Dec. 26, 1961 C. R. CUNNINGHAM ETAL 3,014,629

APPARATUS FOR LONGITUDINALLY PULLING CONTINUOUS MULTIFILAMENT STRANDS

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FIG. 1.

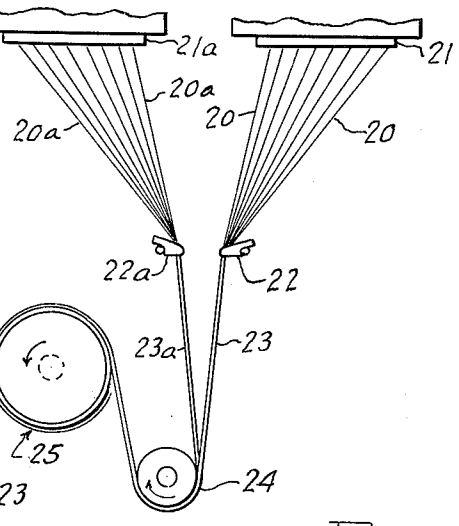
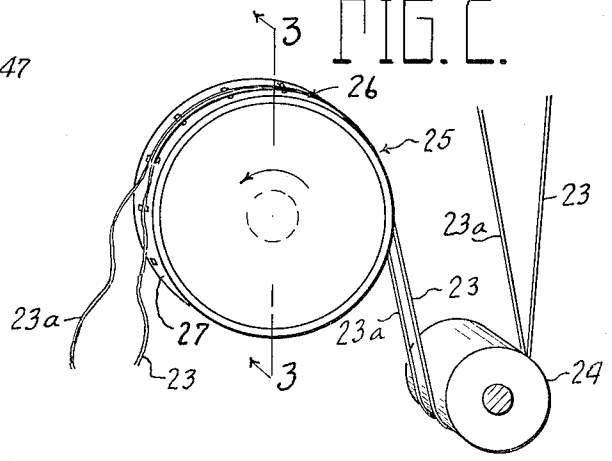


FIG. 2.



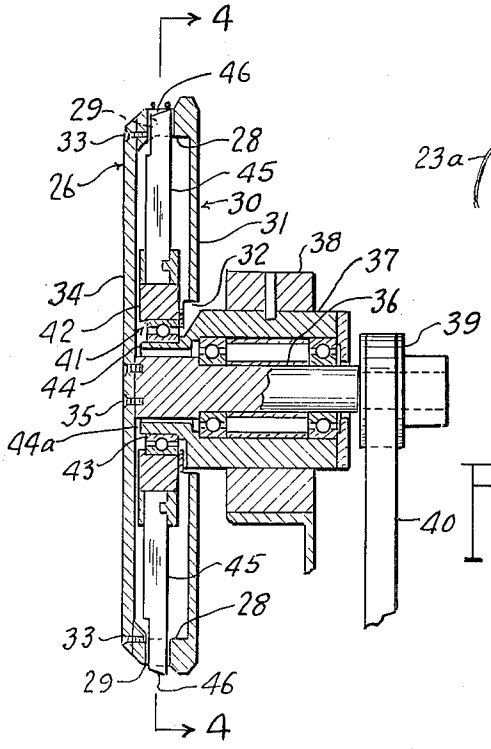


FIG. 3.

INVENTORS
Cecil R. Cunningham &
Thomas F. Costello
BY
Stalin & Overman
ATTORNEYS

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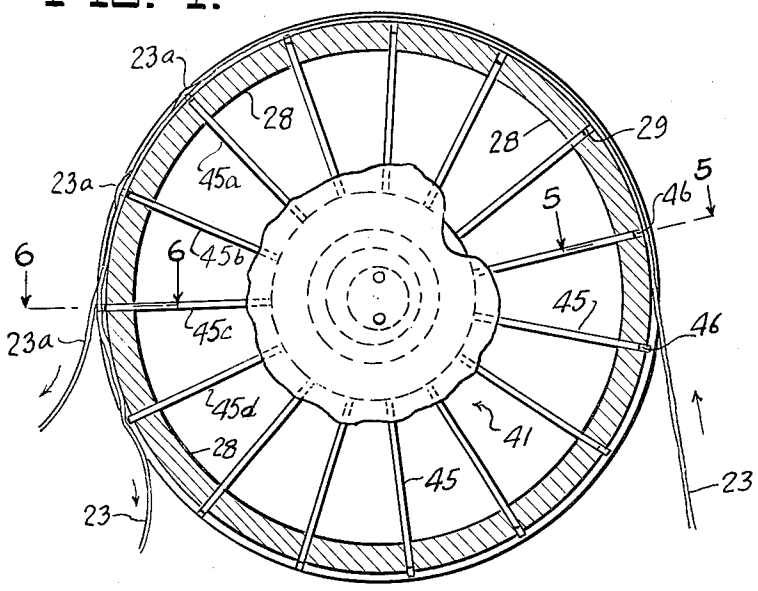
FIG. 4.



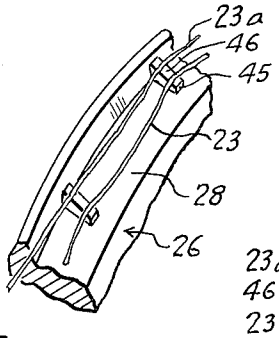


FIG. 7.

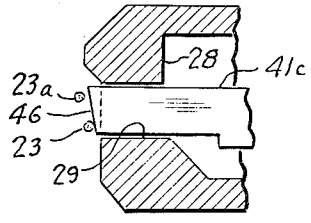


FIG. 6.

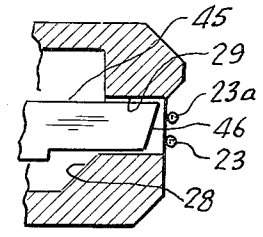


FIG. 5.

INVENTORS
Cecil R. Cunningham &
Thomas F. Costello
BY
Stachi & Overman
ATTORNEYS

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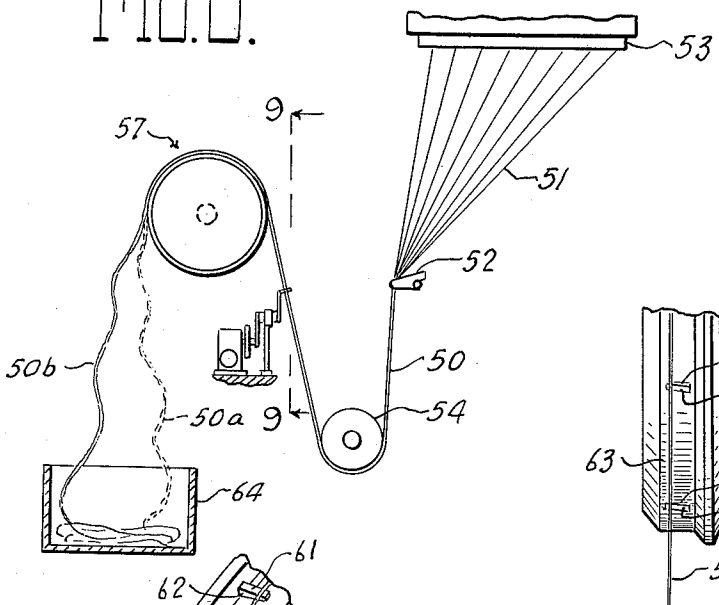
FIG. 8.



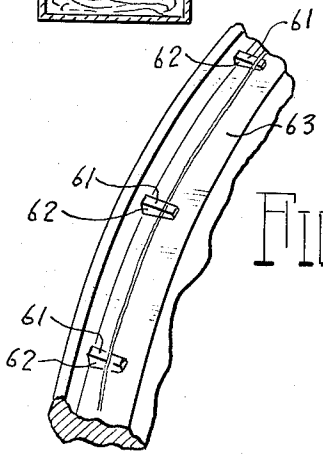


FIG. 10.

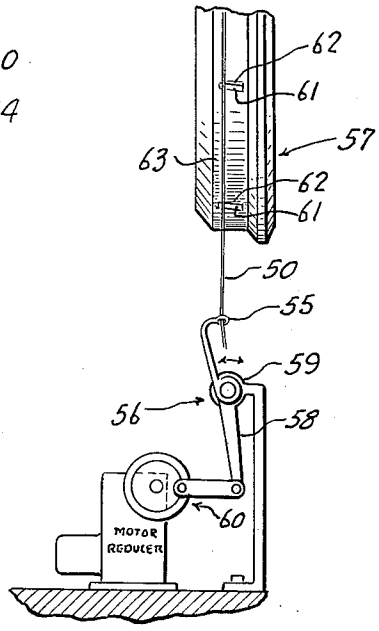


FIG. 9.

INVENTORS
Cecil R. Cunningham &
Thomas F. Costello
BY
Hathi & Quarles
ATTORNEYS

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3,014,629

APPARATUS FOR LONGITUDINALLY PULLING CONTINUOUS MULTIFILAMENT STRANDS

Cecil R. Cunningham, Anderson, S.C., and Thomas F. Costello, Glenbrook, Conn., assignors to Owens-Corning Fiberglas Corporation, Toledo, Ohio, a corporation of Delaware

Filed Feb. 27, 1959, Ser. No. 795,967
3 Claims. (Cl. 226—190)

This invention relates to an apparatus for longitudinally pulling a continuous multifilament strand, for example a glass fiber strand, at high lineal speed and for delivering the strand to a designated point in wave form configuration at a much slower and controlled speed.

Russell Patent 2,868,358 discloses an apparatus comprising a rotary pulling wheel having a generally circular, interrupted periphery with a cooperative strand removal structure which rotates in phase with the wheel and which has spoke-like elements protruding through slots in the periphery of the wheel, the wheel and the structure being mounted upon spaced parallel axes so that the removal elements protrude beyond the periphery of the wheel at one side of the apparatus and are withdrawn beneath the periphery of the wheel at the other side of the apparatus. The continuous multifilament strand to be fed by the apparatus is led into tangential engagement with the wheel at the side where the spoke-like elements are withdrawn and is fed around the wheel by engagement with the peripheral surface thereof until it reaches the point where the spoke-like elements of the removal structure protrude beyond the periphery of the wheel. This sequential protrusion separates the strand from the wheel so that it is discharged. The strand leaving the structure of the Russell patent is a "driving strand," i.e., it moves in a substantially linear configuration along its longitudinal delivery path and at a speed not greatly lower than its pulling speed.

It is an object of the instant invention to provide an apparatus which constitutes an improved modification of the Russell apparatus.

It is another object of this invention to provide an apparatus which constitutes an improved modification of the Russell patent by which two or more strands may simultaneously be fed and delivered to two or more separate delivery points by a single apparatus embodying the invention.

It is another object of this invention to provide a rotary apparatus for pulling a continuous multifilament strand at high lineal speed and for producing in the strand a controlled wave form configuration at delivery from the apparatus and to thus provide for delivery of the strand at a speed which is substantially slower than its speed of pulling so that it can be more readily handled in subsequent operations such as packaging.

These objects and other objects and advantages of the instant invention will be better understood from reference to the specification which follows, and to the drawings, in which—

FIG. 1 is a simplified, diagrammatic view in elevation of an apparatus embodying the invention as employed for the simultaneous attenuating and feeding of two multifilament, continuous, untwisted, glass fiber strands;

FIG. 2 is a fragmentary view in perspective of an apparatus embodying the invention;

FIG. 3 is a vertical sectional view taken along the line 3—3 of FIG. 2 and showing details of an apparatus embodying the invention;

FIG. 4 is a somewhat diagrammatic view with the relative proportions of the parts grossly exaggerated, taken along the section line 4—4 of FIG. 3, and serving

to illustrate the function of apparatus embodying the invention;

FIG. 5 is a fragmentary sectional view on an enlarged scale taken along the line 5—5 of FIG. 4;

FIG. 6 is a view similar to FIG. 5 but taken along the line 6—6 of FIG. 4;

FIG. 7 is a fragmentary view in perspective illustrating a portion of the periphery of apparatus embodying the invention as utilized for simultaneously feeding and projecting the two strands;

FIG. 8 is a view similar to FIG. 1 but illustrating the use of an apparatus embodying the invention for the feeding of a single multifilament strand and its projection with a wave form configuration of large amplitude;

FIG. 9 is a somewhat schematic view taken along the line 9—9 of FIG. 8, and

FIG. 10 is a view similar to FIG. 7 but of the apparatus as employed according to FIGS. 8 and 9.

For purposes of illustration throughout this specification, the apparatus embodying the invention will be shown in use for the pulling and projecting of multifilament, untwisted, glass fiber strands. It is to be understood, however, that the particular strand fed does not modify the function or design of the apparatus and is only illustrative. It should also be observed that the particular strand configurations are not limiting, but only illustrative and that proportions and comparative sizes are not accurate.

A continuous, untwisted, multifilament glass fiber strand is continuously produced by attenuating a plurality of individual glass filaments 20 or 20*a* from minute streams of glass which flow through orifices in the bottom of a heated "bushing" 21 or 21*a*, respectively. Each of the bushings 21 and 21*a* may be located at the bottom of an individual glass melting furnace or both may be fed with molten glass from a single large supply, such as the forehearth of a melting tank. The filaments 20 or 20*a* of each group are gathered together by a suitable gathering shoe fragmentarily indicated at 22 or 22*a* and laterally compacted into a multifilament strand 23 or 23*a* where the fibers lie parallel to each other.

Two such strands 23 and 23*a* may be attenuated or pulled and simultaneously delivered to receiving means by a single apparatus embodying the invention. Such an arrangement is illustrated in FIGS. 1–7. The two strands 23 and 23*a* are led around a single idler pulley 24 in parallel paths and guided thereby tangentially into surface contact with an apparatus generally indicated at 25 embodying the instant invention.

The apparatus 25 comprises two main structural parts, the first being a rotary, generally circular, pulling wheel 26 having an interrupted operative periphery 27. The interrupted periphery 27 is formed by a plurality of circumferentially extending periphery forming elements 28 (see FIG. 4), spaced by radially and axially extending slots 29. Each of the elements 28 has the same circumferential length and their outer surfaces lie in a cylinder concentric with the axis of the wheel 26. The wheel 26 (see FIG. 3) comprises a back half 30 which includes the periphery forming elements 28 and an inwardly directed flange 31 at the center of which there is a circular opening 32. The back half 30 is secured by a plurality of mounting screws 33 to a front disc 34. The front disc 34 is in turn mounted by mounting screws 35 on the front end of a stub shaft 36, the shaft 36 being rotatably journaled in a hub 37 which is carried by a bracket 38. A sheave 39 is keyed on the rear end of the shaft 36 and driven from a suitable motor by a belt 40.

The second major component of the apparatus 25 embodying the instant invention, is a rotary strand removal structure generally indicated at 41. In this embodiment of the invention, the strand removal structure 41 com-

prises a hub 42 which is journaled by a bearing 43 on an eccentric neck 44 of the hub 37. The eccentricity of the neck 44 can best be seen in FIG. 3 where its radial thickness above the shaft 36, indicated by the reference number 44, is less than its radial thickness below the shaft 36, as indicated by the reference number 44*a*. A plurality of thin, flexible spokes 45 is carried by the hub 42, the spokes 45 protruding outwardly and into the slots 29 of the pulling wheel 26. Because of the eccentricity of the axis of the strand removal structure 41, relative to the axis of the pulling wheel 26, and because all of the spokes 45 have the same radial length, the spokes 45 protrude beyond the cylindrical surfaces of the elements 28 at one side of the apparatus and are withdrawn beneath the cylindrical surfaces of the elements 28 at the other side of the apparatus. Protrusion of the spokes 45 beyond the cylindrical surface of the elements 28 is illustrated at the bottom of FIG. 3 and withdrawal beneath these surfaces is illustrated at the top of FIG. 3.

The apparatus so far described may be substantially identical with one of the embodiments of the invention disclosed and claimed in the above mentioned Russell patent. The improvement comprising the instant invention, and by means of which the different and improved functioning of the instant invention is accomplished, consists in cutting ends 46 of the spokes 45 on a diagonal relative to the cylinder in which the surfaces of the periphery forming elements 28 all lie. All of the ends of all of the spokes 45 are diagonally cut so that a surface defining their ends would be that of a cone. The longer portions of the spokes 45 are shown as being at their right sides in FIG. 3 (their upper sides in FIGS. 5 and 6).

The eccentricity of the mounting means for the pulling wheel 26 and strand removal structure 41 is such that the spokes 45 are withdrawn beneath the surfaces of the elements 28 at the point where the two strands 23 and 23*a* are guided into engagement with the apparatus. This is at the right side of FIGS. 2 and 4. In FIGURES 4 and 5 it can be seen that the ends 46 of the spokes 45 are withdrawn beneath the surfaces of the elements 28 at the point of engagement so that the two strands 23 and 23*a* are led into tangential engagement with the surfaces 28 without interference from the spokes 45.

As the wheel 26 and removal structure 41 rotate in a counterclockwise direction (FIG. 4), the spokes 45 are progressively moved outwardly until the longer sides of the diagonal ends 46 protrude sufficiently beyond the surfaces of the elements 28 of the wheel 26 to lift the strand at that side of the apparatus, i.e., the strand 23*a* sufficiently out of engagement with the surfaces of the elements 28 so that it no longer adheres to these surfaces but flies away from the apparatus in a generally tangential direction. This action is illustrated at the left side of FIG. 4 where a first spoke, indicated by the reference number 45*a*, is shown as protruding far enough to slightly lift the strand 23*a*. A second spoke 45*b* is shown as protruding still farther so that it lifts the strand 23*a* a greater distance, and a third spoke 45*c* is shown as protruding beyond the surfaces of the peripheral elements 28 sufficiently so that the strand 23*a* is completely separated at this point from the apparatus.

Simultaneously, of course, the spokes 45 progressively move into engagement with the strand 23 located at that side of the wheel where the shorter lengths of the spoke ends 46 are effective. This is illustrated in FIG. 4 where the spoke 45*b* first engages the strand 23, the spoke 45*c* lifts the strand 23 to a slightly greater degree, and a fourth spoke 45*d* protrudes far enough to separate the strand 23 from the surfaces of the periphery-forming elements 28.

By cutting the diagonal ends 46 on the spokes 45 the two strands 23 and 23*a* are thus engaged in sequence by the same spokes as the spokes begin to protrude beyond

the cylindrical surfaces of the periphery-forming elements 28 of the pulling wheel 26. Because the two strands 23 and 23*a* are spaced from each other axially on the periphery of the apparatus, the strand 23*a* is always pushed away from the surface of the pulling wheel 26 ahead of the strand 23. Thus, the two strands are delivered from the apparatus at a fixed angular distance from each other and are directed tangentially along diverging paths. Since the two strands 23 and 23*a* move along diverging paths, they may be separately received in suitable receptacles spaced from each other so that they do not become entangled. Such receptacles are illustrated in simplified form in FIG. 1 where two rotary buckets 47 and 47*a* are illustrated. It will be appreciated, of course, that rotary buckets are but one of many forms of receivers which may be employed for accumulating strands delivered from apparatus embodying the invention. Other suitable receivers may be reciprocated in a linear path or may simply be stationary.

The utilization of apparatus embodying the instant invention for the production of a wide traverse of wave form configuration in a single strand is illustrated in FIGS. 8, 9 and 10. A continuous multifilament glass strand 50 is gathered from a plurality of individual filaments 51 by a gathering shoe 52, the filaments 51 being pulled from streams of glass flowing through suitable orifices in a conventional bushing 53. The strand 50 is led around an idler pulley 54 and then into engagement with a guide eye 55 of a traverse mechanism generally indicated at 56.

The particular traverse mechanism illustrated in FIGS. 8 and 9 is not a part of the instant invention but is shown merely as one mechanism which may be employed for traversing the strand 50 back and forth axially relative to apparatus embodying the invention generally indicated at 57. The particular traverse 56 comprises an arm 58 pivoted on a bearing 59 and driven by a crank arrangement 60. By traversing the strand 50 axially relative to the apparatus 57, it is carried from a position (illustrated at the left in FIG. 9) where it engages the shorter sides of ends 61 of removale spokes 62 to the other side (right side in FIG. 9) where it engages the longer side of the spoke ends 61.

Where the strand 50 engages the shorter sides of the spoke ends 61, it remains in contact with the pulling wheel 63 of the apparatus 57 for a greater angular distance than it does when it engages the longer sides of the spoke ends 61, and it is discharged along an inner discharge path generally indicated by the dotted line 50*a* in FIG. 8. Conversely, when the traverse mechanism 56 shifts the strand to the longer side of the spoke ends 61 (to the right in FIG. 9), the strand 50 is more quickly engaged as the spokes begin to protrude beyond the cylindrical surface of the wheel 63 and the strand 50 is delivered after a shorter time of contact along a path generally indicated by the reference number 50*b* in FIG. 8. Because the traverse mechanism 56 moves the strand 50 back and forth between these two positions, the strand 50 is alternately discharged from the apparatus 57 along the paths 50*a* and 50*b* producing a wide traverse of movement and thus a wave form configuration of substantial amplitude to still further reduce the speed of discharge and the possibility that the strand will become entangled. An open topped receiver 64 is shown in FIG. 8 for collecting the strand 50 after it is discharged off of the apparatus 57. As an illustration, apparatus embodying the invention in which the wheel 63 has an 8 inch diameter delivers the strand with a 12 to 14 inch traverse at 3 to 3½ feet from the wheel 63.

The speed of operation of the traverse mechanism 56 may be adjusted relative to the speed of rotation of the apparatus 57 as desired. It has been found that preferably the two cycles, i.e., traverse and rotation, should not be precisely in phase in order to avoid excessive wear on the spoke ends 61 during rotation and to prevent a re-

peated pattern of pile up in the receiver 64 or on other devices to which the strand is delivered.

We claim:

1. Apparatus for longitudinally pulling continuous, multifilament strands at high lineal speed and projecting such strands in wave form configuration, said apparatus comprising a rotary, generally circular, pulling wheel having a plurality of evenly spaced, circumferentially extending, periphery-forming elements, the outer surfaces of said elements having equal circumferential length and forming an interrupted surface lying in a cylinder around the axis of said wheel for strand contact and adhesion, a rotary strand removal structure supported independently of and rotatable in phase with said wheel about an axis parallel to and spaced from the axis of said wheel, said structure comprising a hub and a plurality of spokes reciprocable radially through the spaces between said elements, the ends of said spokes being cut diagonally to the axes of said wheel and said structure, and all of said spokes being of identical length sufficient to protrude their ends beyond the cylinder of the surfaces of said elements at one side of said wheel, means for guiding a plurality of strands into generally tangential contact with said wheel, and means for rotating said apparatus away from the point of contact of said strand with said wheel.

2. Apparatus for longitudinally pulling continuous, multifilament strands at high lineal speed and projecting such strands in wave form configuration, said apparatus comprising a rotary, generally circular, pulling wheel having a plurality of evenly spaced, circumferentially extending, periphery-forming elements, the outer surfaces of said elements having equal circumferential length and forming an interrupted surface lying in a cylinder around the axis of said wheel for strand contact and adhesion, a rotary strand removal structure supported independently of and rotatable in phase with said wheel about an axis parallel to and spaced from the axis of said wheel, said structure comprising a hub and a plurality of spokes reciprocable radially through the spaces between said elements, the ends of said spokes being cut diagonally to the axes of said wheel and said structure, and all of said spokes being of identical length sufficient to protrude their ends beyond the cylinder of the surfaces of said elements at one side of said wheel, guide means for guiding a pair of continuous, multifilament strands along parallel paths lying in spaced planes that are normal to the axis of said wheel into tangential contact with the surfaces of said elements at points remote from that side of said wheel where the ends of said spokes protrude beyond the surfaces of said elements, and means for rotating said apparatus away from the point of contact of said strands with said wheel.

3. Apparatus for longitudinally pulling continuous, multifilament strands at high lineal speed and projecting such strands in wave form configuration, said apparatus comprising a rotary, generally circular, pulling wheel having a plurality of evenly spaced, circumferentially extending, periphery-forming elements, the outer surfaces of said elements having equal circumferential length and forming an interrupted surface lying in a cylinder around the axis of said wheel for strand contact and adhesion, a rotary strand removal structure supported independently of and rotatable in phase with said wheel about an axis parallel to and spaced from the axis of said wheel, said structure comprising a hub and a plurality of spokes reciprocable radially through the spaces between said elements, the ends of said spokes being cut diagonally to the axes of said wheel and said structure, and all of said spokes being of identical length sufficient to protrude their ends beyond the cylinder of the surfaces of said elements at one side of said wheel, guide means for guiding a continuous, multifilament strand into tangential contact with the surfaces of said elements at a point remote from that side of said wheel where the ends of said spokes protrude beyond the surfaces of said elements and for traversing said strand axially back and forth across the surfaces of said elements for engagement with the diagonal ends of said spokes at progressively different points, and means for rotating said apparatus away from the point of contact of said strand with said wheel.

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