

[54] **APPARATUS FOR PROCESSING WOUND STRAND FROM FILAMENT FORMING MATERIALS**[75] Inventors: **Svend Aage Petersen**, Toledo;
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York, N.Y.[22] Filed: **Nov. 18, 1971**[21] Appl. No.: **200,082**[52] U.S. Cl. **65/11 W, 242/18 G, 242/35.5 R**[51] Int. Cl. **C03b 37/02**[58] Field of Search **242/18 G, 35.5 R;**
65/1, 2, 11 W

[56]

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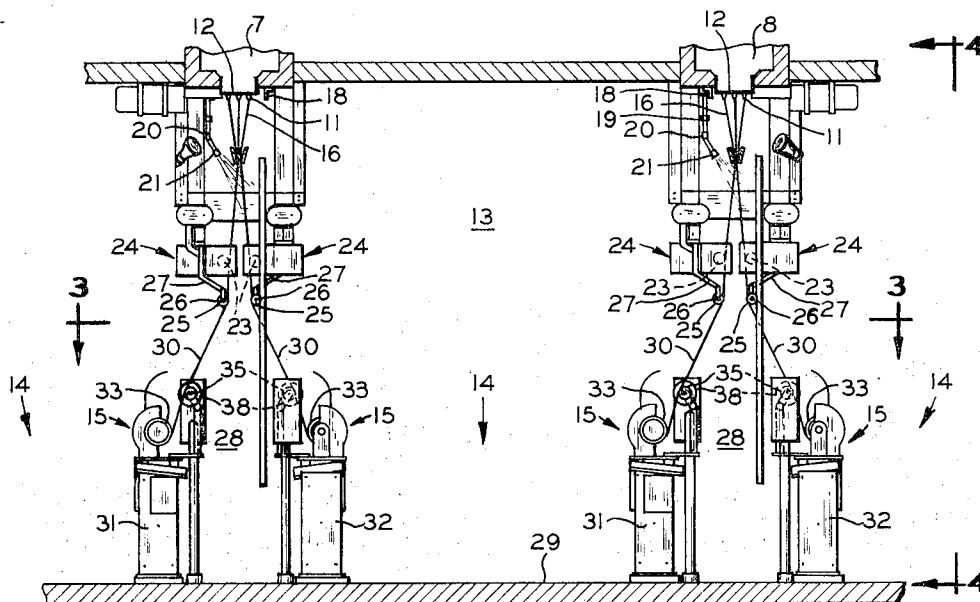
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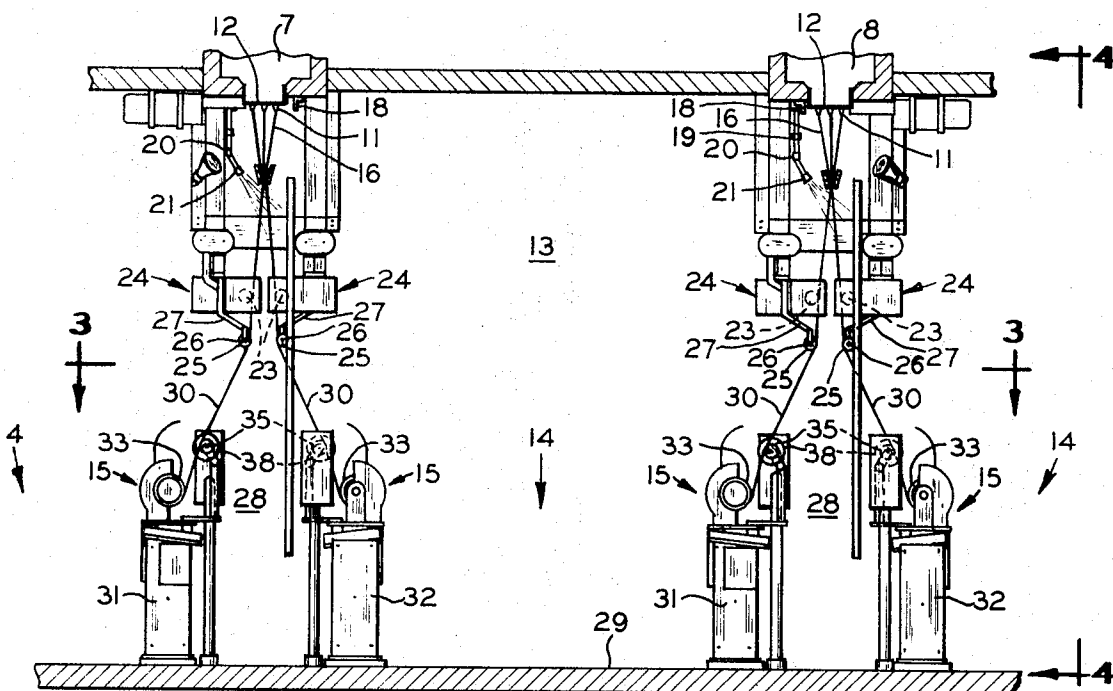
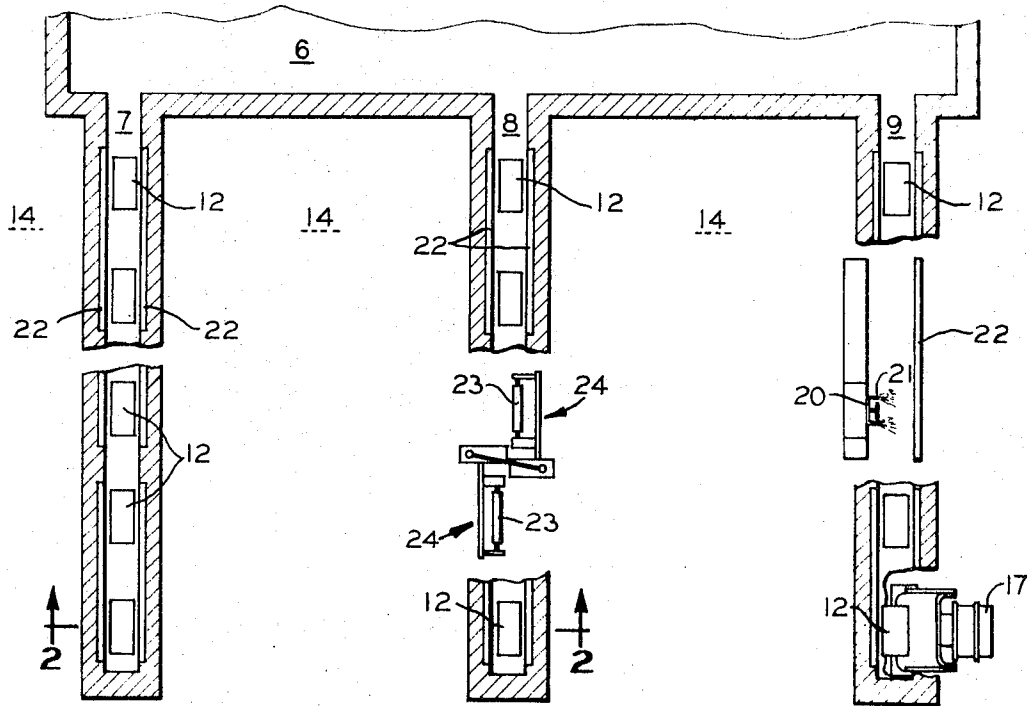
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ABSTRACT

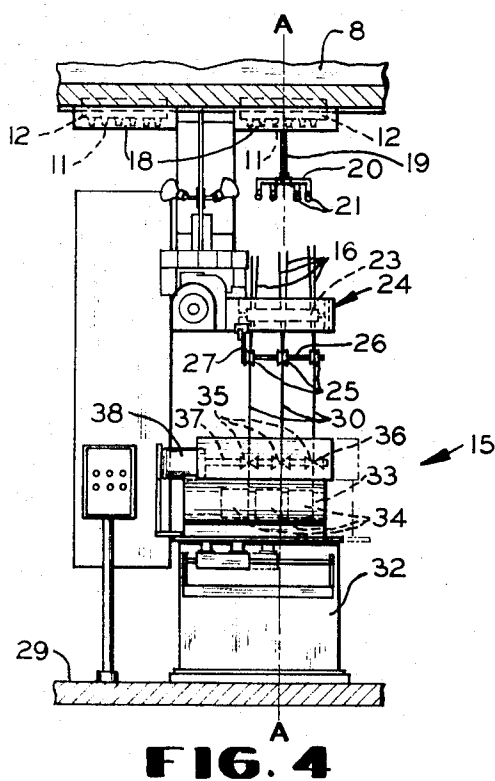
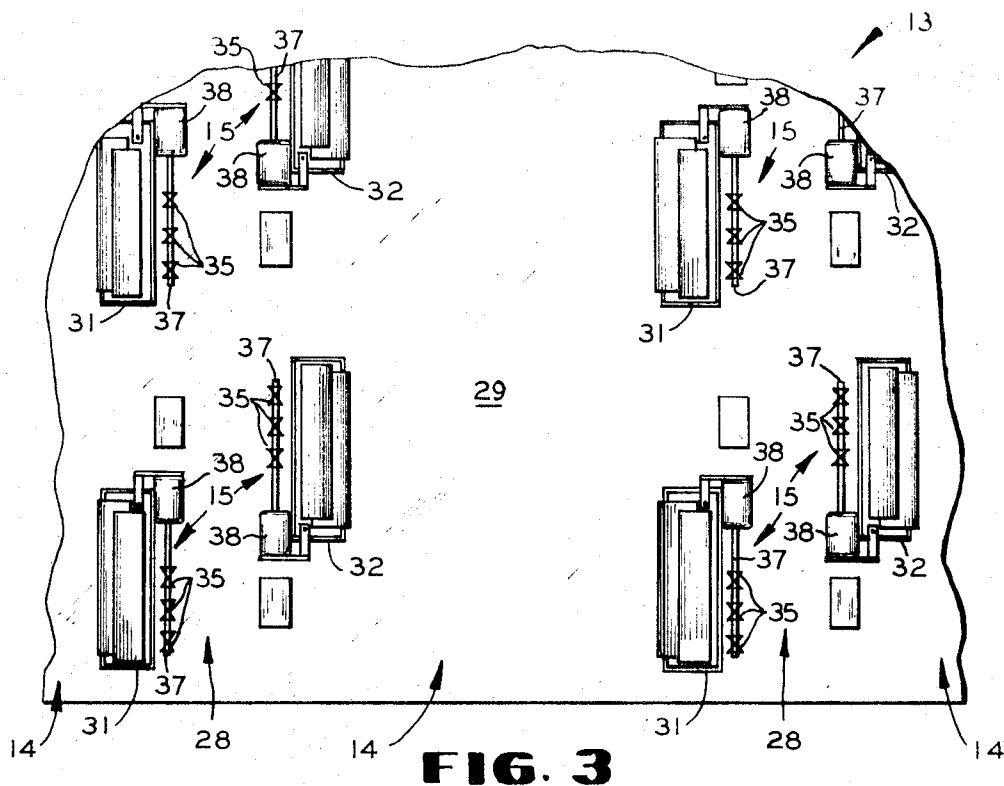
An arrangement of equipment for processing strands of thermo-plastic material in which a common supply channel feeds a plurality of bushings from which filaments making up strands are drawn. The bushings are closely spaced in alignment along the length of the supply channel. A row of winders is located on each side of a projected vertical plane extending through the longitudinal center line of the bushings and supply channel with alternate bushings grouped in a first and second group along the length of the supply channel so that the first group is arranged to supply filaments and resultant strands to adjacent winders on a first side of the projected plane while the second group supplies filaments for the strands to adjacent winders on the second side of the projected plane. Thus, adjacent bushings supply winders on opposite sides of the projected plane. The winders on each side of the projected plane are oriented with their winding axes generally parallel to the plane.

6 Claims, 4 Drawing Figures



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APPARATUS FOR PROCESSING WOUND STRAND FROM FILAMENT FORMING MATERIALS

BACKGROUND OF THE INVENTION

It has been common practice to produce strands of heat-softenable material from a plurality of filaments extruded from a bushing and drawn through a dressing applicator, a filament gatherer, and a collector, usually in the form of a winding tube mounted on a winder collet. Strand has been produced in this manner in a winding room in which rows or banks of winders are located along an aisle and are fed strand from spaced bushings generally above the winders and each supplying one or more given winders. When the bushings from which the filaments are supplied have been arranged to melt glass, fed as rod or marbles, for example, their location and spacing was dictated primarily by the spacing required for the winders. Accordingly, winders were arranged to be tended by operators from the aisle common to all winders and thus from one side only. Such winders have been oriented with their winding axes perpendicular to the aisle, in echelon along the aisle, or parallel to and aligned along the aisle. The aligned and parallel orientation has been found particularly advantageous for winders on which the wound strand is started manually by attendants, since it affords the most convenient access to the winding collets. However, such alignment of winders having long winding tubes mounted in tandem on the collets requires a substantial amount of space along the aisle for each winder. Bushings from which the strands are derived have in the past been spaced along the aisle according to this winder spacing.

When a plurality of bushings are supplied from a channel extending from a melting tank, it is desirable to space the bushings close together along the length of the channel so that the heat-softenable material tends to have a maximum state of uniformity from bushing to bushing. Generally, the heat-softenable material has a rather narrow range of filament forming conditions. By minimizing the length of the channel from which the bushings provide filament issuing apertures, the molten material is maintained in a more homogeneous form and the heat balance is kept in better control from bushing to bushing. Bushing spacing and such arrangements should be based more upon the space required for auxiliary equipment such as cooling fluids to supply ducts and shields around each filament issuing zone and servicing considerations such as the space required for the removal and replacement of an individual bushing while filaments are formed from adjacent bushings along the channel length.

When bushings are spaced according to the above considerations the winders, particularly when they utilize long winding collets and long winding tubes, cannot be oriented in a single rank or line in end to end winder orientation since they tend to interfere. The alternatives of echelon winder alignments or an arrangement with winding axes perpendicular to the operator's servicing aisle causes operator inconvenience even where adequate space for such orientation is available.

SUMMARY OF THE INVENTION

The present invention relates to the layout or relative position of the various pieces of equipment for forming and winding strands into a package and more particularly to such a layout for strands formed from a heat-

softenable material by drawing the material supplied in the molten state into filaments to be collected to form the strand. In one arrangement a plurality of feeders for flowing a number of fine streams of molten material, for example, bushings flowing molten glass, are aligned in a horizontal single file and a plurality of winders having rotatable collets for receiving forming tubes on which the strands may be wound are aligned along their winding axes in two rows arranged to provide maximum space utilization and increase the efficiency of the operator serving the winders.

The winders have an axis about which the strand is wound parallel to the direction of alignment of the bushings. Alternate bushings and a succession of bushings are operatively associated with a winder which is positioned on a common side of a plane passing vertically through the center of all of the bushings so that winders for successive bushings are on opposite sides of that plane. The winders each can be aligned longitudinally of the direction of alignment of the bushings with the individual bushing with which that winder is operatively associated.

The present arrangement of bushings and winders is especially advantageous where the heat-softenable material is fed the bushings in a molten state from a common channel since it facilitates end to end winder orientation without extending the flow channel and bushing spacings to an unwarranted degree. As a result, the material fed the bushings is more uniform, heat losses are minimized, plant floor space for given fiber forming capacity is minimized, and the efficiency of the operators attending the winders is not impaired by an awkward winder orientation.

The above combination results in up to a 50 percent reduction in a given length of a group of winders aligned in a single file and enables the determination of bushing spacing to be undertaken independently of winder spacing considerations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic, sectioned plan of a portion of a plurality of parallel flow channels each supplying molten material from a melting tank to a plurality of filament forming bushings taken in a horizontal plane immediately above the bottom of the flow channels and with portions broken away at typical bushing stations to illustrate the relationship of the cooling means, binder applicator and winder for each bushing;

FIG. 2 is a schematic sectional view of FIG. 1 taken along the line 2—2 and illustrating a portion of a forming room, showing an end view of two channels each containing a plurality of bushings and an end view of four rows of winders and associated equipment in accordance with the invention;

FIG. 3 is a sectional view of the equipment illustrated in FIG. 2 taken along the line 3—3 thereof; and

FIG. 4 is a view partially in section of a single bushing and winder together with their associated equipment illustrated in FIG. 2 taken along the line 4—4 thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A tank 6 in which heat-softenable material is melted is illustrated in FIG. 1 as a source of supply of the molten material to channels 7, 8 and 9. Molten material in the channels is extruded through orifices in tips 11, FIG. 2, in bushings 12 spaced along each of the chan-

nels. A forming room 13 is located beneath the channels and is arranged with a plurality of aisles 14 from which operators attend winding machines 15 in strand winding relationship to the several bushings 12.

Portions of the channels, bushings and registering equipment are broken away in several regions of FIG. 1 at the bushing spray level, at the binder applicator level, and at the winder level to illustrate in plan the relationship of the equipment for each of the bushing-applicator-winder combinations. The particular process and apparatus described is for producing glass strand.

As illustrated in FIGS. 1 and 2 filaments 16 of glass are drawn from a bushing 12 containing at its lower face a rectangular array of tips 11, conventionally grouped in multiples of 204, with files of tips paralleling the longitudinal axis of the channel supplying the bushing. The bushings are controlled as to their temperature electrically and each has an associated transformer 17 which supplies current for resistive heating to augment the flame heating (not shown) at the upper surface of the molten glass in the channels.

Controlled cooling of the filaments 16 is accomplished by shielding them and tips 11 from undesired air currents while directing a liquid spray in the region through which they pass after they are drawn from the tips. Shields 18 restrict and direct the flow of air entrained by the rapidly moving filaments in the vicinity of tips 11. Pot spray conduits 19 supply manifolds 20 on which sprayheads 21 are mounted to direct the spray into the region through which the filaments are drawn prior to the application of a dressing. Temperature conditioning is also afforded by circulating a cooling liquid through cooling panels 22 positioned along the bushings. In the interest of clarity of illustration the various electrical ducts, and wireways and the liquid conduits which must be located beside and between the bushings have not been shown. However it is to be appreciated that space between bushings 12 must be provided not only for accommodating this equipment but also for access to it by servicing personnel.

Dressing liquids, usually as water suspensions or emulsions are applied to the filaments by converging them from the several files of tips making up the tip array and passing them as a sheet array over a driven doctor roll 23 of an applicator assembly 24 suspended adjacent each bushing. Electrical and liquid supply means must also be provided to the applicator assemblies 24. The applicator assemblies also support gathering wheels 25 mounted on shafts 26 along which they can be slid parallel to the longitudinal axis of the tip array. Filaments 16 are gathered as strands 30 made up of filament groups which are guided in the grooves in the gathering wheels. Shafts 26 are suspended from the applicator assemblies 24 by brackets 27.

A free fall zone 28 is provided beneath the bushings 12 so that the filaments which issue from the bushings, when they are not being processed into strand, will not foul the apparatus. Applicator assemblies 24 are arranged to be swung out of the free fall zone by virtue of a pivotal mounting. Winders 15 for the drawn, dressed and gathered filaments are mounted immediately outside of the free fall zone 28 of the filaments and on the floor 29 of the forming room at a level below the bushings, applicator assemblies and previously discussed equipment.

In accordance with the above arrangement the spacing of the bushings 12 along the flow channels 7, 8 and 9 is dictated by the space required for equipment in the upper portion of the forming room 13.

The ultimate measure of efficiency in a given fiber forming operation is the amount of fiber produced. It has been found that optimum winding rates are achieved with the axis of the winder 15 parallel to the aisle 14 from which the operators tend a plurality of winders. Efficiency is enhanced by minimizing doffing time relative to winding time. Accordingly large packages of strands should be wound. Limits are imposed on the diameter range of the package into which strand can be wound due to the change in drawing speed as the diameter grows. Long packages have been employed in order to provide large packages within the acceptable limits of diameter range. Such long packages dictate long winder collets 33 for the reception of winding tubes. For example, it is frequently desirable to mount two 15 inch long winding tubes in end to end relation on a winder collet 33 and therefore a collet at least 30 inches long is employed with sufficient end clearance for reciprocation of the collet to distribute the strands on the packages during winding and for manipulation of the tubes and wound packages during doffing. Accordingly, the length of the winder and their required end clearances exceed the space required for a bushing supplying filaments for the strands delivered to the winder even when the equipment auxiliary to the bushing is accommodated.

Winders 15 are oriented with the desired winder axis alignment in parallelism or near alignment and parallelism to the operators working aisle 14 by associating adjacent winders in a first row 31 along the aisle 14 with alternate bushings along the flow channel. Intermediate alternate bushings are associated with winders in a second row 32. Advantageously the winders of the second row 32 can be positioned on a second aisle 14. Where parallel flow channels supply bushings in parallel rows as from channels 7 and 8, and 8 and 9, a second row 32 of winders from the bushings of channel 7 can be on one side of the aisle serving the first row 31 of winders from the bushings of channel 8, while the second row 32 of winders from the bushings of channel 8 are on one side of the aisle, serving the first row of winders from the bushings of channel 9.

When arranged in two parallel rows, the winders from a single row of bushings can be positioned with the winder rows 31 and 32 on opposite sides of and outside of the filament free fall zone 28 beneath the bushings. Such an arrangement of back-to-back winders is complemented by back-to-back applicator assemblies 24 arranged to be displaced outward of free fall zone. Further the winders on each side of an aisle present their fronts to the aisle and the attending operator in this arrangement.

Another consideration in the winder-to-bushing spatial relationship is the location of the respective elements of the filament and strand handling equipment along the longitudinal axis of the row of bushings. It is desirable to minimize strand and filament travel. An optimum relation is that where the effective portion of the winder collet 33 when in its center position of its axial reciprocation, has its center in a plane normal to the longitudinal axis of the row of bushings 12 and which passes through the longitudinal center of the tip array of the bushing supplying filaments to the winder

15. When such an arrangement is utilized, the winders are staggered in the two rows 31 and 32 associated with a file of bushings.

FIG. 4 illustrates the relationship of longitudinal orientations of the fiber handling apparatus for one winder station. Line A—A represents the edge of a plane passing through the center of the tip array of a bushing along the longitudinal dimension of the bushing and the file of bushings. Three strands 30 are shown formed from the filaments derived from the bushing 12 although the number can vary depending upon the package desired. Single strand packages 34 are illustrated, formed by winding each of the three strands 30 in a predetermined pattern on three winding tubes on the winder collet 33. In the case of a 30 inch collet the tubes each would be essentially 10 inches long.

The winding pattern is established by the relative motion of the strands along the winding tubes during rotation of the tubes. This motion is achieved in part by a traverse mechanism, for example as shown in S. R. Genson U.S. Pat. No. 3,356,304 of Dec. 5, 1967, entitled "Apparatus For Packaging Strand Material," which comprises a series of wires 35 disposed in an array which when rotated generates a camming surface which oscillates the strand around a centerline which is aligned with the centerline of the package 34 when the package is centered between its limits of reciprocation. The winding collet 33 augments the relative motion of strand and package by rotating around its longitudinal axis and reciprocating along its longitudinal axis between the position shown in solid lines and the position shown in phantom in FIG. 4.

In practice the collet is positioned as shown in FIG. 4 during doffing. When new forming tubes are properly positioned on the collet 33 it is started in rotation while strands 30 and their gathering wheels 25 are bunched on the right side of the assembly with all strands essentially in a plane perpendicular to the collet axis and passing through a restraining surface 36 of the right end of the right-hand traverse 35. The strands are started on the collet while guided in this manner. After the collet has achieved the speed of rotation predetermined for drawing strand, usually established by a timer defining an interval from the start of rotation, the traverse motor 38 begins rotating the traverse shaft 37 whereby the strands 30 are passed from restraining surface 36 to the traverse cam faces. The gathering wheels are shifted along shaft 26 so that they are centered on the plane which passes through the longitudinal center of the respective traverse cam surfaces and thus the center of the effective traversing areas defined by those surfaces. As the traverse motor is started, the reciprocating drive for the collet 33 is started. The range of reciprocation generally equals the length of the package to be formed less the length of the traverse area. Thus, traverse location, winding tube location and gathering wheel location are generally symmetrically positioned longitudinally of the tip array around the plane A—A and thus the tube bearing portion of the collet 33 is so positioned. With an odd number of strands the center strand, its gathering wheel 25, its traverse 35, and its winding tube are centered on the plane A—A as shown.

The apparatus illustrated can generally be considered to comprise one or more vessels for containing molten, heat-softenable material in the form of the parallel flow channels 7, 8 and 9, which can be fed from a common source of molten material or individual sources of such

material. Bushings 12 constitute stream feeders in that their array of tips 11 have orifices which communicate with the interior of the vessel to flow a group of streams of the heat-softenable material from the feeders. The bushings 12 or the orifice arrays can have longitudinal axes which are aligned and can be located in a straight line as where associated elements are to be so aligned. Streams of the material are drawn, solidified to filaments, coated with dressing and gathered into strands by the combination of elements which can be considered either individually or jointly to constitute strand forming means. Certain of these elements for transforming the streams into strand have a front and back side in that the attending operator services the elements such as the dressing applicator 24 and the strand gathering wheels 25 from the front sides while the back sides are proximate to a vertical plane projecting downward from and extending along the file of bushings 12 and the waste filament free fall zone therebeneath. Winders 15 are associated with respective stream feeders, the bushings 12, from which the strand they wind is derived. In order to permit spacing the bushings 12 without regard to required winder spacing the winders are arranged in a plurality of rows, as rows 31 and 32 for a two row winder array. The relationship of the stream feeders in the file to the strand winders in a given row is cyclic so that in the case of two rows of winders successive stream feeders along the file provide streams for strand wound on strand winders in different rows. The alternate stream feeders along the file are grouped together into a first and second grouping in the arrangement to supply the two rows of winders.

Advantageously straight line orientations are employed with the aligned stream feeders generally horizontal and at a level above the aligned strand forming means of each winder group. The elements are optimally aligned and parallel. Thus the strand forming means parallel the aligned longitudinal axes of the stream feeders and the two rows of strand winders below the strand forming means have the winding collets of each row aligned and parallel to the aligned longitudinal axes of the stream feeders. Such straight line orientations are particularly advantageous where the apparatus is duplicated since parallel rows of winders which derive their strands from different vessels such as flow channels 7, 8 and 9 can be serviced from an aisle between those winders. In such arrangements the rows of winders associated with a given vessel and file of stream feeders when oriented in back-to-back relationship present their fronts to the aisles upon which the fronts of a row of winders associated with other vessels are exposed.

While a particular line for processing glass filaments into packaged strands has been illustrated it is to be appreciated that this invention lends itself to many variations wherein the spacing of bushings is freed of the constraint of spacing required for strand winders. For example, turret type winders having a multiple collets could advantageously be divided into a multiplicity of rows where strands were supplied by a single row of bushings. Winders could be oriented on a single side of the vertical plane paralleling the longitudinal axis of the bushing row in a multiplicity of winder rows. The offset of some or all of the winders from the plane normal to their respective tip array longitudinal axes might also be utilized with systems employing features of this invention. In view of the possible variations in orientation

of the winders and auxiliary equipment relative to the bushings aligned along a common flow channel which fall within the general concepts of the space saving proposed herein, it should be understood that the present disclosure should be read as illustrative and not in a limiting sense. The invention may be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.

We claim:

1. Apparatus for forming and winding strands into packages comprising:
 - a vessel for containing molten glass;
 - a plurality of stream feeders each having a plurality of orifices for flowing a group of streams of glass therefrom, said feeders being aligned in a single file in a wall of said vessel and having a common centerline;
 - means for forming strands from the groups of streams of glass;
 - a first row of a plurality of strand winders located at a level below said stream feeders, successive winders in said first row being arranged for winding strands derived from respective stream feeders of a first group of stream feeders each of which is separated from successive stream feeders of said first group along the file of feeders by a stream feeder in the file of feeders and grouped with a second group, said winders of said first row being located on a first side of a vertical plane containing said common centerline of said stream feeders,
 - a second row of a plurality of strand winders located at a level below said stream feeders, said second row of strand winders being spaced from said first row and parallel with respect to said first row, successive winders in said second row being arranged for winding strands derived from respective stream feeders of a second group of stream feeders each of which is separated from successive stream feeders of said second group along the file of feeders by a stream feeder of the first group, said winders of said second row being located on a second side of said vertical plane containing said common centerline of said stream feeders; and
 - each of said strand winders having a winding axis parallel to said common centerline of said stream feeders, and each of said stream feeders and its respective strand winder being generally centered in a

vertical plane normal to said common centerline of said stream feeders.

2. Apparatus according to claim 1 wherein said first and second rows of strand winders are parallel and spaced a distance exceeding the dimension of array of orifices of the stream feeders transverse of the file of stream feeders.

3. Apparatus according to claim 1 wherein each of said rows of strand winders has a back side and a front side, said front side being arranged to provide access to attend said winders; and wherein said winders of said first and second rows are in back-to-back relationship.

4. Apparatus according to claim 3 wherein said means for forming strands from the groups of streams are individual to respective stream feeders and respective strand winders, said means for forming strands having a back side and front side, said front side being arranged to provide access to attend said means for forming strands; and wherein said means for forming strands for the winders of said first row and said means for forming strands for the winders of said second row are in back-to-back relationship along lines paralleling said file of stream feeders.

5. Apparatus according to claim 1 including a duplicate vessel, a file of stream feeders on said duplicate vessel, strand forming means for strands derived from said duplicate vessel, a first row of strand winders for strands derived from a first group of stream feeders on said duplicate vessel, and a second row of strand winders for strands derived from a second group of stream feeders alternating with the first group along the file of said duplicate vessel, wherein the first mentioned vessel and duplicate vessel are spaced apart in side by side relationship, the first row of strand winders for winding strands derived from said first mentioned vessel being spaced from the second row of strand winders for winding strands derived from said duplicate vessel to define an aisle providing access to attend said first row of winders for said first mentioned vessel and said second row of winders for said duplicate vessel.

6. Apparatus according to claim 5 wherein said files of stream feeders for said first mentioned and said duplicate vessels are each straight and are parallel, and wherein said rows of strand winders for said first mentioned and said duplicate vessels are straight and are parallel.

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