United States Patent [19]

Spence et al.

[11] **3,865,565**

[45] **Feb. 11, 1975**

[54] **METHOD AND APPARATUS FOR GATHERING FILAMENTS INTO STRANDS**

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[73] Assignee: **Owens-Corning Fiberglas Corporation**, Toledo, Ohio

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[21] Appl. No.: **100,524**

Related U.S. Application Data

[63] Continuation of Ser. No. 10,081, Feb. 16, 1970, abandoned, which is a continuation of Ser. No. 642,849, June 1, 1967.

[52] **U.S. Cl.** ..... **65/2**, 28/1 R, 65/4, 65/11 R, 226/196

[51] **Int. Cl.** **C03b 37/02**

[58] **Field of Search** ..... 65/2, 4, 11 W, 11 R; 226/196, 199; 28/1 R

[56] **References Cited**

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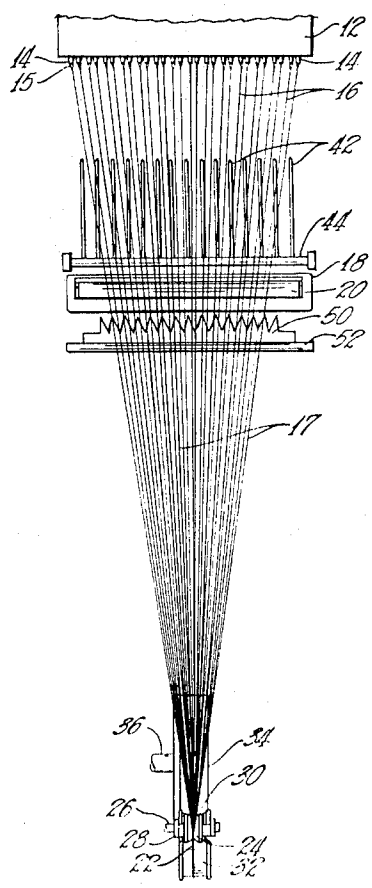
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Primary Examiner—Robert L. Lindsay, Jr.
Attorney, Agent, or Firm—Carl G. Staelin; John W. Overman; Oliver E. Todd

[57] **ABSTRACT**

Apparatus for gathering continuous glass filaments, as they are drawn downwardly as a converging body from a filament forming bushing, into a plurality of strand groups, directing the strand groups in passing contact with a size applicator, and guiding the finally compacted strands in close array to a pull wheel, the initial separation of the filaments into strand groups being accomplished by the temporary, horizontal projection of parallel graphite fingers through the body of filaments immediately above the size applicator, the maintenance of the strand groups and subsequent guiding of the strands being secured through a saw tooth comb placed just below and of a length comparable to that of the size applicator and a comparatively short shoe with a plurality of grooves positioned adjacent the pull wheel.

11 Claims, 6 Drawing Figures



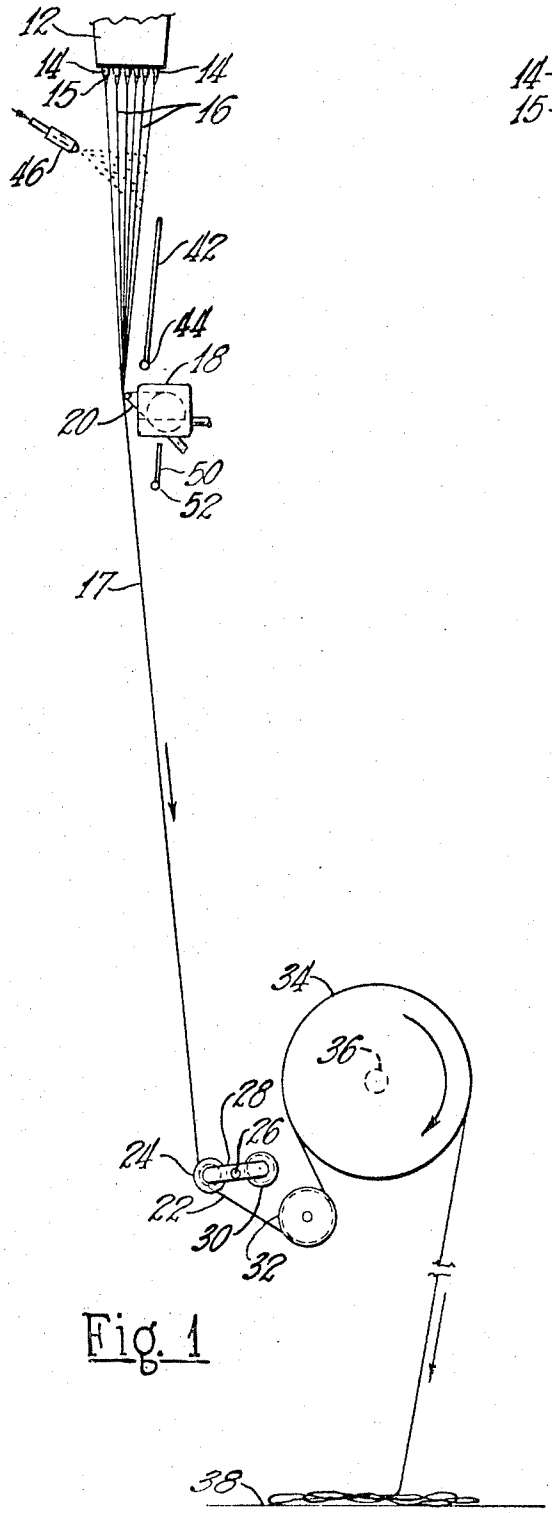

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Fig. 1

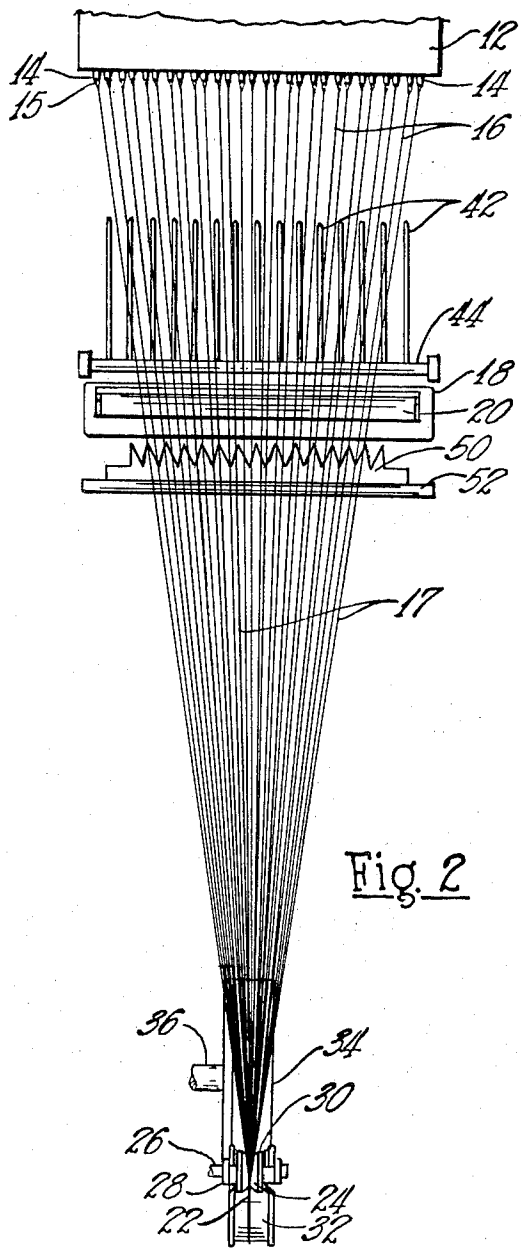

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Fig. 2

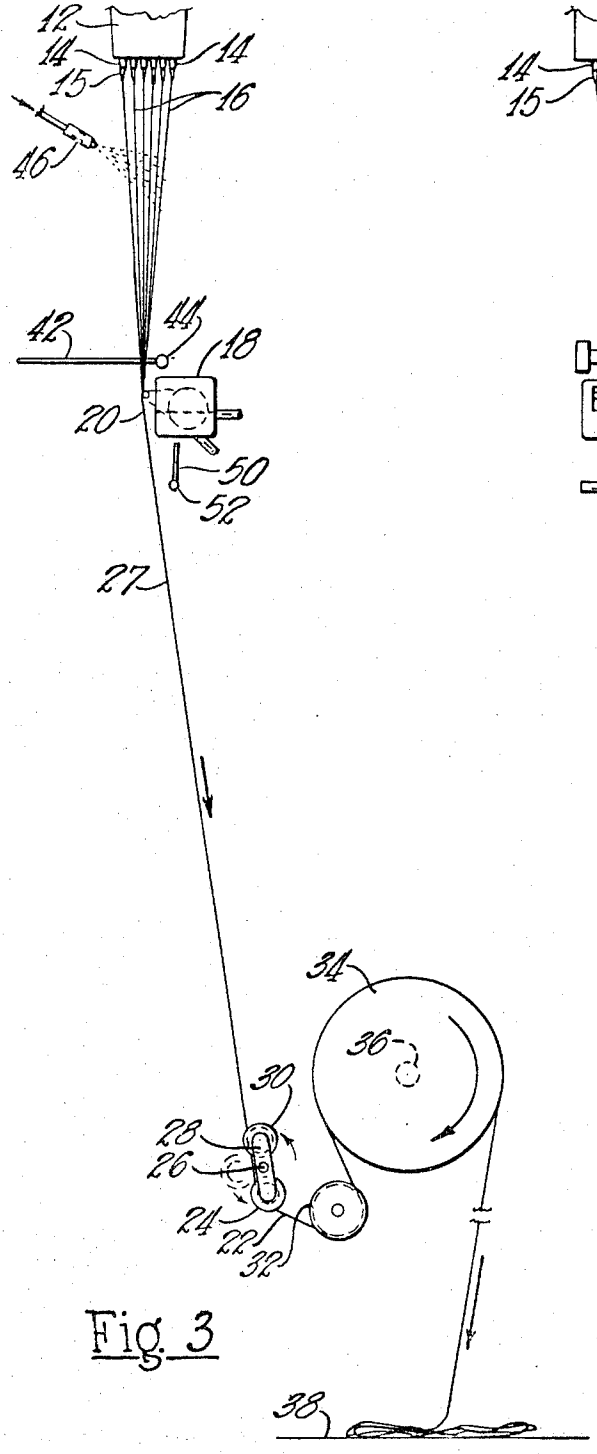

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Fig. 3

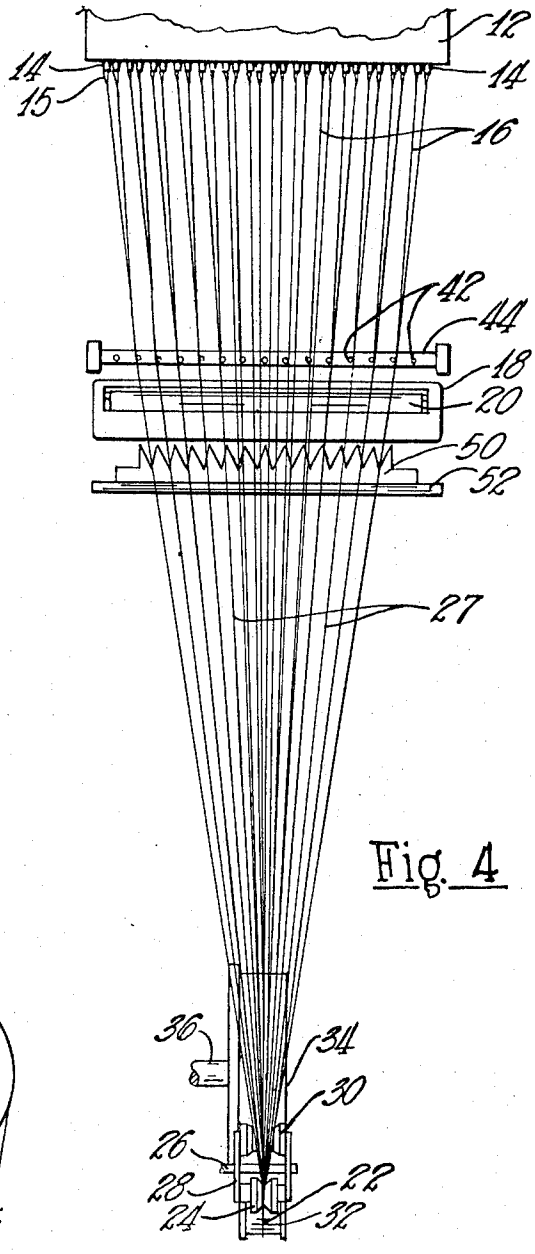

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Fig. 4

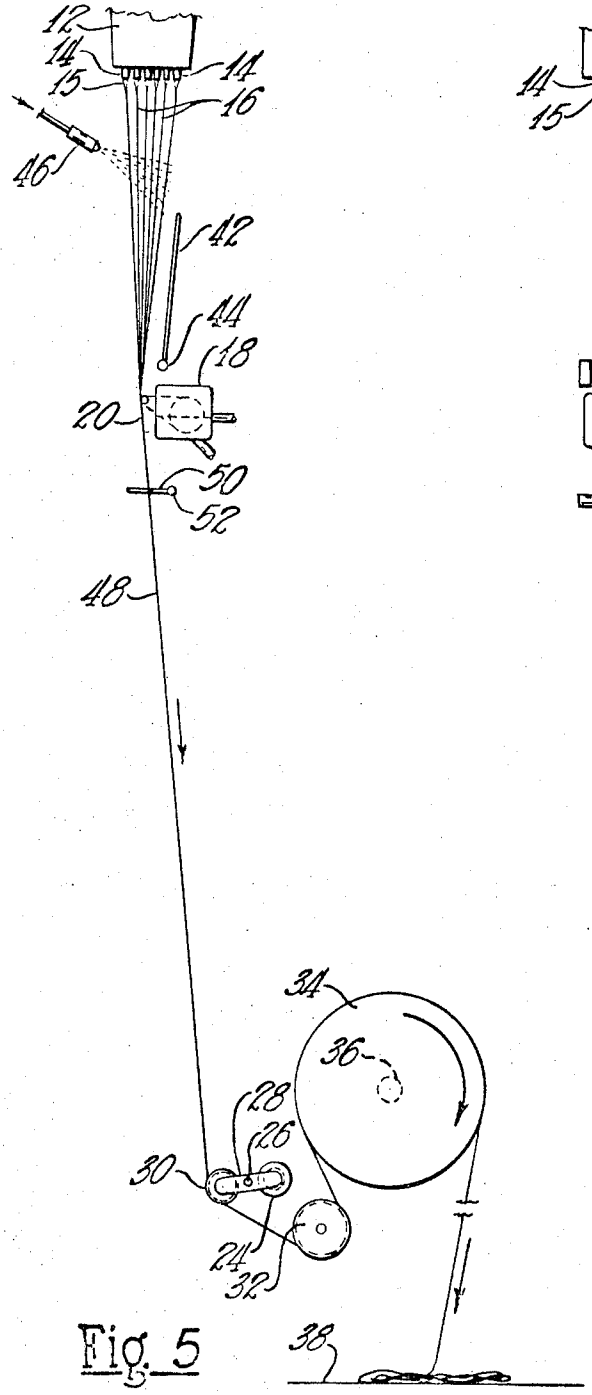

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Fig. 5

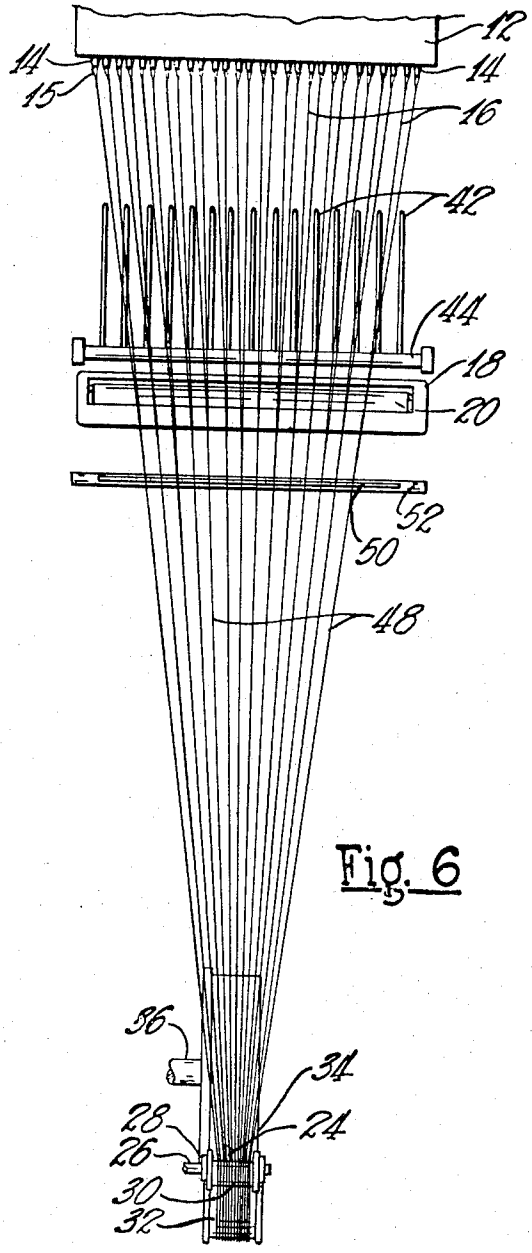

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Fig. 6

METHOD AND APPARATUS FOR GATHERING FILAMENTS INTO STRANDS

CROSS-REFERENCE TO RELATED APPLICATION

This is a continuation of our copending application Ser. No. 10,081, filed Feb. 16, 1970, which is a continuation of Ser. No. 642,849, filed June 11, 1967, both now abandoned.

This invention relates broadly to drawing continuous filaments from molten glass and gathering the filaments into strands.

The prior art is believed to be well exemplified by the disclosure of U.S. Pat. No. 3,265,482 which issued to Langlois and Stream on Aug. 9, 1966. As there shown strand groups of filaments drawn downwardly from a forming bushing pass over a size applicator and are then compacted in strand form in the grooves of a first short shoe just below the applicator. A second similarly grooved shoe of comparable size and positioned adjacent the pull wheel receives the strands in parallel array from the first shoe.

While such apparatus has operated successfully, there have been difficulties which have caused interruptions and irregularities in function. Also, undue time has been required in the gathering of filaments into a plurality of strands in preparing the apparatus for operation.

A primary object of this invention is to provide means for improved maintenance of the integrity of the strands by a more effective arrangement for preventing straying of filaments from one strand group to another.

A further object is to facilitate a faster and more accurate initial division of the filaments into strand groups.

Another object is to provide means for lessening gathering strain on the filaments and therethrough reducing fracture of the filaments and consequential processing shut-downs.

These and other objects and advantages of the invention are attained mainly through the utilization of separating fingers above the size applicator for dividing the filaments into strand groups; through the use of a long comb immediately below the applicator for holding the strand groups apart; and by having the final restriction of the converging strand groups into compacted strands provided by a shoe of multiple grooves located adjacent the pull wheel whereby the converging angle of the body of filaments from the bushing is reduced in size.

The objects and benefits of the invention will be brought out more clearly in the course of the following description of a preferred embodiment of the invention and with reference to the drawings, in which:

FIG. 1 is a front elevational view of apparatus embodying the invention with elements in starting positions;

FIG. 2 is a side elevation of the apparatus of FIG. 1;

FIG. 3 is a view similar to that of FIG. 1 with the graphite fingers **42** brought down to a horizontal setting to initially separate the filaments into strand groups, and the shoe **30** has been swung upwardly half way through its arcuate movement toward its final strand engaging station;

FIG. 4 is a side elevation of the apparatus of FIG. 3; and

FIGS. 5 and 6 are further front and side elevational views wherein the grooves of the shoe **30**, following continued arcing movement of the shoe, have been brought into full pressing engagement with the strands; comb **50** has been pivoted to a horizontal position with its teeth projecting between the strand groups; and, as a final step, the fingers **42** have been returned to their vertical position.

Referring to the drawings in more detail, in FIGS. **1** and **2** the apparatus is arranged for the starting of operation. As conventionally practiced the first formed filaments have been loosely grasped by hand and pulled down around the single groove shoe **24**, around the idler wheel **32** and the pull wheel **34**. Through the adhesion of the single strand **22** thus formed to the peripheral surface of the rotating pull wheel the filaments are thereafter continuously drawn from the bushing **12**. Release of the strand **22** (or strands) from the pull wheel and projection thereof to a receiving surface **38** is effected preferably by the momentary projection of elements through openings in the peripheral surface of the pull wheel as shown in the previously mentioned U.S. Pat. No. 3,265,482.

The molten glass from an associated furnace flows from the bushing **12** through the minute orifices in tips **14**, usually arranged in parallel rows. To facilitate portrayal a comparatively low number of tips is here illustrated. As may be noted in FIG. **1** there are six tips in each row extending crosswise of the bushing and there are twenty eight such rows of six lengthwise of the bushing as may be determined from FIG. **2**. This makes a total of **168** tips which is roughly only two fifths of the number which would likely be utilized in a commercially productive bushing. Tiny cones or wells **15** of molten glass form at the orifices of the tips **14** and the filaments **16** are drawn therefrom.

The path of the filaments is angled slightly (about three degrees) as they pass the size applicator **18** in order that the filaments be pressed against the size carrying apron **20** of the applicator. This causes a converging of the filaments of each crosswise row of six as may be seen in FIG. **1**. There is thus formed a downwardly converging fan **17** of twenty eight loose sub-strands, containing six filaments apiece.

The size deposited upon the filaments by the applicator may merely be water to reduce friction between filaments as they are subsequently joined together in strand form. A more complex size or binder is however desired to promote coherence of the filaments when combined as strands, and adherence of the strands of filaments to the surface of the pulling wheel.

The fan **17** becomes a single bulk strand **22** on reaching its apex in the single groove of starting shoe **24**. The latter is swingably mounted upon a pivot pin **26** through side arms **28**. On the other ends of arms **28** is carried in presently non-operative position the shoe **30** which is this case has fourteen strand grooves.

The bulk strand is led around the idler wheel **32** which has non-adhering land surfaces preferably of graphite and over the pull wheel **34** which is driven by shaft **36**. Due to the high peripheral speed of the pull wheel, the strand is forcefully projected to the receiving surface **38** which normally would be that of a belt conveyor on which the strand or strands would be collected in the form of a mat.

The temporary single groove gathering shoe **24** and the operational multiple groove shoe **30** are preferably

of wheel form, as illustrated, because this shape is easy to manufacture, provides excess groove area to present new unworn surfaces when required, and avoids sharp lead and departure edges. Many other structural shapes upon which curved grooves could be machined or molded would function quite satisfactorily.

After the continuous drawing of the filaments has been established, the filaments are divided into strand groups. In prior practice this was accomplished by hand. In this invention graphite fingers **42** carried on a pivotably bar **44** are utilized for this purpose. A diameter of one quarter of an inch and a length of approximately ten inches have proved effective dimensions for the fingers. They are shown in non-operative vertical position above the size applicator **18** in FIGS. **1** and **2.** As the fingers **42** are turned downwardly they intercede between predetermined numbers of filaments some distance above their final horizontal position. In this instance the fingers **42** are spaced and positioned to isolate twelve filaments (two cross rows of six filaments) between each pair of fingers. Because of the entry of the fingers into the body of filaments above their final position a slight lateral spreading of the fan of filaments occurs as indicated in FIG. **4.**

The filaments slide easily past the fingers due to the non-sticking graphite composition of the fingers and the lubrication provided by the water mist deposited upon the filaments by spray nozzles **46.**

After the strand groups have thus been segregated by the fingers the assembly comprising the temporary single groove shoe **24** and the multiple groove shoe **30** joined by arms **28** is turned counter clock-wise as pictured in FIG. **3.** The peaks between the fourteen grooves of shoe **30** then enter between the strand groups of filaments as set by the fingers **42** and each group is consolidated as a strand in a single groove.

The resulting strands are brought under greater tension as the shoe **30** reaches its final fixed position depicted in FIGS. **5** and **6.** This is vertically below its original strand compacting point and therethrough complies with and relieves the lateral spreading of the fan resulting from the action of fingers **42.** The graphite fingers and the shoe **30** thus coact to maintain the same fan contour of the strand groups by both engaging them at comparable points above their final more downwardly located positions.

After the shoe **30** is fixed in its operating position, comb **50** is turned on its pivotable supporting base **52** to bring its teeth in projecting array between the strand groups; the fingers **42** are then raised out of contact with the strands. The comb **50** may be made of any durable material with a low coefficient of friction relative to glass but is preferably composed of a highly compressed resin-textile laminate commercially available as Micarta. This is easily formed into irregular shapes.

As the filaments are more widely spaced in the broad fan configuration of FIG. **2** at the upwardly or bushing end of the fan a more accurate and equal division of the filaments into strand groups may be made there. The insertion of the graphite fingers into the fan above the applicator provides the precise division desired which is then maintained by the receipt of the strand groups and their consolidation into strands by the grooves of the multiple groove shoe **30.**

The permanent stabilization of the strand groups is assured by the projection of the teeth of comb **50** therebetween. No lateral straying of the filaments from one strand group to another is then possible. Such migration due to wandering of the filaments upon the apron of the applicator, to air currents or other causes has in the past been responsible for irregular deposit of the strands.

Another feature of the invention which serves to curb breakage of the filaments is that the fan of strand groups of filaments does not reach its final restriction until the strands are received in the grooves of shoe **30** adjacent the pull wheel **34.** This moderates the angle of convergence and the disparate distances of the filament travel as compared to former processing in which the strand groups were brought to their final closely spaced array in the grooves of a short shoe positioned just below the applicator.

The fine strands with which this invention is concerned are excellent reinforcing media for organic resinous materials and also for inorganic structural foams such as foamed surfur. The strands may be used alone, as an alternate for or combined with glass flakes or glass pellets for such reinforcement.

The sequence of the steps of the described method may be slightly altered advantageously when any delay is apt to occur between the division of the filaments into strand groups by the graphite fingers **42** and the following engagement and consolidation of the strand groups in the grooves of shoe **30.**

To forestall any lateral straying of filaments derived from their riding contact over the apron **20** of the size applicator **18** during the time between these procedural steps, immediately after the initial segregation of the filaments into strand groups through the dividing action of the graphite fingers **42,** the comb **50** may be pivoted into its horizontal position with the strand groups lodged between the teeth of the comb.

This not only promptly fixes the division of the filaments established by the graphite fingers below the size applicator but also compacts the strand groups for easier entry into the grooves of shoe **30** when it is later swung into final engagement with the strand groups.

It may be seen from the preceding that the invention provides a novel and improved apparatus and method for precisely initiating the division of the filaments into strand groups and to maintain the integrity of such groups during the full processing period.

While a pull wheel has been disclosed herein as the preferred form of device for attenuating the filaments through the application of pulling force thereon, pneumatic nozzles, belts and other mechanical devices may serve quite satisfactorily.

Other modifications and substitutions for elements of the apparatus of this invention will easily occur to those skilled in the art, and any such obvious changes are considered within the spirit of the invention and the scope of the accompanying claims.

We claim:

1. Apparatus for drawing filaments from a molten glass source, gathering the filaments in a plurality of strands and depositing the strands upon a collecting surface to form a mat, said apparatus comprising an elongated multiple orifice bushing for delivering minute streams of molten glass, rotary means below said bushing peripherally receiving and applying pulling force upon the strands and therethrough continuously drawing the streams of molten glass into attenuated filaments, said rotary means projecting the strands onto the collecting surface, a multiple grooved filament

gathering shoe adjacent said rotary means to which the filaments descend from said bushing in converging fan formation and are received in strand groups which are individually and separately compacted into strands in individual grooves of said gathering shoe, a second shoe having a single groove for initially receiving the filaments in a single strand for pulling by said rotary means, and means for withdrawing said second shoe from engagement with the filaments.

2. Apparatus according to claim **1** in which said multiple grooved shoe and said second shoe are mounted on opposite ends of a pivotable means whereby as said second shoe is swung downwardly and laterally away from engagement with the filaments said multiple grooved shoe is swung upwardly and laterally into engagement therewith.

3. Apparatus for drawing filaments from a molten glass source, gathering the filaments in a plurality of strands and depositing the strands upon a collecting surface to form a mat, said apparatus comprising a multiple orifice bushing for delivering minute streams of molten glass, rotary means below said bushing peripherally receiving and applying pulling force upon the strands and therethrough continuously drawing the streams of molten glass into attenuated filaments, a first shoe having a single groove and positioned laterally adjacent said rotary means to which the filaments descend in converging fan formation and which initially receives the filaments as a single combined strand for transfer to said rotary means, a multiple grooved shoe, mounting means for said shoes, means for relatively moving said mounting means whereby said multiple grooved shoe is brought into engagement with the fan of filaments above said first shoe to divide and compact the filaments into separate strands in the grooves of said multiple grooved shoe and to disengage the filaments from said first shoe, means for releasing the multiple strands delivered thereto from said multiple grooved shoe from the peripheral surface of said rotary means whereby they are propelled downwardly therefrom, and means providing a collecting surface positioned below the rotary means for collecting the strands into a mat.

4. Apparatus according to claim **3** in which said multiple grooved shoe is initially positioned between said first shoe and said rotary means.

5. Apparatus according to claim **3** in which said means for relatively moving the mounting means for the shoes includes a pivotable bar.

6. Apparatus according to claim **5** in which said multiple grooved shoe and said first shoe are mounted on opposite ends of said bar.

7. A method of drawing filaments and gathering the filaments in a closely arrayed set of strands and forming a mat which comprises drawing filaments in a downwardly converging fan formation from minute streams of molten glass issuing from a molten glass source, gathering the filaments at the apex of the fan formation into a single strand below the molten glass source and adjacent to means by which the filaments are drawn, moistening the filaments after they are first formed, then dividing the filaments of the converging fan formation into strand groups by inserting elements therebetween, thereafter applying a lubricating size to the filaments of the strand groups, after the application of the size inserting members between the strand groups of filaments to maintain their independent integrity while still in fan formation, dividing the single strand into the established strand groups of filaments and consolidating them into compact strands for receipt by the means by which the filaments are drawn, and depositing the compact strands on a collecting surface to form a mat.

8. A method of drawing filaments and gathering the filaments in a closely arrayed set of strands and forming a mat which comprises drawing filaments in downwardly converging fan formation from minute streams of molten glass issuing from a molten glass source, moistening the filaments after they are first formed, then dividing the filaments of the converging fan formation into strand groups by inserting elements therebetween, thereafter applying lubricating size to the filaments of the strand groups, after the application of the size inserting members between the strand groups of filaments to maintain their independent integrity while still in fan formation, consolidating the strand groups of filaments at the apex of the fan formation into compact strands for receipt by the means by which the filaments are drawn, withdrawing the elements by which the filaments were divided into strand groups, and depositing the compact strands on a collecting surface to form a mat.

9. A method for drawing filaments from a molten glass source, gathering the filaments in a plurality of strands and forming a mat from the strands which comprises downwardly drawing streams of molten glass from an elongated multiple orifice bushing into attenuated filaments descending in downwardly converging fan formation, projecting parallel spaced fingers into the fan of filaments to separate them into strand groups, depositing size on the filaments in the strand groups, introducing members between the strand groups after the size has been deposited thereon to maintain them in separate relation in the fan formation, at the apex of the fan formation of filaments compacting the strand groups of filaments into strands, and depositing the compacted strands on a collecting surface to form a mat.

10. Apparatus for drawing filaments from a molten glass source, gathering the filaments in a plurality of strands and depositing the strands upon a collecting surface to form a mat, said apparatus comprising an elongated multiple orifice bushing for delivering minute streams of molten glass, rotary means below said bushing peripherally receiving and applying pulling force upon the strands and therethrough continuously drawing the streams of molten glass into attenuated filaments, said rotary means projecting the strands onto the collecting surface, a multiple grooved filament gathering shoe adjacent said rotary means to which the filaments descend from the elongated bushing in converging fan formation and are received in strand groups which are individually and separately compacted into strands in individual grooves of said gathering shoe, an applicator depositing size on the filaments as they travel downwardly from said bushing to said gathering shoe, divider means above said applicator with parallel spaced fingers, means movably mounting said divider means by which said fingers may be temporarily projected into the fan of filaments to initially separate them into strand groups for receipt by said gathering shoe, and a comb positioned between said applicator and said gathering shoe having teeth projecting be-

tween strand groups of the fan of filaments to maintain the filaments in said strand groups.

11. Apparatus for drawing filaments from a molten glass source, gathering the filaments in a plurality of strands and depositing the strands upon a collecting surface to form a mat, said apparatus comprising an elongated multiple orifice bushing for delivering minute streams of molten glass, rotary means below said bushing peripherally receiving and applying pulling force upon the strands and therethrough continuously drawing the streams of molten glass into attenuated filaments, said rotary means projecting the strands onto the collecting surface, a multiple grooved filament gathering shoe laterally positioned adjacent said rotary means to which the filaments descend from the elongated bushing in converging fan formation and are received in strand groups which are individually and separately compacted into strands in individual grooves of said gathering shoe, an applicator located between said bushing and said gathering shoe for applying size to the filaments, and a plurality of parallel spaced elements mounted adjacent said applicator and projecting into the fan of filaments to separate them into strand groups for receipt by the gathering shoe.

* * * * *