March 3, 1970 C. J. STALEGO 3,498,772

FIBER PRODUCING APPARATUS

Filed June 15, 1967 2 Sheets-Sheet 1

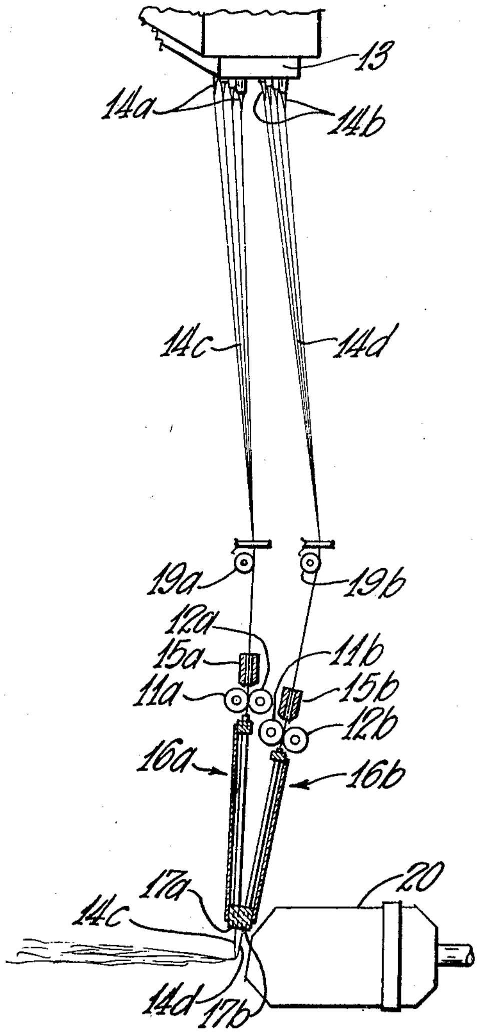

Fig. 1

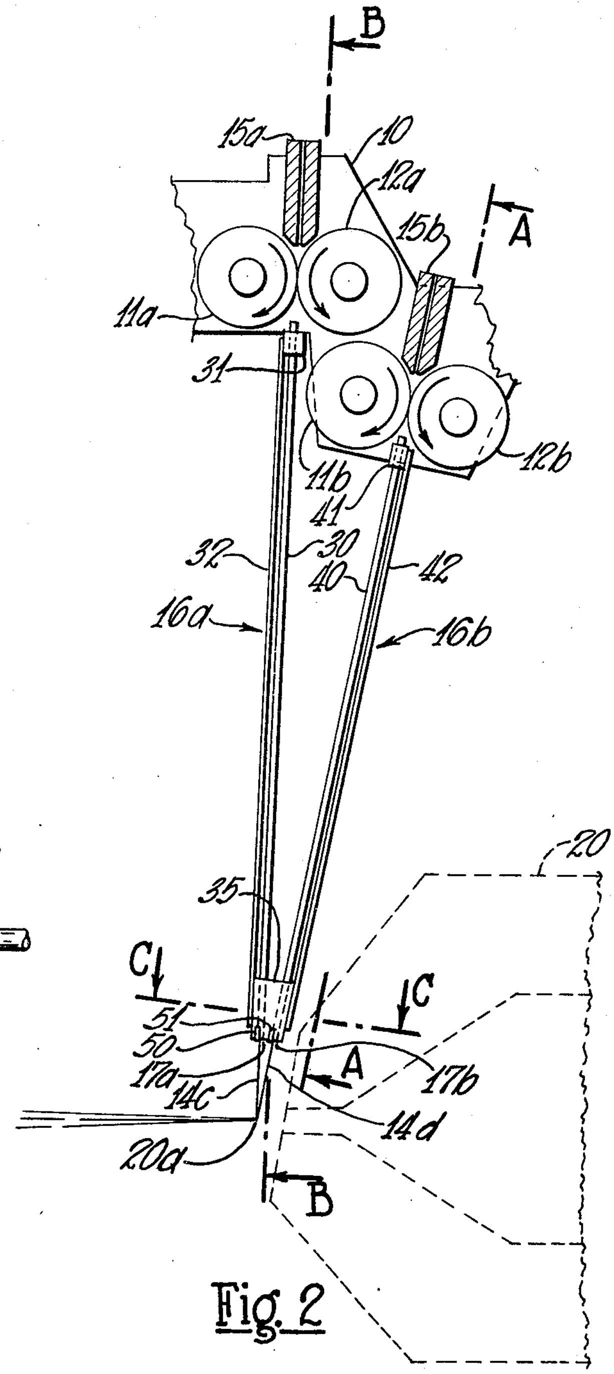

Fig. 2

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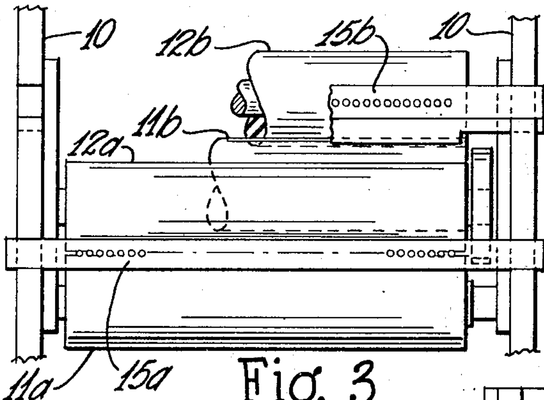

Fig. 3

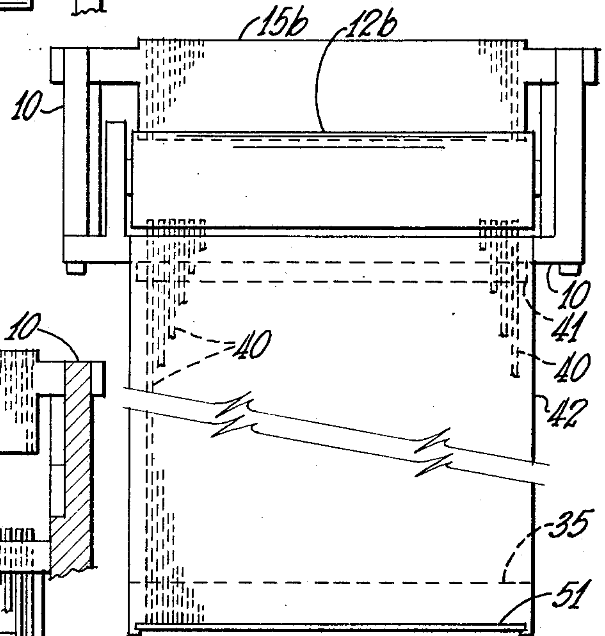

Fig. 4

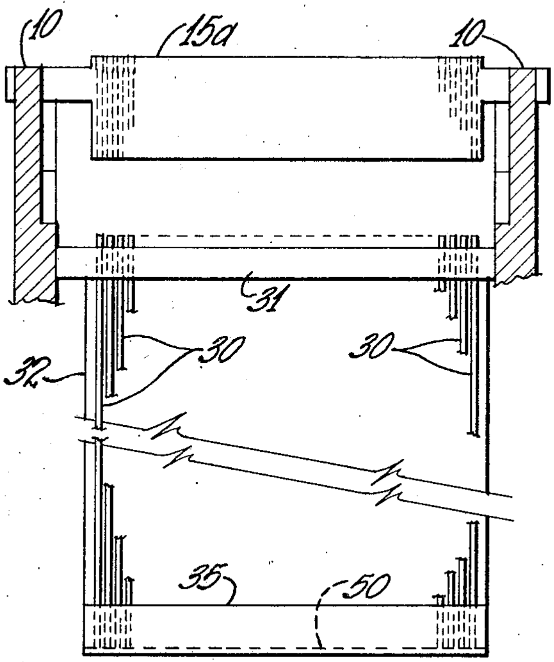

Fig. 5

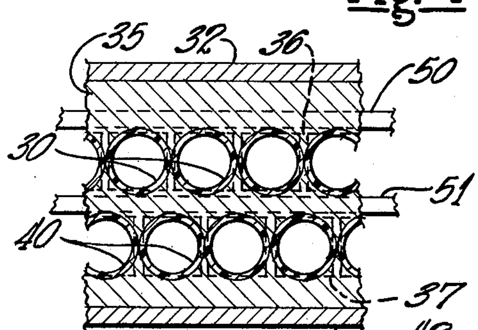

Fig. 6

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FIBER PRODUCING APPARATUS

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Int. Cl. C03b *31/06*

U.S. Cl. 65—16 8 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for producing fibers of heat-softenable material which forms primary filaments from streams of the material and guides the primary filaments into a high velocity flame to further attenuate the filaments into very fine fibers. The guide apparatus is fabricated from a plurality of tubes shown herein as forming an array of channels.

In order to illustrate the invention an example of the use of the apparatus will be described with respect to handling fibrous glass. In one such method it is the practice to pull a plurality of streams of molten glass from a feeder or melter, attenuate the streams into filaments and feed the filaments continuously into a high velocity flame of a burner to form very fine fibers. With this type of fiber-forming operation, it is necessary to introduce the primary fibers singly into the flame and spaced apart so that they do not weld together when softened by the heat produced within the flame.

In order to achieve maximum production of fibers and burner efficiency the fibers are normally spaced as close as practicable by means of a guide which supports the fibers as they are attenuated by the gaseous blasts. The primary glass fibers or filaments may be pulled from the container orifices at a uniform rate by continuously rotating friction rolls or the like to assure a substantially uniform diameter.

Most primary fiber guides of the past have had to be machined with, for example, 230 or more grooves. Machining is time consuming with respect to jig setting and actual machining time, resulting in a high cost per guide. Further, since the wear rate of the primary guides have been very high, the fiber-forming station must be shut down in a comparatively short time to replace the primary guide with another expensively machined guide means. It has been discovered that metal tubing can be made with small diameters and with very thin wall thicknesses in the order of two to three thousandths of an inch, with tolerances on the order of five ten-thousandths of an inch or better. Thus guides can be made from an array of tubes, that may be assembled in a jig to precisely space the tubes, at a much lower cost than machining the guides. Further since the present machine guide slots generally wear on one side only, more wear can be obtained from the tubes by rotating the tubes to expose different sides of the interior of the tube to wear. In addition, the tubes may be mounted in a support means so that they may be easily replaced when they are worn or if they are damaged.

In accordance with the above discoveries, it is an object of this invention to provide improved fiber-producing apparatus.

It is a further object of this invention to provide improved fiber-producing apparatus which includes novel guide means.

It is another object of this invention to provide improved guide means for primary filaments which may be inexpensively produced and which enables the replacement of worn or damaged parts with ease.

In a specific embodiment of the primary guide of this invention there is illustrated a plurality of rows of tubes,

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the tubes in each row being closely spaced. The tubes in each row are also offset from the tubes in the remainder of the plurality of rows so that primary filaments issuing from any row of tubes will be interspaced between filaments issuing from the remainder of the plurality of rows of tubes. Means are utilized for supporting the plurality of rows of tubes in an array in the spaced and offset positions.

In another embodiment disclosed in this invention a primary guide may be constructed from a single row of tubes for use in applications similar to those utilized in the prior art, without regard to the spacing and offsetting of a plurality of rows of tubes discussed above, with the tubes adjustably secured in a support means so that they may be rotated to present different interior wear surfaces to the primary filaments passing therethrough. The tubes may be also removably secured in the support means to enable easy replacement of damaged tubes.

Other objects, advantages, and features of this invention will become apparent when the following description is taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side elevational view of fiber-producing apparatus embodying the teaching of this invention;

FIGURE 2 is an enlarged side elevational view of the primary guide means illustrated in FIGURE 1;

FIGURE 3 is a plan view of a guide apparatus illustrated in FIGURE 2;

FIGURE 4 is an end view of the primary guide illustrated in FIGURE 2 taken from line A—A;

FIGURE 5 is a cross-sectional view of the apparatus illustrated in FIGURE 2 taken along line B—B; and

FIGURE 6 is an enlarged partial view in cross section of the apparatus illustrated in FIGURE 2 taken along line C—C.

Although the invention will be described in relation to fibrous glass processes, it is to be understood that the equipment is adapted for use with other fiber fabricating processes in which individual fibers of other materials are guided.

In FIGURE 1 two pairs of pulling rolls **11***a*, **12***a*, and **11***b*, **12***b* are situated below a feeder **13** having two rows of orifices through which streams of glass **14***a* and **14***b* emit. Rolls **11***a*, **12***a* and **11***b*, **12***b* in conjunction with upper guides **15***a*, **15***b* and lower guides **16***a*, **16***b*, both of which have spaced-apart individual groove openings or channels for each fiber, pull the filaments **14***c*, **14***d* formed from the streams of glass downwardly in a spaced-apart relationship, the fibers **14***c*, **14***d* emitting from openings **17***a*, **17***b* of the lower guides **16***a*, **16***b*, respectively. Rolls **11***a*, **12***a* and **11***b*, **12***b*, which may be made of rubber or other resilient material, are rotatably supported at opposite sides of the paths of the fibers and cooperate with one another to frictionally engage the fibers and attenuate them as they are fed into succeeding mechanism.

Although the feeder is shown as having two rows of laterally spaced orifices, it is to be understood that the invention is applicable with a feeder having only one row of orifices or a plurality of rows of orifices. The lateral spacing of the guide channels is usually somewhat less than the corresponding spacing of the orifices in the feeder, whether a single row or a plurality of rows are provided in the feeder, so that the fibers travel along converging paths from the feeder to the respective guide means and are thereby confined into a more compact space. In order to properly align the fan of fibers for each guide means and to provide for a division of the fibers into a plurality of rows the dividing and aligning means **19***a* and **19***b* are provided. The means **19***a* and **19***b* may also be utilized to assist in initially threading the divided rows into the guide means below.

As best shown in FIGURES 2 and 5 the guide means **16**a comprises a plurality of small tubes **30** held in a planar array in a row by an upper support means or bar **31** and a lower support bar **35**. The bars **31** and **35** are maintained in their spaced and supporting relationship by a back support plate **32**. Similarly, the guide means **16**b as illustrated in FIGURES 2 and 4 comprises a plurality of tubes **40** held in a planar array in a row by an upper support bar **41** and a lower support bar **35**, the spacing of the bars **41** and **35** being maintained by a front support plate **42**.

The upper support bars **31** and **41** of lower guide means **16**a and **16**b are maintained in a spaced apart relationship by attaching them by any suitable means to frame members **10**. This disposes the rows of tubes and the channels formed in the tubes at an angle with respect to each other so that interspacing of the filaments occurs substantially along a single line **20**a (FIGURE 2) in the high velocity blast from burner **20**. This prevents interference and slugging between filaments being attenuated by insuring that one row of filaments does not enter the effective portion of the flame from the burner **20** in advance of the other row whereby attenuation of the first row would cause an intertwining or entangling of attenuating fibers, resulting in fused slugs of the material under the softening effect of the flame.

The tubes **30**, **40** in each row are closely spaced as can be seen in FIGURES 4 and 5. The tubes **30** in the first of the rows are offset from the tubes **40** in the remaining row so that primary filaments issuing from the row of tubes **30** will be interspaced between filaments issuing from the row of tubes **40**. This may be best seen by examining the spacing of the tubes as shown in FIGURE 6, which is an enlarged view to make the arrangement more clear. It will be noted that the axes of the tubes **30** are centered between the axes of the tubes **40**.

Also shown in FIGURE 6 are wear bars **50** and **51** which are positioned below the rows of tubes **30**, **40** to resist the wear caused by the substantial thrust of the flame from the burner **20** pushing the filaments against the support means **35** of the guide means **16**a, **16**b or the bottom edges of the tubes **30**, **40**.

Each tube may be secured in place in the support bars **31** and **41** and the bottom support bar **35** by gravity with the weight of each tube bearing against ledge portions **36** around apertures **37** which are formed in the bottom of the support bar **35** to permit the filaments to issue from the tubes. If desired the apertures bored in the supports bars **31**, **41** and **35** to receive the tubes may be formed to provide a snug or a press fit to additionally secure the tubes in place. It is desirable that the tubes be rotatable within the support blocks so that a new interior wear surface may be presented to the primary filament passing therethrough since guide channels of this type tend to wear only on one side. It is further desirable that the tubes be relatively easy to remove so that damaged tubes or worn out tubes can be easily replaced. Both of these conveniences may be provided by choosing the relative diameters of the tube receiving apertures in the support bars and the outside diameters of the tubes so that the tubes may be snugly held in place but be movable with a minimum exertion of force.

While the guide channels in the upper guide means **15**a, **15**b, have been shown as formed in bars of metal, it is intended that the upper guide means may be constructed from an array of tubes in the same manner as disclosed for lower guide means **16**a, **16**b. Further, the cross-sectional area of the filament receiving channels in the upper guide means is preferably sufficiently large to accept stones formed in the filament passing therethrough.

In experimental operations with primary fibers that are 12 to 13 thousandths of an inch in diameter the provision of a tube channel of 80 thousandths of an inch in diameter will pass almost all stones occurring in a filament. If it is desired to pass larger stones the interior diameter of the tube channels may be enlarged. If the spacing of the primary filaments as they issue into the flame becomes too wide for maximum efficiency, then the principle illustrated herein can be adapted to provide three or more rows of guide means so that minimum spacing of the filaments in the flame may be achieved while providing the largest stone accepting channel size desired. By offsetting the tubes or channels in each of the plurality of rows with respect to any other rows, as taught herein, proper interspacing can be achieved. Similarly, by controlling the angle of disposition of the rows of channels with respect to each other the interspacing can be made to occur along substantially a single line in the flame to prevent interference or slugging between primary fibers as they are attenuated in the flame.

By taking advantage of the fact that the thrust of a flame against the primary filaments issuing from the flame against the primary filaments issuing from the against the furthest side of the wall from the flame the circular guide channels, as particularly provided by tubes, will center each of the filaments against the arc of the circular channel to provide precision interspacing of the rows of filaments. It is within the scope of this invention that the cross section of the channels may be oval, egg-shaped, or other deviations from a circle in order to insure that the primary filament stays centered against one wall of a channel under most conditions.

As noted hereinbefore primary fiber guides in the prior art have had to be machined with, for example, 230 or more grooves. This is expensive and the fact that the primary fiber guides wear out in relatively short order increases the expense. It is therefore within the purview of this invention to provide a primary fiber guide constructed from an array of tubes, for example a single row of tubes. Guides may be assembled from tube materials in precise arrays in jigs or by other methods at a considerably smaller expense. Further, the tubes may be held or secured in the support means so that they may be rotated to present additional sides for wear against the primary filament. This then reduces the expense of such a guide even further. In addition, a primary guide so constructed may have the tubes removably secured so that replacement of worn or damaged tubes is easily attained, again reducing the expense.

It is apparent that within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

I claim:

1. A primary guide for guiding and introducing primary filaments in combination with a high velocity blast of combustion products discharged from a burner to attenuate said filaments comprising a plurality of tubes, each tube aligned to accept a primary filament and guide said filament into said high velocity blast, and means for supporting said plurality of tubes in an array so that primary filaments issuing therefrom are positioned with respect to each other for proper attenuation in said blast, said tubes being individually removably secured in said support means to enable replacement of damaged tubes, said tubes also being individually adjustably secured in said support means so that they may be rotated to present different interior wear surfaces to said primary filaments passing therethrough.

2. A primary guide as defined in claim 1 in which said support means comprises an upper support member and a lower support member maintained in a spaced and supporting relationship by support plate means.

3. Fiber producing apparatus comprising a feeder having a plurality of spaced orifices for flowing a number of streams of heat-softenable material to form a like number of primary filaments, guide means including a plurality of tubes, each tube aligned to receive and guide a primary filament into a gaseous blast for attenuation, means for supporting said plurality of tubes in an array

so that primary filaments issuing therefrom are positioned with respect to each other for proper attenuation in said blast, said tubes being individually removably secured in said support means to enable replacement of damaged tubes and individually adjustably secured in said support means so that they may be rotated to present different interior wear surfaces to said primary filaments passing therethrough, and means for advancing each filament into its corresponding tube.

4. Fiber producing apparatus as defined in claim **3** in which said filament advancing means includes a pair of pull rolls spaced from said feeder, and which further includes second guide means for each filament interposed between said feeder and said pull rolls to guide each filament into the bite of said pull rolls, said second guide means including a tube for each filament.

5. Apparatus as defined in claim **4** in which each of the tubes in said primary guide means and in said second guide means has a cross-sectional area sufficiently larger than the cross-sectional area of a primary filament passing therethrough to also accept for passage therethrough a stone formed in said filament.

6. Apparatus as defined in claim **3** in which said array of tubes comprises a plurality of rows of tubes, the tubes in each row being offset from the tubes in the remainder of the plurality of rows so that primary filaments issuing

from any row of tubes will be interspaced between filaments issuing from the remainder of the plurality of rows.

7. Apparatus as defined in claim **6** in which said support means holds any row of tubes at an angle with respect to the remainder of rows so that the interspacing of the filaments occurs substantially along a single line in the high velocity blast to prevent interference and slugging between filaments being attenuated.

8. Apparatus as defined in claim **3** in which each of the tubes in said primary guide means has a cross-sectional area sufficiently larger than the cross-sectional area of a primary filament passing therethrough to also accept for passage therethrough a stone formed in said filament.

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18—8; 65—5, 7, 13