material therefrom.

15. The method as claimed in claim 14 in which said screening step is carried out by directing the chopped strands onto a screening means having apertures therein sized to pass only desired sizes of the chopped strands, and vibrating said screening means to cause material screened out by said screening means to travel across at least a portion of said screening means to a discharge point while chopped strands of desired size pass through the apertures of said screening means.