Nov. 4, 1952 H. E. HOLCOMB 2,616,239

STRAND AND METHOD OF MAKING THE SAME

Filed Nov. 25, 1949 2 SHEETS—SHEET 1

Fig. 1.

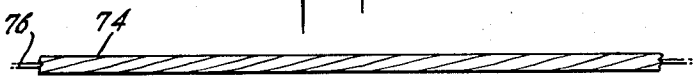

Fig. 2.

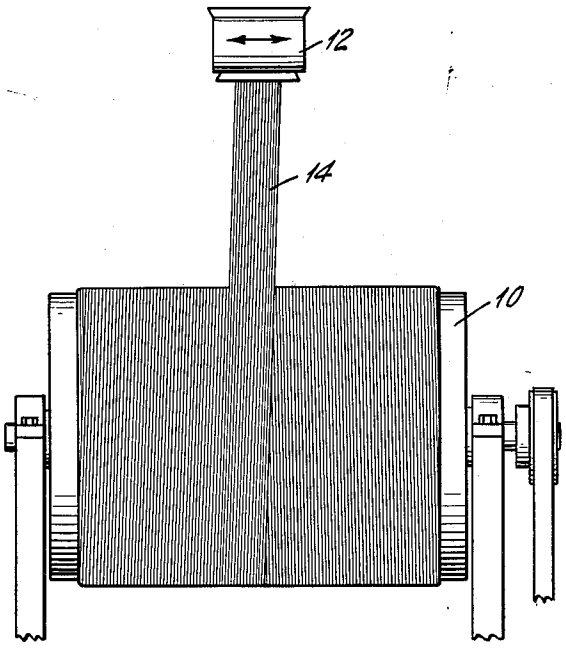

Fig. 3.

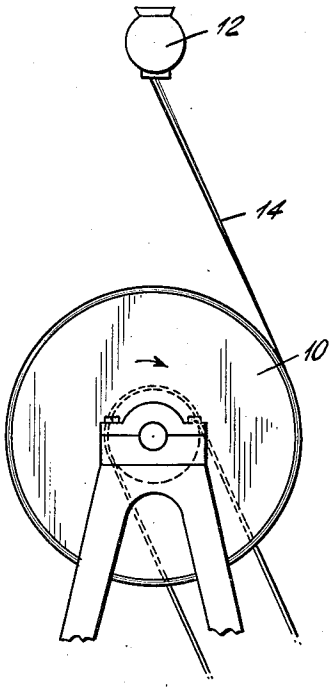

Fig. 6.

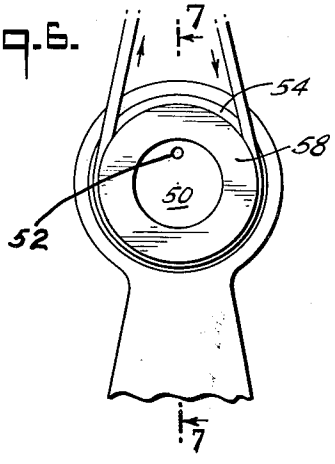

Fig. 7.

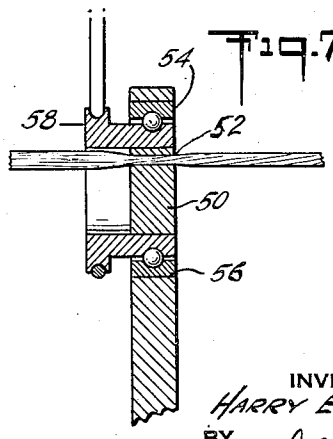

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Fig. 4.

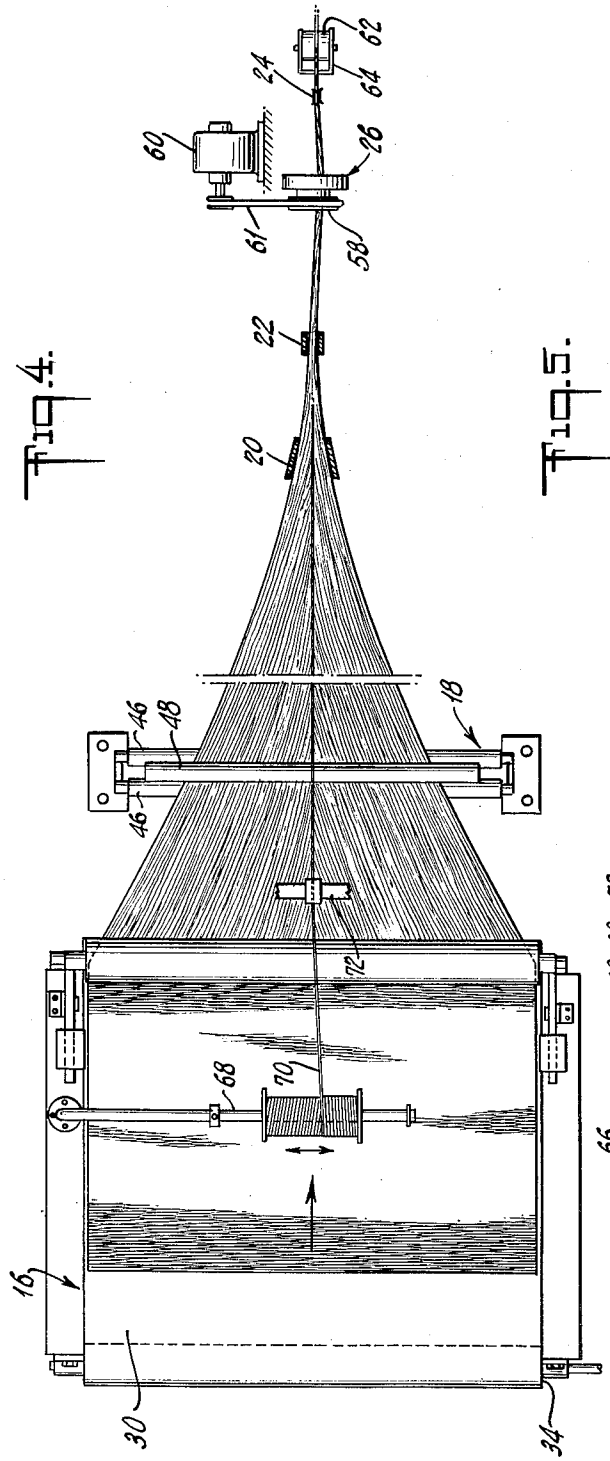
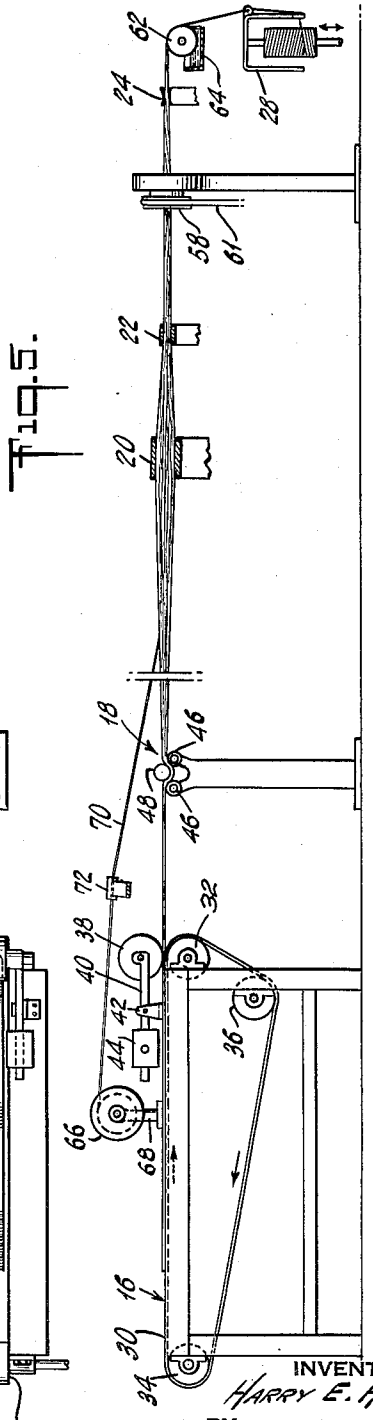


Fig. 5.



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2,616,239

STRAND AND METHOD OF MAKING THE SAME

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15 Claims. (Cl. 57—140)

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The instant invention relates to strands such as yarns or strands composed, at least predominantly, of glass fibers. The principal object of the invention is the provision of products of this kind embodying discontinuous or staple filaments of unusual length, whereby exceptional strength characteristics are obtained.

A known method of forming and accumulating glass filaments consists in drawing continuous filaments from a glass furnace and simultaneously winding them on a drawing drum to form a plurality of superposed layers with the filaments of adjacent layers crossing at acute angles. The accumulated fibers, when removed from the drum, form a multi-layer mat with the filaments running generally in one direction of the mat, but with the filaments of adjacent layers crossing at acute angles.

Attempts have been made heretofore to convert such mats into yarns or strands. For example, it has been proposed to cut the accumulated mat while on the drum into a continuous strip and then twist the strip. This produces a relatively short staple fiber yarn which is weak and has poor surface characteristics because of the protruding ends of the numerous short fibers. It has also been proposed to draw the accumulated mat endwise off the drum and simultaneously twist it. Again, a yarn of relatively short staple fiber is produced, due to the fact that the operation tends to ball up the filaments and break them into many short lengths.

An object of the invention is the provision of a method by which such mats, upon removal from the drawing drum, may be successfully made into yarns without excessive fiber breakage. More specifically an object of the invention is the provision of a method involving the application of a drawing force to one edge of the mat at a point intermediate the lengths of the filaments and continuing the drawing operation until the filaments are first drawn into extended V's and the legs of the V's then into substantially parallel relationship whereby a strand or mass of parallel individual filaments is obtained. This strand is then subjected to conventional twisting operations to convert it into yarn. Very little filament breakage occurs so that the individual filaments of the product retain substantially their original doubled lengths and a very strong smooth surfaced product is obtained.

A further object of the invention is the provision of a method of the type described above in which a core strand is introduced into the mass of filaments during the drawing operation whereby the filaments are grouped therearound in the final product.

My invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the more detailed description of a preferred embodiment of the invention which is to follow and to the accompanying drawings in which:

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Fig. 1 is an elevational view of a yarn embodying the instant invention;

Fig. 2 is a front elevational view of an apparatus employed in the instant invention for producing the filamentary glass mat;

Fig. 3 is an end elevational view of the apparatus of Fig. 2;

Fig. 4 is a top plan view of the filament drawing and strand forming apparatus;

Fig. 5 is a side elevational view of the apparatus of Fig. 4;

Fig. 6 is a front elevational view, on an enlarged scale, of a device for applying a primary twist to a strand; and,

Fig. 7 is a sectional view, taken on the line 7—7 of Fig. 6.

Referring now to the drawings and particularly to Figs. 2 and 3, a known apparatus is shown for forming a mat of glass filaments, the mat being of the type which by the instant invention is converted into strand or yarn form. This apparatus consists of a drawing drum 10 and a glass melting furnace 12. The drawing drum is rotated by any suitable driving means (not shown) at a relatively high speed in the direction indicated by the arrow in Fig. 3. The furnace 12 is located above the drum, the furnace including a suitable orifice plate from which filaments 14 are drawn, the filaments extending from the orifices to the drawing drum. Either the furnace or the drum is reciprocated to lay the filaments on the drum in a plurality of layers of spirals with the filaments of each layer crossing the filaments of adjacent layers. In the apparatus illustrated the furnace 12 is reciprocated as indicated by the double ended arrow in Fig. 2. The rate of reciprocation relatively to the drawing speed, that is the rotational speed of the drum, is such that the filaments of adjacent layers cross each other at acute angles.

In the preparation of the original condensed mat a plurality of the layers of filaments are accumulated on the drum until a body of the desired thickness is obtained. It will be appreciated that the thickness of the body will control, to a large extent at least, the size of the yarn to be produced. When the drawing operation is completed the drum is stopped and the body of fibers is cut along a line parallel to the axis of the drum and removed from the drum as a rectangular mat with the filaments of successive layers intercrossing but extending generally in one direction of the mat.

Referring now to Figs. 4–7 inclusive, the apparatus and method by which the condensed fiber mat produced as described above is converted into a strand or yarn will be described. Fundamentally the method consists in grasping the mat midway of a lateral edge, that is, an edge in substantial parallelism with the fiber lengths, and drawing the filaments in a direction at substantially right angles to their lengths until they take the form of extended V's, continuing the

drawing operation until the legs of the V's are drawn into substantial parallelism and the mass of filaments form a bundle or strand, and then twisting the strand into the desired yarn form. It will be appreciated that in this operation each of the individual filaments will be bent upon itself or doubled to form two legs corresponding portions of which extend in the same direction, so that in the product the effective staple length of the filaments will be approximately half their original lengths. For example, if the condensed mat is made upon a relatively large drum, say a drum of 44" diameter and 66" width, a fiber mat will be produced which is 60" in one dimension and 138" in the other. Inasmuch as the filaments are drawn from the edge having the 138" dimension, the staple fiber will be 69" in length.

The apparatus for carrying out the method includes a feed table 16 on which the condensed mat is laid with its long edge running transversely of the table, a tensioning device 18, a plurality of successive condensing dies 20, 22 and 24, a primary twister 26 between the condensing dies 22 and 24, and a main twister 28.

Feed table 16 in its preferred embodiment comprises an apron or conveyor 30 mounted on rolls 32, 34 and 36, the latter being driven by any suitable means (not shown) to move the apron in the direction indicated by the arrows in Figs. 4 and 5. Mounted above roll 32 is a pressure roll 38 carried by arms 40 pivoted as at 42 on brackets supported by the table. Arm 40 projects rearwardly from its fulcrum and the rearwardly projecting portion is adapted to carry an adjustable weight 44 whereby the pressure of the roll 38 may be readily adjusted.

Tensioning device 18 may be of any suitable type to exert a drag on the filaments. In the construction shown three bars are employed, the lower bars 46 being rotatably supported in a substantially horizontal plane below the filamentary material. A third bar 48 rests upon the filaments above the gap or bight between the two bars 46.

Condensing dies 20, 22 and 24 are of conventional construction and are adapted to gradually condense the filaments into a compact bundle or strand. The dies may be supported by brackets from some fixed part of the equipment.

Primary twister 26 also may be of any suitable construction to impart a primary or false twist to the bundle of filaments and, as shown (see particularly Figs. 6 and 7) consists of a disc 50 having a perforation 52 offset from its center and mounted for rotation in a bearing 54 carried by a support 56. Disc 50 includes a pulley element 58 adapted to be driven by motor 60 through belt 61 to rotate disc 50. Twister 28 may be of any suitable or conventional type employed in the textile field.

In preparing the apparatus for operation, the condensed mat is laid upon apron 30 and fed forwardly until its forward edge projects just beyond the bight between rolls 32 and 38. The edge of the mat is then grasped mid-way between the ends of the filaments and drawn forwardly and inserted between the bars 46 and 48 of the tensioner, and then through the successive condensing dies and the primary twister and finally attached to the spindle of the main twister 28. The primary and main twisters are then driven at the desired speeds to provide the required degree of twist, the operation of the main twister also continuously drawing the filaments from the edge of the condensed mat. The filaments are first drawn out into extended V's, as illustrated, and as the drawing continues and as the mats or filaments pass through the condensing dies, the filaments are drawn into close association with each other and the legs of the V's of individual filaments are drawn into substantial parallelism until, at the location of the condensing die 22, a bundle or strand of substantially parallel filaments is obtained. This bundle of filaments is given a primary twist by twister 26 whereby the filaments are held in associated strand relationship and then are finally twisted into yarn form by twister 28. The strand or yarn collected on the spool of twister 28 may be further processed by conventional textile machinery into yarn of the desired type.

Conventional lubricants, waxes, sizes, etc., may be applied to the strand prior to the twisting operation. For example, the strand between die 24 and twister 28 may pass over a guide roll 62 rotating in a bath 64 of the lubricant or size, whereby a coating of the material is continuously applied to the strand.

The feed of the mat may be either continuous at a slow rate of speed, or may be intermittent, in either case the feed being regulated so that the filaments are drawn from between the bight of rollers 32 and 38 and are reoriented as described above. The twister 28 is spaced a substantial distance from the mat and tensioning device 18 to permit the desired drawing and rearrangement of the filaments. For example, for a condensed mat of the dimensions previously referred to, the twister is preferably from 20' to 40' from the mat.

The instant method and apparatus permit a core strand to be readily inserted in the yarn. Thus, a spool 66 may be supported for free rotation on a shaft 68 above table 16. The core strand 70 is drawn from the spool and passed through a centering guide 72 and carried along with the filaments, the guide insuring that the core strand will lie substantially at the apexes of the V's and, during the drawing and condensing operations, becoming embedded in the mass or body of filaments. As will be appreciated, any suitable or desired material may be employed for the core strand for the purpose of imparting additional strength to the product or for any other purpose.

The yarn produced as described above and illustrated at 74 in Fig. 1 is of staple type, the individual fibers or filaments, however, being much longer than in other types of staple glass yarns. Hence, a very strong product is obtained. Also, the product may include a core 76 of any desired characteristics. The method is economical and no expensive equipment is required.

Having thus described my invention in rather full detail, it will be understood that these details need not be strictly adhered to and that various changes and modifications may suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What I claim is:

1. The method of forming a strand from long filaments comprising deforming each filament into extended V-shape with the legs of the V lying substantially parallel, and associating the filaments into strand form.

2. The method of forming a strand from long glass filaments comprising forming each filament into extended V-shape with the legs of the V

lying substantially parallel, associating the filaments in strand form and twisting the strand.

3. The method of forming a strand of long glass filaments comprising forming each filament into extended V-shape with the legs of the V lying substantially parallel, associating said filaments into strand form about a core, and twisting the strand.

4. A method of forming strands from a mat of intercrossed filaments with the filaments lying generally in one direction of the mat comprising applying a drawing force intermediate the ends of the filaments and drawing the filaments in a direction at substantially right angles to their lengths until the individual filaments form extended V's, and continuing the drawing operation until the filaments lie in substantial parallelism as a strand of parallel filaments.

5. The method comprising forming a mat of a plurality of layers of glass filaments with the filaments extending generally in one direction of the mat and with the filaments of adjacent layers crossing at acute angles, applying a drawing force to an edge of the mat intermediate the ends of the filaments and drawing the filaments from said edge in a direction at substantially right angles to their lengths until the individual filaments form extended V's, and continuing the drawing operation until the filaments lie in substantial parallelism as a strand of doubled parallel filaments.

6. A method of forming a strand from a mat of intercrossed filaments with the filaments lying generally in one direction of the mat comprising applying a drawing force intermediate the ends of the filaments and drawing the filaments in a direction substantially at right angles to their lengths until the individual filaments form extended V's, continuing the drawing operation, and condensing the drawn filaments until the filaments lie in substantial parallelism as a strand of parallel filaments.

7. A method of forming a yarn from a mat of intercrossed filaments with the filaments lying generally in one direction of the mat comprising applying a drawing force intermediate the ends of the filaments and drawing the filaments in a direction substantially at right angles to their lengths until the individual filaments form extended V's, continuing the drawing operation, condensing the filaments until the filaments lie in substantial parallelism as a strand of parallel doubled filaments, and twisting the strands into yarn form.

8. A method of forming a yarn from a mat of intercrossed filaments with the filaments lying generally in one direction of the mat comprising applying a drawing force to an edge of the mat intermediate the ends of the filaments and drawing the filaments from said edge in a direction at substantially right angles to their lengths until the individual filaments form extended V's, feeding the mat forwardly as the filaments are drawn from the edge thereof and continuing the drawing operation until the filaments lie in substantial parallelism as a strand of parallel doubled filaments, and twisting the strand into yarn form.

9. A method of forming a strand from a mat of intercrossed filaments with the filaments lying generally in one direction of the mat comprising applying a drawing force to an edge of the mat intermediate the ends of the filaments and drawing the filaments from said edge in a direction at substantially right angles to their lengths until the individual filaments form extended V's, applying a retarding force to said filaments adjacent the mat, and continuing the drawing operation until the filaments lie in substantial parallelism as a strand of doubled parallel filaments.

10. A method of forming a yarn from a mat of intercrossed filaments with the filaments lying generally in one direction of the mat comprising applying a drawing force to an edge of the mat intermediate the ends of the filaments and drawing the filaments from said edge in a direction at substantially right angles to their lengths into extended V's, continuing the drawing operation until the filaments lie in substantial parallelism as a strand of parallel doubled filaments, applying a primary twist to said strand, and then twisting the strand into yarn form.

11. A method of forming a yarn from a mat of intercrossed glass filaments with the filaments lying generally in one direction of the mat comprising applying a drawing force to an edge of the mat intermediate the ends of the filaments and drawing the filaments from said edge in a direction at substantially right angles to their lengths until the individual filaments form extended V's, applying a retarding force to said filaments adjacent the mat, continuing the drawing operation and condensing the drawn filaments until the filaments lie in substantial parallelism as a strand of parallel filaments, and twisting the strand into yarn form.

12. A method of forming strands from a mat of intercrossed filaments with the filaments lying generally in one direction of the mat comprising applying a drawing force to an edge of the mat intermediate the ends of the filaments and drawing the filaments from said edge in a direction at substantially right angles to their lengths until the individual filaments form extended V's, associating a core strand with said filaments, and continuing the drawing action and condensing the filaments around said core strand until the filaments lie in substantial parallelism around said core strand.

13. A strand comprising associated filaments, each filament being bent upon itself to form two legs, corresponding portions of said legs extending in the same direction.

14. A staple fiber strand comprising, intertwisted long glass filaments, each filament being bent upon itself to form two legs, corresponding portions of said legs extending in the same direction.

15. A staple fiber strand comprising, intertwisted long glass filaments, each filament being bent upon itself to form two legs, corresponding portions of said legs extending in the same direction, and a core strand enclosed by said filaments.

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