Oct. 18, 1955 J. F. COURTNEY ET AL 2,720,728

GLASS FIBER DRAWING APPARATUS

Filed July 12, 1951

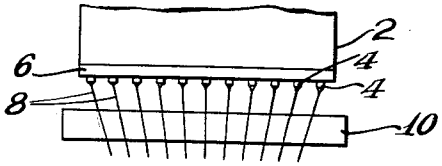


FIG. 1.

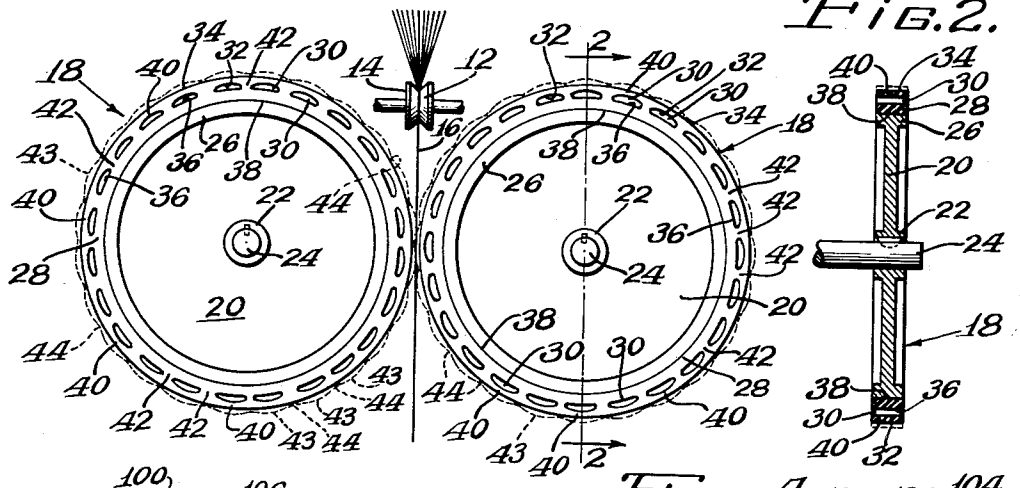


FIG. 2.

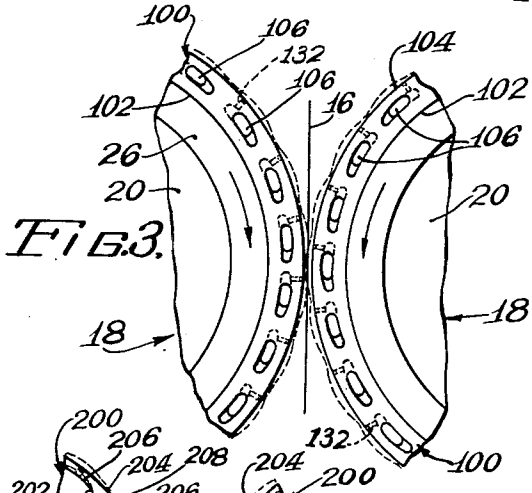


FIG. 3.

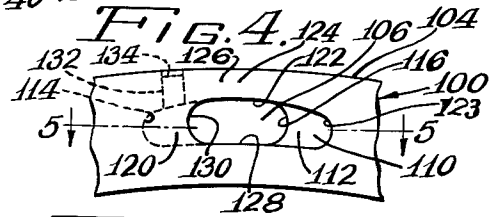


FIG. 4.

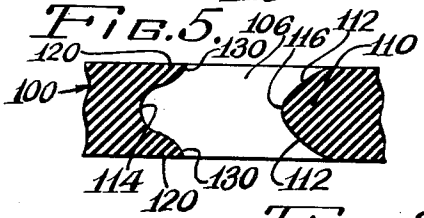


FIG. 5.

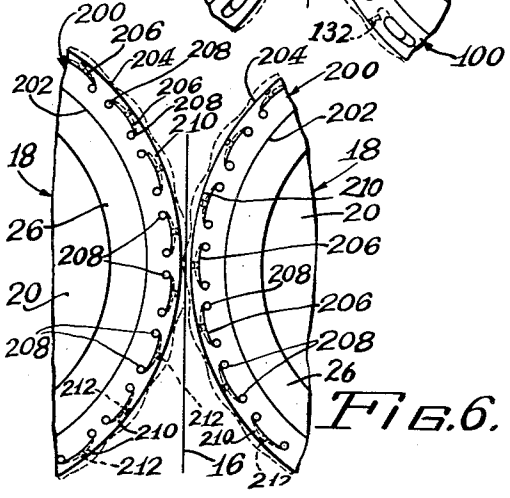


FIG. 6.

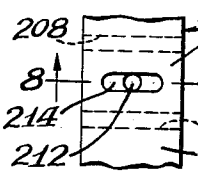


FIG. 7.

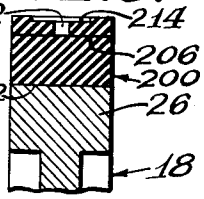


FIG. 8.

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GLASS FIBER DRAWING APPARATUS

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3 Claims. (Cl. 49—17)

This invention relates to apparatus for attenuating thermoplastic material and has particular reference to the manufacture of glass filaments.

A general object of the invention is to provide a simple mechanism for grasping the material with mild pressure along a sinuous relatively extensive surface while imposing an attenuating tensile force thereon.

A more specific object is to provide a drawing assembly incorporating a pair of opposed rolls each of which comprises a peripheral section of readily distortable rubber with perforations therethrough designed to obtain a plurality of expansible segments formed and arranged to displace radially outwardly different distances under the influence of centrifugal force pursuant to rotation of the rolls to provide a scalloped peripheral surface profile on each roll and which is adapted to engage the fibers entered between the rolls and to cause conformance of the fibers to said surface in intimate contact therewith as the fiber is being passed between the opposed contacting portions of the rolls.

A further object is to form and arrange the perforations in such manner as to obtain a substantially symmetrical undulation of the peripheral surfaces of the rolls throughout the entire circumferential extent thereof.

Certain embodiments of the invention contemplate the provision of peripheral blower passages through the outer edges of the drawing wheels to accentuate stripping of the material from the rolls.

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 embodiment of the drawing mechanism with environmental components shown diagramatically.

Figure 2 is a radial sectional view taken substantially along the line 2—2 of Figure 1.

Figure 3 is a fragmentary side elevational view of another form of the invention.

Figure 4 is a fragmentary enlarged side elevation of the embodiment of Figure 3.

Figure 5 is a transverse sectional view taken substantially on the line 5—5 of Figure 4.

Figure 6 is a fragmentary side elevational view of another form of the invention.

Figure 7 is a fragmentary edge view of one of the drawing elements shown in Figure 6, and

Figure 8 is a sectional view on line 8—8 of Figure 7.

Describing the invention in detail and referring first to the embodiment shown in Figures 1 and 2, the furnace 2 contains molten glass which is arranged to descend through a plurality of apertured bosses 4, 4 of a bottom plate 6. The glass oozes through the bosses and forms inverted cones of glass from the vortices of which gravitationally flow filaments 8, 8 which are adapted to be collected by an operator and trained over an applicator assembly 10 which is designed to coat each filament with a suitable film preferably of thermoplastic or thermosetting material. The filaments are then drawn by the operator into a peripheral groove 12 in a gathering sheave 14 which is adapted to associate the filaments 8, 8 into a strand 16 such strand being entered between a pair of opposed drawing rolls or elements generally designated 18, 18. It will be noted that in static condition the drawing rolls are spaced from each other as shown in solid lines and provide an entry gap therebetween whereby the strand may be readily positioned between the rolls.

Each roll 18 comprises preferably a metallic wheel or disc 20 having a hub 22 suitably keyed to a driving shaft 24. The outer edge of the plate 20 is formed with a rim 26 about which is disposed a circumscribing annulus 28 which is formed of yieldable resilient rubberlike material such as soft rubber. The inner periphery of the annulus 28 has a cylindrical contour in complementary fit against the outer face of the associated rim 26 and suitably bonded or vulcanized thereto. Under static conditions, the outer periphery of the annulus 28 is of cylindrical form as shown in solid lines in Figures 1 and 2. The annulus 28 is formed intermediate its inner and outer edges with transverse slots 30, 30 which are regularly spaced and elongated circumferentially of the annulus. Each slot or aperture 30 is defined by a curved outer surface 32 whose center of inscription is eccentric with respect to the axis of rotation of the related drawing member 18 whereby the surface is nonconcentric with respect to the inner and outer peripheries of the annulus. The surface 32 is bowed from its circumferentially spaced ends arcuately outwardly towards the outer periphery 34 of the annulus whereby the radial thickness of the material between the surface 32 and the segment of the surface 34 in radial alignment therewith progressively decreases toward the center of the segment. Each circumferentially spaced end of each surface 30 is formed with a radius which turns inwardly and joins with the adjacent end of the inner surface 36 of the slot, said inner surface 36 being preferably concentric with the inner surface 38 of the annulus. The arrangement of the slot and its elongation circumferentially of the annulus as well as the contour of the slot determines the expansibility of the associated segment 40 of the annulus outwardly thereof. It will be seen as represented by phantom lines that each segment 40 will expand or bulge radially outwardly due to the imposition of a centrifugal force pursuant to rotation of the related member 18 in a manner which develops or distorts the normally cylindrical surface 34 into an undulant or wavy contour. The thinnest portion of each section 40 bulges outwardly the greatest distance, the bulging progressively decreasing as the section becomes thicker toward each of its circumferentially spaced ends and the outward displacement is the least in areas in radial alignment with segments 42 intermediate the slots 30, 30. It will be noted that the opposed members 18, 18 are so arranged and their rotation controlled so that the bulged out segments will mesh with each other at the grasping areas of the rolls and that the centrifugal force and the nature of the material forming the annuli is sufficient to close the gap between the rolls and thereby effect a grasp on the strand while deflecting the strand to conform to the sinuous contour developed between the engaging surfaces. The construction of the slots 30, 30 by the provision of a radius at each end of the surface 32 thereof avoids concentration of stresses which would tend to tear the material and at the same time, the construction is such that the lightest part of each section 40 is caused to effect maximum deflection of strand whereby a light gentle deflecting action is obtained.

This feature begets a modifying effect in the initial engagement of the lightest mass at crest 43 of each bulge in that it may be moved or flattened inwardly momentarily

as it engages the strand and then recover and bulge outwardly to press it into the mating concavity **44** on the opposed roll at the grasping region of the rolls. The yielding nature of the grasp is conducive to the formation of a strand which is substantially uniform and throughout its length which is devoid of transverse deformations and the like.

In the description of the following embodiments parts identical with those in Figures 1 and 2 are identified by corresponding reference numerals.

Referring now to Figures 3–5, the annulus generally indicated **100** comprises normally cylindrical inner and outer surfaces **102** and **104** as in the previous embodiment and on its surface **102** is bonded to the rim **26** of the wheel. The annulus **100** is formed of flowable, deformable flexible rubberlike material such as soft rubber and is provided intermediate its inner and outer peripheries with a plurality of apertures or transverse slots **106, 106** which are spaced uniformly and elongated circumferentially of the annulus. The drawing elements are rotatable as shown by the arrows and each opening is provided at its leading edge with a baffle **110** which is formed at its opposite sides with circumferentially converging air guide surfaces **112, 112** directed from the respective side edges of the annulus inwardly thereof in the direction opposite to the direction of rotation of the annulus. The trailing edge of each opening **106** is formed with a pocket **114** which is concaved in a direction facing in the direction of rotation of the annulus toward the trailing edge **116** of the baffle **110**, the pocket **114** being defined by side walls or webs **120, 120** at opposite sides thereof and diverging on their inner sides in a direction toward the baffle **110**. It will be seen that the contour of the radially outer periphery **122** of the slot **106** is curved, the curvature being defined from an axis eccentric with respect to the curvature of the surfaces **102** and **104** of the annulus **100** and so arranged that the mid-section **124** of the segment **126** of the annulus outwardly of each slot **106** is substantially thinner radially than the adjoining sections which progressively thicken radially as they approach the opposite ends of the slot. It will be seen that the trailing edge **116** of the baffle **110** is formed with a radius or filet which merges at its outer extremity with the related surface **122** and at its inner extent with the surface **128** of the inner periphery of the slot **106**, the surface **128** being preferably concentric with the surfaces **104** and **102**. Similarly the leading edges **130** of each side wall **120** of the pocket **114** are formed with a radius which merges at its outer end into the surface **122** and at its inner end into the surface **128**. Each end of the surface **122** at opposite sides of the baffle is also formed with a gentle radius as at **123** (Figure 4) which merges into the opposite ends of surface **128**. This construction eliminates concentration of stresses at opposite ends of the slot such as would tend to tear the material and at the same time provides effective air flow characteristics. A radial passage or blower opening **132** has its inner or inlet end open to the pocket **114** and at its outer or outlet end is open through the periphery **104** of the annulus. To extend the area of influence of each blower **132**, the outer periphery **104** is formed with a depression **134** elongated transversely of the annulus.

In operation, rotation of the drawing members **18, 18** develops centrifugal force which effects the expansion of each annulus **100**. It will be noted that the construction of the slots controls the outward bulging of the sections **126** of the annulus so that the mid-section **124** bulges out farther than the adjoining sections which progressively are displaced closer inwardly to the axis of rotation thereof. This feature develops an undulant or sinusoidal contour of the periphery **104** and the radially outward displacement closes the gap between the opposed members **18, 18** whereby at the grasping zone of the rolls, and with controlled rotation of each roll, the crests of each roll are adapted to mate into the concavities of the opposed roll which obtains a deflection of the strand disposed therebetween and effects intimate contact with the rolls along sinuous surfaces which are arranged to interlock with the strand under relatively light pressure over an extensive length thereof thereby providing the desired grasp on the strand while imposing an attenuating pulling force thereon.

It will be noted that the construction effects maximum deflection of the strand by the sections **124** of the material having the smallest or least mass whereby the deflecting action is gentle and eliminates any possibility of deforming the strand. The construction of the blowers is such as to strip the strand effectively from the gripping surfaces by blowing the strand away therefrom. The disposition of the baffle surfaces **112, 112** directs the air during rotation of the annulus into the trailing pocket **114** which discharges the air through the outlet **132**.

Referring now to the embodiment shown in Figures 6 to 8, each member **18** is provided with an annulus **200** formed of flowable flexible rubberlike material such as soft rubber and statically having concentric inner and outer substantially cylindrical surfaces **202, 204**, the surface **202** being secured as by vulcanizing to the rim **26** of the associated member **18**. The annulus **200** is formed intermediate the surfaces **202** and **204** with a series of uniformly circumferentially spaced transverse slits **206, 206** elongated circumferentially of the annulus. Each slit is terminated at its circumferentially spaced ends tangentially to a transverse cylindrical aperture **208** which is disposed inwardly of the slot and designed to eliminate concentration of stresses at the ends of the slot. The curvature of each slot is determined from an axis eccentric with respect to the axis of the surfaces **202** and **204** and is arranged to bow outwardly with its crest in tangential relationship to an inscribing cylinder concentric with the surface **204**. This arrangement develops a variation in the thickness in the material segment **210** between the slit and the surface **204** and this thickness progressively diminishes from opposite ends of each slit to the mid-section of the portion **210**. This variation controls outward bulging of the segments **210** so that the portion forming the crest of the bulge is of lightest mass whereby engagement with the strand passing between the opposed members **18, 18** will be relatively delicate. To accentuate stripping of the strand as it leaves the grasping area between the members **18, 18** whereat the strand is sinuated between the mating bulged-out areas as in the previous designs, a radial aperture **212** is provided through each segment **210** with an inlet open to the associated slit **206** and the outlet communicating with a transverse elongated depression **214** in the peripheral surface **204**.

In operation, the members **18, 18** which are normally spaced apart under static conditions, are rotated which expand, through centrifugal force, their annuli **200, 200** and deform the surfaces **204** thereof to undulant substantially symmetrical generally sinusoidal contour. The members **18, 18** are controlled in their rotation to mate the bulged-out segments **210** within the concavities between the similarly bulged-out segments of the other roll as may well be seen in the drawings. The openings **212** serve as peripheral blowers which blow the strand away from the grasping surfaces, the cavities **214** merely serving to widen the outlet area of the openings **212**.

It will be observed that in each of these embodiments, the openings or cuts are designed to provide a circumferentially elongated floating section outwardly thereof and that each cut is designed to control the bulging contour in such manner as to achieve a gentle nondeformative and yielding engagement of the crest of each bulge with the strand. The term rubberlike is used to denote any substance having characteristics similar to rubber as to elongation, deformity, yieldability etc.

What is claimed is:

1. A rotatable glass fiber drawing element comprising

a flexible annulus formed of flowable resilient material having axially spaced sides, said annulus formed with an annular series of perforations therethrough open through the sides and disposed intermediate the inner and outer peripheries of the annulus and elongated circumferentially thereof, a pair of laterally spaced webs at opposite sides of the annulus integral therewith and disposed at one end of each perforation and defining a pocket forming an air scoop facing into the direction of rotation of the element and said annulus formed with passageways from each pocket through the outer periphery of the annulus to effect a blowing action from the pocket outwardly through the periphery to strip fiber engaged with the periphery.

2. An element according to claim 1 wherein the webs flanking each pocket diverge in the direction of rotation of the element.

3. An element according to claim 1, and said annulus formed with baffle means at the other end of each aperture and presentive sides converging toward the related pocket.

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