May 5, 1959 J. F. COURTNEY ET AL 2,885,257

FILAMENT DRAWING MECHANISM

Original Filed April 18, 1951 2 Sheets-Sheet 1

Fig. 1

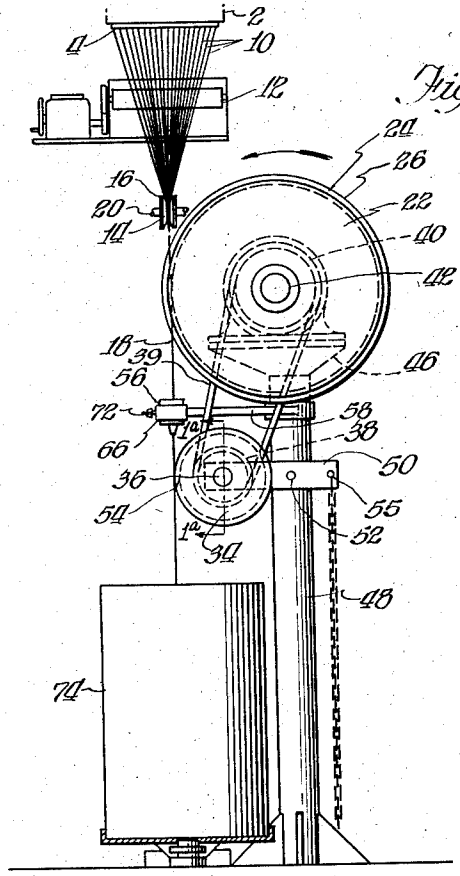



Fig. 2

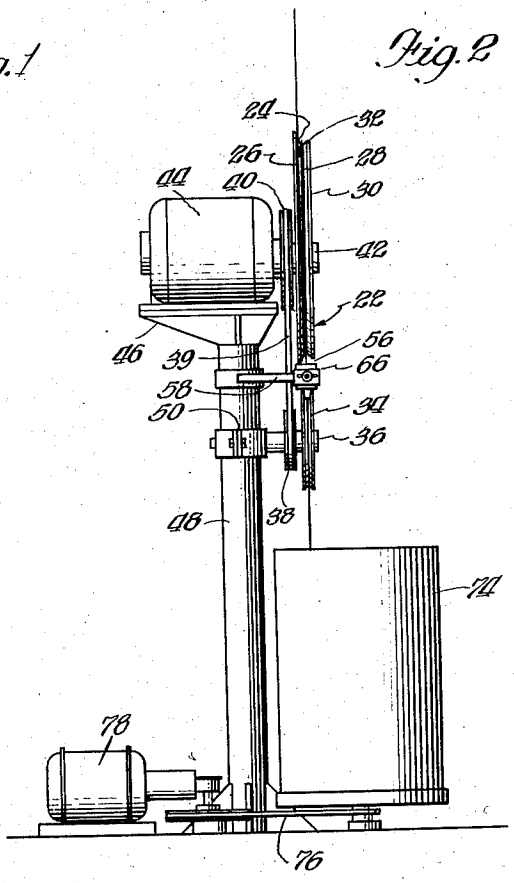



Fig. 2a

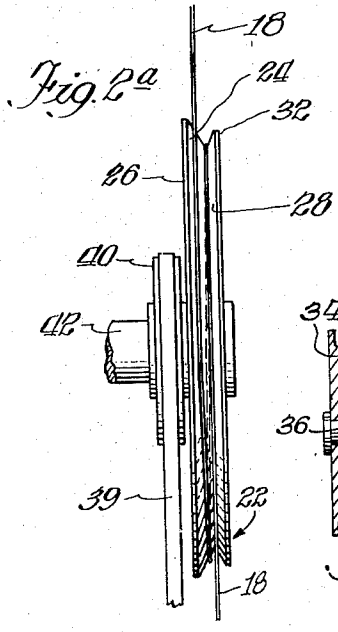
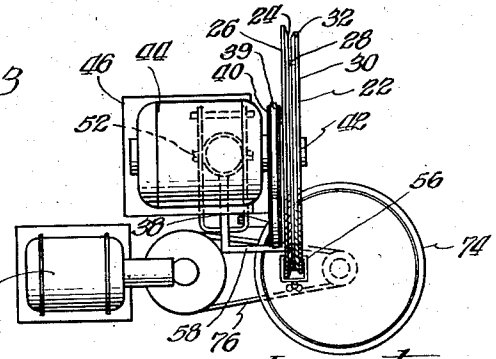



Fig. 3



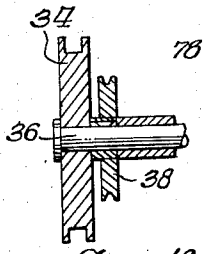




Fig. 1a

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Fig. 4

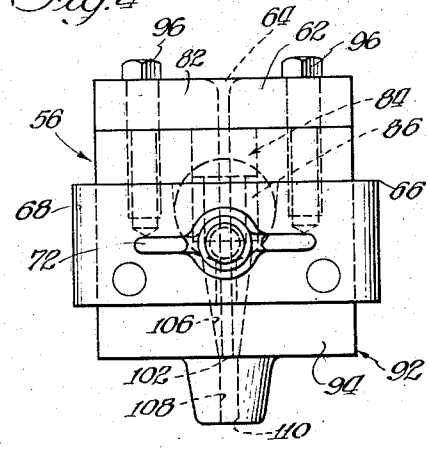



Fig. 5

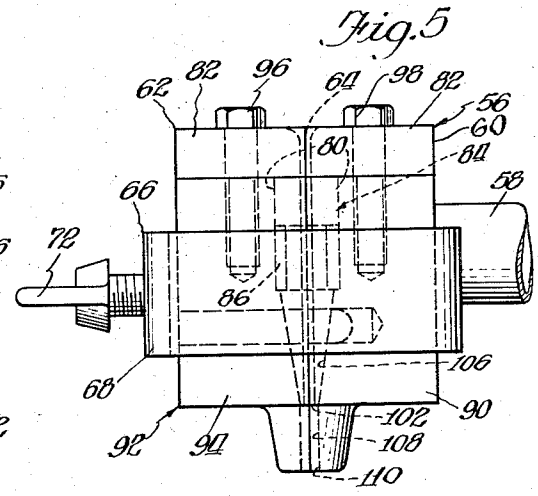



Fig. 6

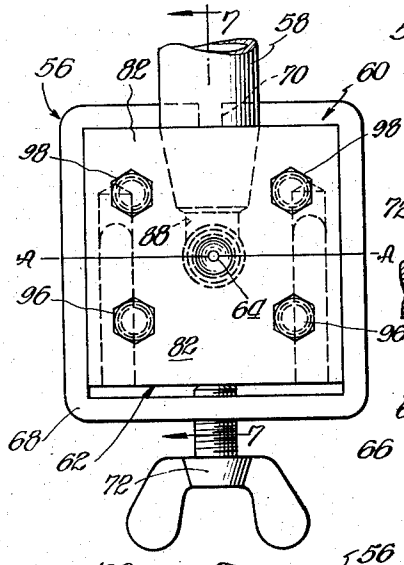



Fig. 7

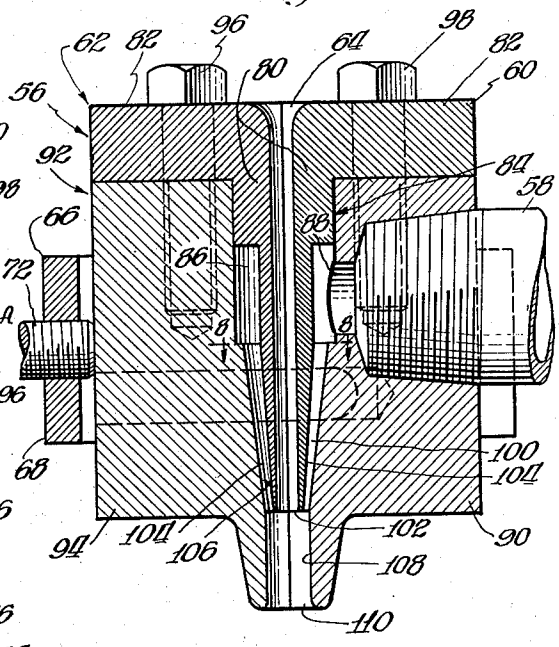
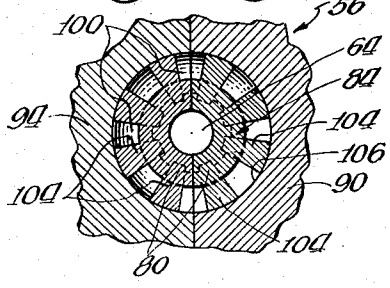



Fig. 8

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2,885,257

# FILAMENT DRAWING MECHANISM

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Original application April 18, 1951, Serial No. 221,596, now Patent No. 2,747,335, dated May 29, 1956. Divided and this application March 22, 1954, Serial No. 421,301

1 Claim. (Cl. 18—54)

This invention relates to means for attenuating thermoplastic material and has particular refrence to the manufacture of glass filament strands and the like and is a division of U.S. application, Serial No. 221,596, filed April 18, 1951, for Glass Fiber Drawing Mechanism and Process, now Patent No. 2,747,335.

In the production of such strands, molten glass is drawn into a plurality of fine filaments which are individually coated with a bonding agent and then gathered in parallel to form a strand while the coating is still fluid or adherent so that the coatings on contiguous filaments may coalesce and thus hold the filaments together.

It will be observed that each filament is only several microns in diameter and that normally several hundred filaments having a collective tensile strength of a few pounds are grouped into a strand. The diameter, texture and flexibility of the filaments are in part determined by the nature of attenuation, and it has been established that to obtain satisfactory characteristics the filaments must be drawn at present at a rate of approximately ten thousand feet per minute and be devoid of transverse deformation.

In view of the extremely fast drawing rate and the fragility and low tensile strength of the material involved, considerable difficulty has been encountered in providing a satisfactory drawing mechanism.

Arrangements heretofore considered practical contemplated grasping the strand between opposed rolls or winding it on a rotating mandrel. The former has proved objectionable in that it obtains approximately line contact with the strand and thus concentrates opposing pressures which effect transverse deformation of the strand and frequently cause unset coating to exude from between the filaments so that they are exposed to abrade against each other. The high pressure necessary to obtain a positive grasp on the strand, at times also causes the coating, which is preferably a plastic, to adhere to the rolls and peel off the filaments. In addition, because of the small areas of engagement of the rolls with the strand, slippage of a roll is inherent and apt to fray the material.

Winding directly on a mandrel produces a constantly changing drawing rate in that as successive layers are deposited, the peripheral speed of the surface on which each succeeding layer is wound increases, thus drawing filaments of continuously shrinking diameter and changing texture. In such an arrangement, the pressure of overlaying windings is cumulative and may be of sufficient magnitude to cause permanent deformation of the strand or at least adherence between or fracture of the coatings on contacting or crossing windings.

Other mechanisms proposed have failed to provide a positive drawing attitude or required uniformity of operation.

A general object of the invention is to provide simple,



novel drawing means which obviate the disadvantages incident to those heretofore available.

A further object is to devise means which will effect the necessary pull on the fibers without imposing high transverse stresses.

The invention contemplates the provision of means designed to obtain a gentle grasp or pressure on the strand over an extensive area thereof whereby the cumulative effort provides a sufficient hold on the strand for drawing without deforming or otherwise injuring the strand.

A different object is to provide drawing means which will maintain a substantially uniform pulling rate and apply it to the strand in such a manner as to prevent its breakage.

A more specific object is to devise drawing means providing extensive frictional contact with the strand along a smooth curved or sinuous flow path whereby a positive pulling effect is established without imposing high transverse pressures on the strand.

These and other objects of the invention will become more apparent from the specification and the drawings wherein:

Figure 1 is a side elevational view of one form of the invention with environmental components shown diagrammatically.

Figure 1*a* is a cross sectional view taken substantially on line 1*a*—1*a* of Figure 1.

Figure 2 is an edge view thereof,

Figure 2A is an enlarged edge view of the drawing wheel showing the strand applied thereto, and

Figure 3 is a plan view of the mechanism.

Figures 4 through 8 illustrate the air suction nozzle forming part of the drawing apparatus; Figure 4 being a front elevation; Figure 5 a side elevation taken from the right as seen in Figure 4; Figure 6 a top plan, Figure 7 a vertical cross-section taken substantially on the line 7—7 of Figure 6, and Figure 8 a transverse section taken approximately on the line 8—8 of Figure 7.

Describing the invention in detail and referring to the embodiment shown in Figures 1 through 8, the glass melting furnace 2 is a conventional ceramic type with a preferably platinum bottom die plate 4 provided with a plurality of minute apertures or ports through which molten glass descends by gravity. The glass initially issues from these ports as filaments 10, 10 of course texture and relatively thick diameter. The filaments themselves which are arranged in a fan spread due to the spacing of the die apertures are gathered together by the operator and drawn manually over a power driven applicator roll 12 which applies a suitable preferably plastic coating on each filament. The coated filaments are converged by passing into a V-groove 14 of a gathering sheave 16 to group the filaments in parallel into a strand 18 while the coating is still in a cohesive state so that it may coalesce to form a sheath holding the filaments together. The sheave 16 may be suitably journaled on a supporting shaft 20.

The strand 18 is then trained around a drawing wheel 22 and arranged therewith to produce a capstan effect. The strand is entered against a diagonal side surface 24 adjacent to its outer periphery, surface 24 being formed on the inner side of a flange 26 on the outer perimeter of the drawing disc 22. The flange 26 is disposed at one side of the disc and the surface 24 thereon converges radially inwardly with an opposed face 28 on the inner side of a peripheral flange 30 at the opposite side of the disc 22. It will be noted that the flange 26 and the surface 24 thereon is of larger extent and projects radially outwardly of the flange 30.

From a consideration of Figure 1 it will be seen that

the strand passes from the gathering roll 16 under the disc 22 which rotates in the direction of the arrow.

The strand, which is continuously being snubbed against the disc 22, immediately after its entry upon surface 24 is caused to gradually slide into the apex of the groove 32 defined by the surfaces 24 and 28. It will be readily appreciated that this arrangement permits the strand to engage the surface of the drawing wheel along an extent of almost 360°, the path of travel of the strand is along a gentle curve and the arrangement provides a capstan effect. Transverse pressures on the strand are practically negligible and the drawing is principally effected by frictional engagement between the strand and the drawing surface of the wheel.

The disposition of the entry zone radially outwardly of the discharge zone and the joining of the two zones by a gently sloping area reduces abrasion on the strand to the minimum as it is progressed from one zone to the other. This is due to the fact that the strand travels at maximum speed when it is at the outer periphery of surface 24 and the speed of all areas radially inwardly of the periphery is slower. It will be observed that when the strand is moved along the sloping area the lateral shifting of the strand is compensated for at least in part by the faster moment of each increment of the strand than the surface radially inwardly thereof and towards which the increment is constantly being advanced.

The strand is initially snubbed against the drawing wheel 22 by a pulling force exerted thereon by a starter drum or spool 34 which is positioned below disc 22 in substantial vertical alignment therewith. The drum 34 is rotatably mounted on a shaft 36 and is driven thereby through friction alone, the shaft 36 being driven by a pulley 38 keyed thereto and pulley 38 in turn driven by a belt 39 trained thereon and around a pulley 40 of larger diameter than pulley 38. Pulley 40 is keyed to a shaft 42 which drives disc 22. Shaft 42 is preferably an extension of an armature shaft of a constant speed motor 44 which is carried on a mounting plate 46 at the upper end of a standard 48 which at its lower end may be bolted or otherwise secured to a floor or the like.

The shaft 36 is journaled to one end of an arm 50 pivoted intermediate its ends as at 52 to the standard 48 below disc 22. The other end of the arm may be connected as at 55 to a linkage which may be manually operated to pivot the arm for raising and lowering the drum for a purpose hereinafter described.

It will be noted that in operating position, the drum 34 is lowered as shown in Figure 1 and that the periphery of the drum is disposed to be vertically cotangential with the apex of groove 32. In operating position of drum 34, the belt 39 is engaged with pulleys 38 and 40 and in view of the smaller diameter of pulley 38 with respect to pulley 40, the former rotates slightly faster than the latter.

The operator snags the end of the strand discharging from the disc 22 in a notch 54 in the reel 34 to wind an initial length of strand thereon. The reel 34 which is tending to rotate at a slightly faster rate than the strand is being discharged from disc 22 imposes a pulling force on the strand to snub it against the drawing surface of wheel 22 and to strip the strand from this surface at the intended point or area of discharge of the strand from wheel 22. It will be appreciated that the reel merely has a slipping engagement with the driving shaft 36 so that it is prevented from overrunning the speed of the drawing wheel although it has that tendency.

It will be understood that the sequence of operation heretofore described is progressed manually from the furnace across the applicator, through the gatherer, about the drawing element and terminated at the reel. This operation is performed as rapidly as possible, however the slow drawing rate obtains course relatively inflexible filaments which are not commercially acceptable. The



motor is energized as soon as the strand is secured to the reel. The strand is wound on the reel until the disc is rotating at the rated speed and the filaments are being drawn to required diameter.

In addition to the reel, the mechanism comprises a take-up and stripper means 56 in the form of a nozzle carried by a pipe 58 which may be suitably secured to the standard 48. The nozzle 56 comprises a pair of opposed mating sections 60 and 62, the section 60 being connected directly to the pipe 58 and providing on its mating side one-half of a strand passage 64.

It will be seen from a consideration of Figure 1, that the nozzle or primary snubbing means is located down-stream of the discharge of the disc 22 and up-stream of the reel or auxiliary or secondary snubbing means 34 and that the strand during winding on the reel passes through the semi-circular groove within the section 60. This arrangement permits the initial course heavy diameter strand to move unobstructively past the nozzle. As soon as the strand is being drawn to desired diameter which will conveniently fit within the passage 64, the segment 62 is mated to the segment 60 and secured thereto by means of a C-shaped clamp member 66. The clamp member 66 comprises a closed rectangular frame 68 which is split at one side to provide a passing slot 70 to afford entry and exit of the strand with respect to the interior of the frame. The frame extends around the two sections 60 and 62 and at its outer side is provided with an adjusting or tightening screw 72 which is threaded therethrough, the screw abutting the outer side of the section 62 and arranged in conjunction with the clamp to draw the section 62 tightly against the section 60. The provision of the slit nozzle permits forming the air passage 64 of sufficient diameter with respect to the thin strand which passes therethrough when the strand is being drawn at rated speed. In this manner the course larger diameter strand is accommodated past the nozzle and is wound on the reel and the desired diameter strand is automatically aligned with the passage 64 so that operation is continuous. After the strand is reduced in size the nozzle is assembled and energized by forcing air through the pipe 58 at which time the nozzle exerts a pulling force on the strand as it discharges from the disc 22. As soon as the nozzle begins operating, the reel is declutched by pivoting upwardly with arm 50 about point 52 so as to disengage the belt 39 from the drive 40 (see Figure 1). The strand is then severed below the nozzle and thereafter deposited within a canister or a container 74, the strand entering the container eccentrically thereof and the container being rotated on a substantially vertical axis by means of a suitable drive arrangement 76 driven by a motor 78.

Referring now to Figures 4 through 8, illustrating the nozzle 56 in detail, it will be seen that the sections 60 and 62 are substantially identical and that each section comprises substantially centrally along its mating face a depending nozzle segment 80 which at its upper end is formed integral with an outturned flange portion 82. Each portion 80 of the nozzle, generally indicated 84, is circumferentially recessed in an area intermediate the ends thereof below the flange portions 82 to provide an annular chamber 86 which communicates with pipe 58 through a passage 88 in a segment 90 of an enclosure member generally indicated 92, the segment 90 being threaded to the pipe 58 which communicates with the passage 88. The member 92, in addition to the segment 90 comprises a mating segment 94.

Referring to Figure 7, it will be seen that the segment 94 of the enclosure member is positioned beneath the flange portion of the member 62 and is fastened thereto as by bolts 96, 96 and that similarly the segment 90 is disposed beneath the flange portion of the section 60 and is fastened thereto as by bolts 98, 98. The segments 90 and 94 as well as the flange portions 82, 82 and nozzle segments 80, 80 of the sections 60 and 62 mate at

the parting plane indicated A—A in Figure 6. Below the chamber **86** the nozzle **80** is vertically fluted to provide a plurality of downwardly directed slots or air passageways **100**, **100** to direct the air to issue in straight streams downwardly past the discharge end **102** of the passage **64** at the lower end of the nozzle **84** and thus create a pressure differential between the upper or inlet end of the passage **64** and the discharge end thereof whereby the air surrounding the strand moving through the passage **64** is caused to impinge thereagainst and to exert a pulling force thereon thereby snubbing the strand against the drawing surface of the wheel **22**. It will be seen that the flutes **104** at the lower end of the nozzle are tapered downwardly and fit snugly within an inverted frusto conical chamber **106** of which one-half is formed in the segment **94** and the other half in the segment **90**. The chamber **106** is terminated at the discharge end **102** of the passage **64** and is then continued as a cylindrical passage **108** in the portions **90** and **94** and extending below the discharge end of the passage **64**. The lower end of the passage **108** is flared outwardly as at **110**. The construction of the chamber **106** and passage **108** and the relationship thereof with the passage **64** provides a venturi effect which efficiently funnels the air to exert a pulling force on the strand **18**. The slit nozzle has been found to materially reduce the working pressures of the air in that the thin strand fits closely within or is matched to the passage **64**. The reduced pressures and the directional effect of the flutes **104** reduces the turbulence about the strand so that a more uniform pull is obtained against the strand and the strand issues into the container with a directed attitude which is prolonged by the extension of passage **108**.

It will be understood that the ends of the strand are controlled in that the first end may be lapped over the edge of the canister when it is parted from the portion of a strand wound on the take-up reel **34** and that the last end may be similarly identified and lapped over the upper edge of the container and secured thereto before the strand is cut while it is being deposited into another container. It will be readily observed that the strand is not being compressed or in any way stressed by the manner of coping or packaging herein provided.

It will be observed that several furnaces may be employed in conjunction with the drawing means and the filaments from each furnace may be gathered into a single strand in the embodiments described.

What is claimed is:

In a system for drawing material comprising a filament drawing drum, an auxiliary snubbing means for snubbing a filament on said drawing drum and spaced therefrom the improvement comprising: a primary snubbing means for application to a moving filament along the length thereof between said drawing drum and the auxiliary snubbing means and comprising a pair of complementary mating sections for quick assembly about said moving length of strand, said sections having confronting grooves collectively defining a filament passage receiving said length therein, quick connect means for releasably holding said sections together, and said sections having blower passages communicating with said filament passage for directing air axially of the strand in pulling relation thereto for snubbing it on said drawing drum.

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