April 17, 1962 R. G. RUSSELL 3,029,993

APPARATUS FOR FEEDING A CONTINUOUS UNTWISTED MULTIFILAMENT STRAND

Original Filed Dec. 20, 1954

2 Sheets-Sheet 1

FIG. 1.

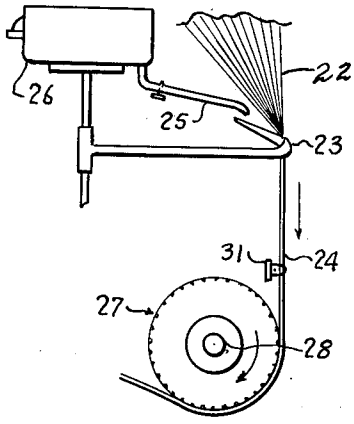


FIG. 3.

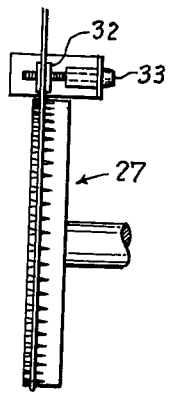
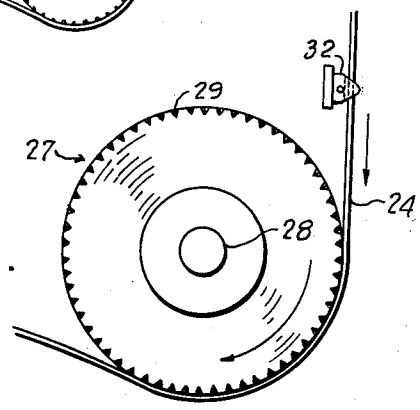


FIG. 2.



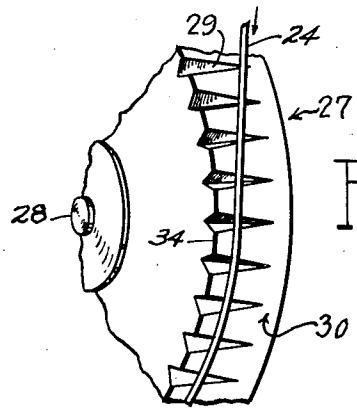


FIG. 4.

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APPARATUS FOR FEEDING A CONTINUOUS UNTWISTED MULTIFILAMENT STRAND

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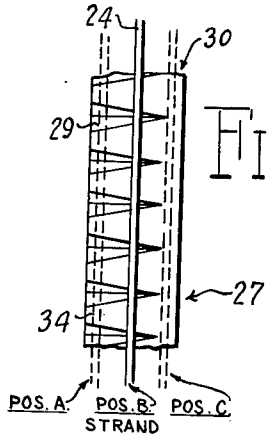


FIG. 5.

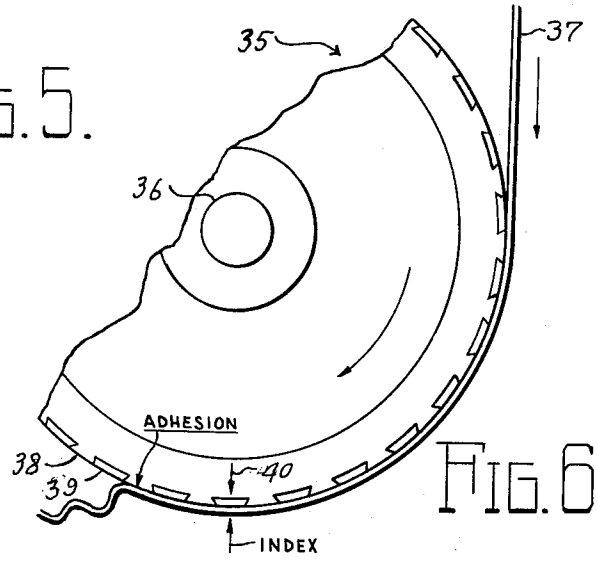


FIG. 6.

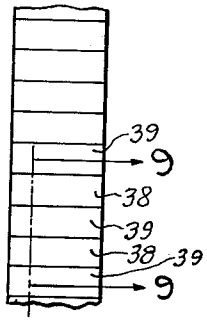


FIG. 8.

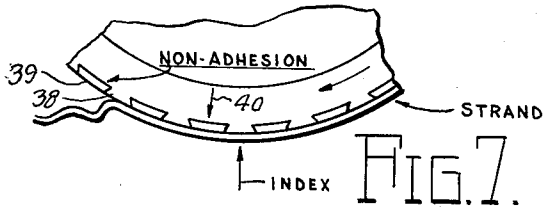


FIG. 7.

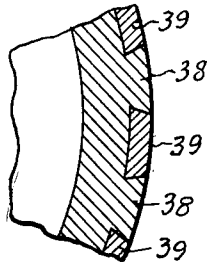


FIG. 9.

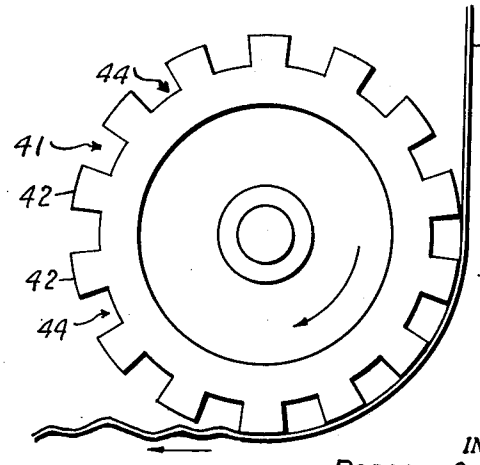


FIG. 10.

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APPARATUS FOR FEEDING A CONTINUOUS UNTWISTED MULTIFILAMENT STRAND

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Original application Dec. 20, 1954, Ser. No. 476,193. Divided and this application Oct. 23, 1958, Ser. No. 769,138

2 Claims. (Cl. 226—190)

This application is a division of my co-pending application Serial No. 476,193, filed December 20, 1954, now abandoned.

This invention relates to rotary means for feeding a continuous multifilament strand and, more particularly, to rotary means consisting of a single high speed wheel so designed that only portions of its peripheral surface are contacted by the continuous multifilament strand being fed.

Although pulling wheels embodying the invention may be utilized for feeding many different types of continuous strands they are particularly useful for feeding continuous multifilament glass fiber strands and will be shown for such use. Such a strand is formed by simultaneously attenuating some 200 to 400, individual fine glass fibers, laterally compacting the group of fibers together in substantially parallel, untwisted relationship and then handling the strand thus associated as a unit.

Some success has been achieved in feeding strands of this type at high lineal speeds by feeding them between the peripheries of co-acting rotary pulling wheels mounted upon parallel axes so spaced that the strands are tightly gripped between the bites of the pulling wheels, the peripheries of the pulling wheels being fabricated from deformable material. The use of co-acting rotary pulling wheels of this type induces a serious problem in that such a strand of a multiplicity of parallel fibers tends to split and to lick, i.e. to wrap around, one or both of the pulling wheels.

Another difficulty with co-acting pairs of pulling wheels is the necessity that their surfaces be deformable to an extent such that they will contact each other tightly around the strand being fed. When wheels having surfaces capable of thus contacting each other are rotated at sufficient speeds so that the peripheral speeds reach the neighborhood of, say 14,000 to 15,000 feet per minute, the centrifugal force created is so great that the deformable material soon passes its limitations and, as a result of the repeated, constant flexing in the bite between the wheels, bits and pieces of the material fly off the wheels.

It is the object of this invention to provide a pulling wheel which maintains peripheral contact over only portions of its peripheral surface with a multifilament strand being fed but which is not subject to overwhelming destructive forces since it can be fabricated from material having great tensile strength.

Another object of this invention, therefore, is to provide a single pulling wheel around at least a portion of the periphery of which a strand being fed is led and which can be rotated to produce linear speeds of the strand greatly in excess of the speeds formerly limited by the lack of sufficient tensile strength in resilient surfaced pulling wheels.

A still further object of the invention is to provide a single high speed rotary pulling wheel having a periphery so designed as to facilitate both the engagement and disengagement of the strand therefrom.

These objects and others will be better understood from the following description and from the drawings, in which:

FIG. 1 is a somewhat diagrammatic view in front elevation of a strand feeding wheel constructed and operated according to the invention and showing its use for the feeding of a multifilament, untwisted strand comprising a large number of fibers.

FIG. 2 is an enlarged view in side elevation of one modification of pulling wheel embodying the invention.

FIG. 3 is an end view of the pulling wheel shown in Fig. 2.

FIG. 4 is a fragmentary view in perspective, and on a further enlarged scale, of a pulling wheel embodying the invention as shown in FIGS. 2 and 3.

FIG. 5 is a fragmentary view in elevation of a part of the pulling wheel shown in FIGS. 2 and 3.

FIG. 6 is a fragmentary side view on an enlarged scale similar to FIG. 2, but showing another modification of pulling wheel embodying the invention.

FIG. 7 is a fragmentary view similar to FIG. 6, in part, and illustrating the pulling wheel shown in FIG. 6 at a slightly advanced position with respect to the position of FIG. 6.

FIG. 8 is a fragmentary view in elevation similar to FIG. 5 but of the pulling wheel shown in FIGS. 6 and 7.

FIG. 9 is a fragmentary vertical sectional view taken along the line 9—9 of FIG. 8.

FIG. 10 is a view similar to FIGS. 2 and 6, but of yet another modification of pulling wheel embodying the invention.

As illustrative of one of the many uses for pulling wheels embodying the invention, in FIG. 1 a plurality of individual glass filaments **22** is shown as being grouped together in parallelism by a gathering shoe **23** to form a multifilament, untwisted continuous strand **24**. The gathering shoe **23**, as shown in FIG. 1, is simply a small trough lined with an absorbent material, for example, felt, into which there is dripped a small quantity of a liquid that flows from a valve controlled pipe **25** connected to a supply tank **26**.

The liquid employed may be denominated as a lubricant or coating and it serves the function of lubricating the individual filaments from each other as well as causing them to adhere together somewhat as a unitary strand and, as will be explained below, of cooperating according to the method of the invention with a pulling wheel designed according to the invention for successfully feeding the strand **24**.

While direct application of a liquid to the filaments **22** is shown in FIG. 1, this figure is merely illustrative and so arranged to show the nature of the strand **24** as being made up of a plurality of separate fibers which are not twisted together as well as showing one way of applying liquid thereto. In other uses of pulling wheels according to the invention, the liquid may be applied directly on the strand **24** or may already be on the strand **24**, as for example, when it has been coated at the time of initial formation and then is subsequently fed according to the invention. The force for feeding the strand **24** is provided according to the invention by a high speed rotary pulling wheel **27** mounted for rotation upon a generally horizontal axle **28**.

The embodiment of the invention illustrated in FIGS. 2–5 comprises the pulling wheel **27** which is illustrated as having a plurality of spaced peripheral notches **29**. Each of the notches, as can best be seen in FIG. 4, extends inwardly from one edge of the rim of the pulling wheel **27** towards its opposite edge and each of the notches **29** becomes narrower as it proceeds across the surface of the pulling wheel **27**. A circumferential area, generally indicated at **30**, may be left at the side of the wheel opposite that to which the notches **29** extend, where the surface of the pulling wheel **27** is continuous. The shape of the notches **29** shown in the pulling wheel **27** of FIGS.

2–5 is illustrative with respect to the particular angles between the edges of the notches 29, their depth, their axial length, etc., but the basic concept of the notches and their circumferential spacing from each other is fundamental to the invention.

In this embodiment of the invention the multifilament strand 24 is illustrated as being guided onto the surface of the pulling wheel 27 by a laterally movable guide shoe 31, the guide shoe 31 being mounted upon a carriage 32. The carriage 32 may be moved axially of the pulling wheel (see FIG. 3) by rotating a vernier knob 33 or similar mechanism, so that the line of engagement of the strand 24 with the surface of the pulling wheel 27 may be varied as desired. In FIG. 5 the strand 24 is shown in solid lines at the center of a fragment of the pulling wheel 27, this position being denominated as "Pos. B," with broken line indications of two, more or less, extreme positions of the strand being denominated as "Pos. A" and "Pos. C." By shifting the shoe 32 axially with respect to the pulling wheel 27 and thus moving the line of engagement of the strand 24 across the surface of the pulling wheel 27, the strand 24 is engaged with more or less wheel surface; for example, if the strand 24 is guided into "Pos. A" (FIG. 5), it engages with only the ends of tooth-like portions 34 of the wheel surface between the notches 29 and thus with a much lesser total length of the surface of the wheel 27. Conversely, if the strand 24 is led onto the surface of the wheel 27 in the position denominated "Pos. C," then it is in contact with the wheel 27 throughout the angular extent of its wrap around the wheel 27.

By properly guiding the strand 24 onto the pulling wheel 27, so that the extent of strand contact with the wheel is of the proper duration, the strand 24 can be delivered from the pulling wheel 27 as a unitary driving strand directed in the direction selected according to the degree of contact.

Factors which modify the degree of angular contact between the strand 24 and the pulling wheel 27, and are thus determinative of the proper positive of the strand 24 axially on the pulling wheel 27, include the nature of the liquid on the strand 24, its surface tension, adhesion to the material of which the wheel 27 is fabricated, the size of the strand 27, the resistance to feeding of the strand 24, etc. With respect to any particular strand, experimentation may be necessary to determine the precise angle of application of the strand 24 to the surface of the pulling wheel 27 and the position axially of the wheel to which the strand is guided, as illustrated in FIG. 5. "Pos. C" of FIG. 5 is shown therein merely illustratively and is not an operating condition according to the invention.

The belief that surface tension of the liquid wetting the surface of the pulling wheel contributes to the operation of a wheel according to the invention is based upon experimentation made with the embodiment of the invention illustrated in FIGS. 2–5. The axial position of the strand 24 with respect to the notches 29 (FIG. 5) is determinative of the length of surface of the wheel 27 which the strand 24 contacts. The tractive force of the wheel 27 constructed and operated according to the invention may be varied according to the resistance to pulling of the particular strand being pulled and to achieve the point of departure of the strand 24 from the pulling wheel 27 which is desired. With respect to any particular strand 24, it will be found that shifting the strand too far to the left (FIG. 5) so reduces the surface contact of the strand 24 with the wheel 27 that it will not be fed at all. Conversely, shifting the strand 24 too far to the right (FIG. 5) places the strand 24 in continuous contact with the surface of the wheel 27 and separation of the strand 24 without additional separation means is made unreliable.

In this embodiment of the invention, the tooth-like portions 34 function as adhesive or tractive portions of the surface of the pulling wheel 27, the intervening notches 29 not acting to exert any tractive force in the strand 24 and thus not contributing to its feeding.

The embodiment of the invention just described, as well as others, are capable of use for feeding multifilament, untwisted glass fiber strands where no co-hesive force exists between the parallel filaments without splitting the strand because the tendency of such strands to lick the surface can be controlled. Such wheels and such method are, therefore, useful in the initial formation of such strands by attenuating the filaments from individual hot streams of glass while feeding them.

The embodiment of the invention illustrated in FIGS. 6–9, as in the case of the earlier embodiment, consists of alternating tractive and non-tractive wheel portions, in this case provided by the use of alternating sections of material to which the strand does and does not adhere. In this embodiment of the invention a pulling wheel 35 is mounted for high speed rotation upon an axle 36 and utilized to feed a continuous multifilament strand 37 of the type generally described above. The peripheral surface of the pulling wheel 35 consists of alternating areas which are fabricated from materials that are, for example, wettable and non-wettable by the liquid applied to the filaments or to the surface of the pulling wheel. These circumferentially spaced areas of the periphery exert tractive or feeding forces on the strand 37 and intervening areas do not.

In the pulling wheel 35 of FIGS. 6–9, the tractive or pulling areas are portions of the wheel itself and are indicated by the reference number 38. These areas are alternated with inserts formed from non-wettable material and which are, therefore, non-tractive, the inserts being indicated by the reference number 39. One manner of forming the areas 39 is shown most clearly in FIG. 9 where they are illustrated as consisting of arcuate dovetailed inserts made of a material different from that from which the pulling wheel 35 is constructed and having a surface which repels liquid applied to the strand to be fed and thus is not wetted.

As a result of the alternating wettable and non-wettable areas 38 and 39, the strand 37 tends to cling tightly to the wettable or adhesive areas 38 and to fall free immediately from the non-wettable or non-adhesive areas 39. The resulting action is shown diagrammatically in FIGS. 6 and 7. For purposes of comparison of these figures, an index arrow is shown exteriorly of the pulling wheel 35 and an indicator arrow numbered 40 in FIGS. 6 and 7 is shown on the side of the pulling wheel 35. It will be observed by comparing FIGURES 6 and 7 that the wheel 35 has rotated a distance sufficient to move the indicator 40 away from the index a circumferential distance corresponding to one of the alternating areas 38 or 39. While the alternating areas 38 and 39 are illustrated as having the same extent circumferentially, it will be appreciated that by making the inserts 39 either smaller or larger than the areas 38 of the wheel itself, varying results in the amount of tractive force exerted and in the manner and position of strand delivery off of the wheel can be achieved.

In FIG. 6, the strand 37 is shown as clinging to an area 38 at the point indicated by the legend "adhesion." In FIG. 7 the strand 37 is shown as falling free from the next following one of the areas 39 as indicated by the legend "non-adhesion." The strand 37 is thus alternatingly carried up slightly and then dropped by the wettable and non-wettable areas 38 and 39 and the strand is delivered off the pulling wheel 35 with a generally sinusoidal configuration.

By controlling the factors involved, for example, the speed of rotation of the pulling wheel 35, the circumferential extent of the wettable and non-wettable areas 38 and 39, the quantity of liquid placed on the strand 37,

ambient air temperature and currents, etc., the strand **37** may be fed by the pulling wheel **35** and delivered at a controllable position off the wheel **35** and in a controlled wave form configuration. Delivery of the strand in a wave form configuration according to this embodiment of the invention reduces its net linear speed by the ratio between the actual length of the strand extending between two points along the strand and the distance between those two points along a straight line.

While the embodiment of the invention illustrated in FIGS. 2–5 is designed to permit simple variation in the circumferential extent of the wettable surfaces **34** with which the strand is in contact, the wettable surfaces **38** of the embodiment of the invention illustrated in FIGS. 6–9 are pre-selected as a result of experimentation to perform in a certain manner with respect ot the feeding of a strand of certain size and weight, and under certain conditions.

Similarly, the embodiment of the invention illustrated in FIG. 10 is a simple modification of the embodiment of FIGS. 2–5 according to the manner of FIGS. 6–9. In FIG. 10 a pulling wheel **41** is shown as having spaced, protruding, tooth-like portions **42** which function as wettable and adhesive portions to provide traction for the feeding and attenuation of a continuous multifilament strand **43**. Alternating with the wettable portions **42** are intervening notches **44** which extend from side to side of the pulling wheel of FIG. 10. In common with the earlier described embodiments of the invention, in the embodiment of FIG. 10 the strand **43** or wheel **41** carries a suitable liquid for wetting the surface portions **42** to cause adhesion and thus traction between the pulling wheel **41** and the strand **43**.

As in the earlier embodiments of the invention, a slight wave formation may be placed in the strand **43** by reason of its adherence to the wettable portions **42** and, of course, its non-adherence to the spaces provided by the notches **44**. Such a configuration is shown in FIG. 10.

I claim:

1. Means for longitudinally feeding a continuous multifilament glass fiber strand, said means consisting of a single rotary pulling wheel having a cylindrical periphery, means for mounting said wheel for rotation about a horizontal axis, circumferentially spaced areas of the periphery of said wheel lying in and extending circumferentially along a substantially smooth, cylindrical surface generated around said horizontal axis of said wheel and being separated circumferentially from each other by intervening, radially depressed areas, said areas being triangularly shaped notches in plan with the apex of each triangular notch lying in the surface of the wheel and the base of each triangular notch opening at one edge of said wheel, there being a continuous cylindrical surface along the edge of said wheel adjacent the apexes and an interrupted cylindrical surface between said triangular notches adjacent the bases, means for longitudinally guiding said strand generally tangentially into contact with the periphery of the said wheel, means for applying a liquid, having a high surface tension and capable of wetting the spaced cylindrical surface areas of said wheel, to said strand prior to its engagement with said wheel, and means for rotating said wheel at high speed about said horizontal axis.

2. Means according to claim 1 in which said means for longitudinally guiding said strand generally tangentially into contact with the periphery of said wheel comprises a guide shoe, a carriage for mounting said guide shoe, and means for selectively moving said carriage axially of said pulling wheel to vary the line of engagement of said strand with said wheel whereby the amount of peripheral surface of said wheel in engagement with said strand is altered to change the degree of angular contact between said strand and said wheel, said degree being decreased as said carriage is moved in the direction of the bases of said notches, and increased as said carriage is moved in the direction of the apexes of said notches.

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