July 6, 1965 F. B. POWELL 3,192,649

STRAND ANNEALER

Filed April 19, 1962 2 Sheets-Sheet 1

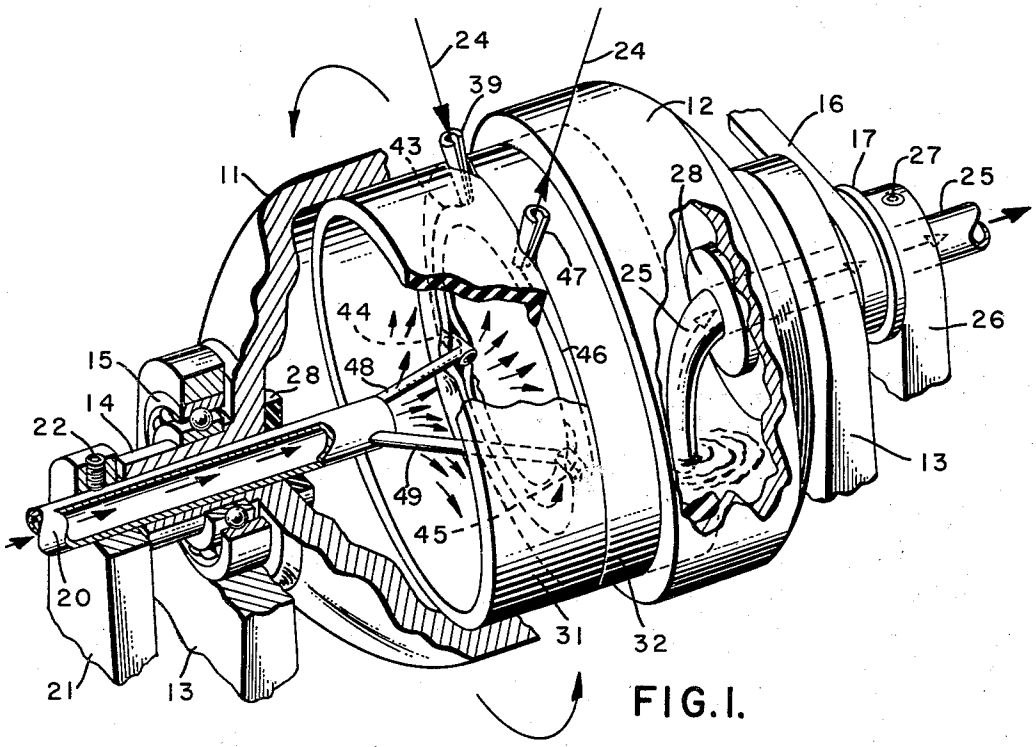


FIG. 1.

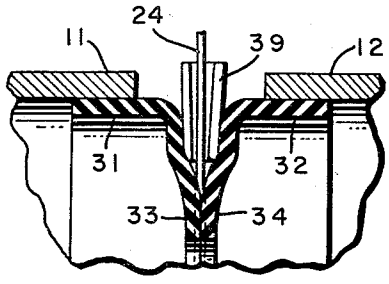


FIG. 2.

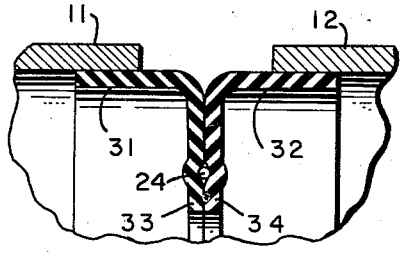


FIG. 3

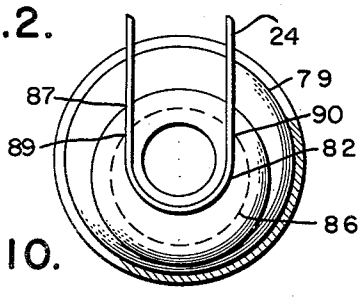


FIG. 10.

INVENTOR
FRED B. POWELL

BY Robert L. Broad Jr
ATTORNEY

July 6, 1965 F. B. POWELL 3,192,649

STRAND ANNEALER

Filed April 19, 1962 2 Sheets-Sheet 2

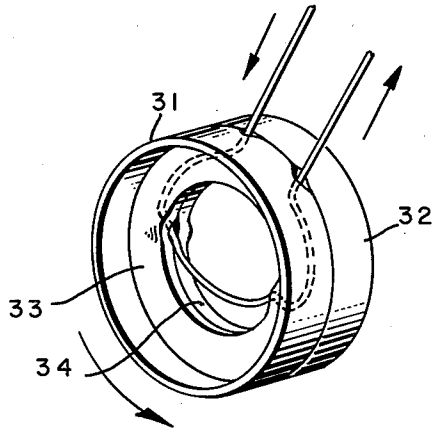


FIG. 4.

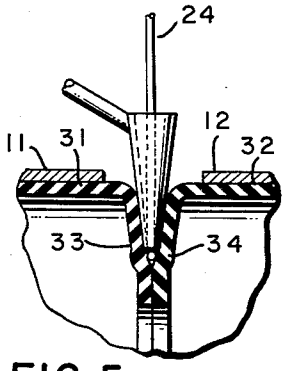


FIG. 5.

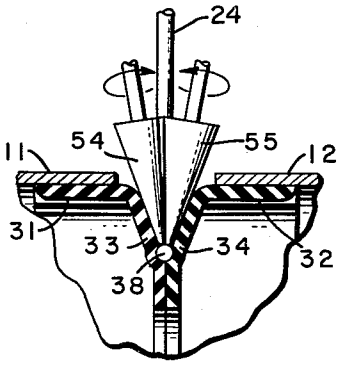


FIG. 6.

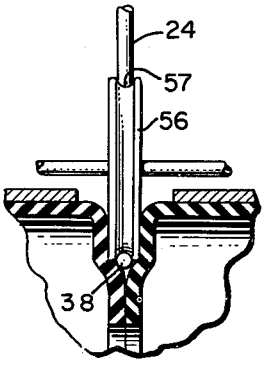


FIG. 7

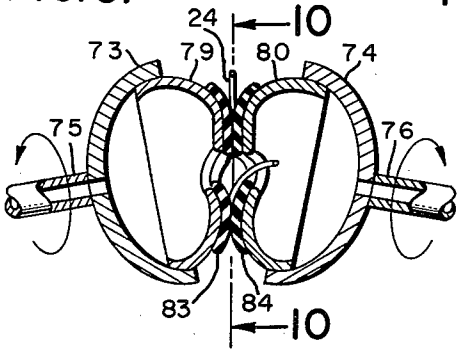


FIG. 9.

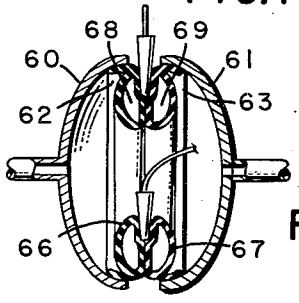


FIG. 8.

INVENTOR
FRED B. POWELL

BY Robert L. Burdsall

ATTORNEY

United States Patent Office 3,192,649 Patented July 6, 1965

3,192,649

STRAND ANNEALER

Fred B. Powell, Decatur, Ala., assignor, by mesne assignments, to Monsanto Company, a corporation of Delaware

Filed Apr. 19, 1962, Ser. No. 188,820
10 Claims. (Cl. 34—155)

This invention relates to annealers and more particularly to continuous annealers for thermoplastic filaments.

It is well known that chemical fibers must be annealed to impart desirable characteristics. There are other operations in the textile and other fields where a strand or filament must be annealed or treated with a gaseous medium. In the annealing of chemical filaments the batch process is usually used, i.e., a large quantity of the material is sealed in a chamber and steam applied to it. This method is time consuming and costly. Annealers have been designed to continuously anneal a moving bundle, or tow, of filaments. Most of these have not been usable, since the leakage of steam past the tow is almost impossible to prevent. Seals of various types have been tried, but most of them do not serve the purpose. With this in mind, one of the objects of this invention is to provide a novel and improved continuous annealer.

Another object of this invention is to provide a continuous annealer having an efficient seal.

A further object of this invention is to provide a continuous annealer having a rotating seal.

Still another object is to provide a continuous annealer wherein a strand to be annealed is introduced into an annealing chamber through a seal which divides the chamber into separate parts.

A still further object of this invention is to provide a continuous annealer having a rotating annealing chamber.

Yet another object of this invention is to provide a rotating annealing chamber which is divided along a plane perpendicular to the axis of rotation and which is sealed by flexible flanges.

One embodiment of the present invention contemplates a continuous annealer which includes an annealing chamber made up of a pair of generally cylindrical shells with open, facing ends. The remote ends of the shells are closed and are supported for rotation of the shells. The facing ends of the shells are provided with generally cylindrical, resilient seals, the seals each having wide flanges extending radially inward in engagement with each other. Steam or some other annealing medium, which is admitted to the chamber through the axis of the shell-supporting shaft, urges the flanges together to completely seal the chamber. A filament or tow to be annealed is inserted between the flanges from the outside of the chamber at a first point. At a second point, spaced circumferentially from the first point, the inner edges of the flanges are separated and the tow is drawn into the chamber where the annealing takes place. At a third point, spaced circumferentially from the second point, the tow is inserted between the flanges from the inside of the chamber. At a fourth point, spaced from the third point, the tow is withdrawn to the outside of the shell. Thus, the tow travels in and with the moving seal between the first and second points and the third and fourth points. This completely eliminates leakage from the chamber.

Other objects and advantages will become apparent when the following detailed description is read in conjunction with the appended drawings, in which

FIGURE 1 is a perspective view of one embodiment of the invention with portions cut away to show the general structural arrangement of the apparatus;

FIGURE 2 is an enlarged cross sectional view of the resilient seals showing the manner in which the tow is inserted between the seals;

FIGURE 3 is an enlarged cross sectional view of the seals showing the manner in which the tow is held by the seals between the points where the tow is inserted and removed from the seals;

FIGURE 4 is a perspective view of the seals showing the path followed by the tow through the seals and the chamber;

FIGURES 5, 6 and 7 are enlarged cross sectional views showing three embodiments of structure for inserting the tow into the seals;

FIGURE 8 is a cross sectional view of another embodiment of the invention showing inflated seals;

FIGURE 9 is a cross sectional view of still another embodiment of the invention showing seals of fixed contour whereby the tow feeds itself into and out of the seals without the use of inserting or removing devices; and

FIGURE 10 is a sectional view taken on line 10—10 of FIGURE 9 showing the path followed by the tow along the seal.

Referring now in detail to the drawings, a pair of shells 11 and 12 are shown rotatably mounted on base supports 13, the shells 11 and 12 being provided with tubular supports 14 which are rotatably mounted in bearings 15 on the base supports 13. The facing ends of the shells 11 and 12 are open, the shells generally having the configuration of greatly enlarged cups. These shells make up an annealing chamber.

A tube 20 secured in a base support 21 by a set screw 22 and extending through the tubular support 14 on the shell 11 serves to introduce steam to the chamber for annealing a tow 24. Condensate is withdrawn from the chamber through a tube 25 which extends through the tubular support 14 of the shell 12 and which is secured in a base support 26 by a set screw 27. Seals 28 secured to the tubes 20 and 25 and engaging the end walls of the shells 11 and 12 prevent the leakage of steam through the tubular supports 14. A belt 16 passes over a pulley 17 to drive the chamber.

The opening between the shells 11 and 12 is closed by a pair of flexible seals 31 and 32 which are generally cylindrical in configuration and which are bonded to the shells 11 and 12, respectively. The seals 31 and 32 are provided with wide flanges 33 and 34, respectively, which extend radially inward, the flanges 33 and 34 engaging each other in a face-to-face relationship to completely seal the chamber against leakage therefrom. The pressure of the steam in the chamber holds the flanges 33 and 34 together.

The tow 24 to be annealed is introduced into the chamber between the seals 31 and 32. The tow 24 passes through a tapered tubular guide or "inserter" 39 attached to the base or frame of the machine (the physical connection is not shown) to a point about midway between the inner edges of the flanges 33 and 34 and the junction of the flanges with the cylindrical shells 11 and 12. Henceforth, this midway point will be referred to as the center or central point of the flanges 33 and 34.

Inasmuch as the chamber is rotating, the tow 24 leaves the inserter or tube 39 and travels along a path 43 (FIGURE 1) to a tapered, tubular guide or "extractor" 44 which extends from the inner edges of the flanges 33 and 34 and guides the tow 24 into the chamber. FIGURE 3 best shows the manner in which the tow 24 is carried from the inserter 39 to the extractor 44. From this view it is obvious that there is no leakage between the seals 31 and 32.

From the guide 44 the tow 24 travels along a path

through the chamber completely exposed to the steam in the chamber. The tow 24 passes along a chord of the circle defined by the inner edges of the flanges 33 and 34 and enters another guide or inserter 45 which inserts the tow between the flanges 33 and 34 to the center thereof. The guides 44 and 45 are mounted on rods 48 and 49, respectively, attached to the end of the steam inlet tube 20.

The tow leaves the tip of the guide 45 and passes along a path 46 to a second "extractor" or guide 47 mounted on the base of the machine and is withdrawn through this guide and advanced to a takeup mechanism (not shown) of a well known type.

Inasmuch as the flanges 33 and 34 are moving and firmly hold the tow, there is very little resistance to the passage of the tow through the annealer even at high rates of speed. FIGURE 4 shows the path taken by the tow 24 through the apparatus. If a longer dwell time is required, the tow may be wound back and forth on rolls (not shown) in the chamber, rather than passing more or less directly from the guide 44 to the guide 45. To provide for shrinkage or elongation of the tow in the chamber the guides 45 and 47 may be offset from the "center" of the flanges 33 and 34.

FIGURES 5–7 show different arrangements which may be used to insert or remove the tow from the seals 33 and 34, the embodiment of FIGURE 5 being that shown in FIGURE 1.

In FIGURE 6, tapered rolls 54 and 55 are used to spread the flanges 33 and 34 to insert the tow 24 therebetween. In using these rolls, the problem of friction between the tow inserting guide and the seals is eliminated.

In the embodiment disclosed in FIGURE 7, a grooved pulley 56 is used to insert the tow 24 between the flanges 33 and 34, the pulley being provided with a peripheral groove 57 through which the tow passes. In the event that it is desirable to operate the chamber under a vacuum the seals 33 and 34 will be mounted to extend radially outward from the seals 31 and 32, rather than inwardly as shown.

FIGURE 8 discloses a second embodiment of the invention wherein shells 60 and 61 are provided with seals 62 and 63 having inflated flanges 66 and 67, these flanges having air chambers 68 and 69, respectively. The above-described guides and supporting structure are used with this apparatus. The apparatus of this embodiment is considered to be more desirable when lower steam pressures are used.

A third embodiment of the invention is disclosed in FIGURE 9. In this embodiment a different type of seal is used, so that the guides of the first two embodiments can be dispersed with, the tow 24 being fed into and out of the chamber by rotation of the chamber. A pair of shells 73 and 74 are canted or inclined as illustrated in FIGURE 9. Steam is fed into the chamber through the support 75, while the condensate is withdrawn through the support 76 in the manner described in connection with the apparatus shown in FIGURE 1.

The chamber is sealed by a pair of seals 79 and 80 having generally hemispherical configurations. The larger ends or sides of the seals 79 and 80 are bonded to the shells 73 and 74 as illustrated in FIGURE 9, the smaller ends or sides of the seals abutting each other as shown. The smaller ends or sides of the seals 79 and 80 are provided with central openings through which the tow passes into the chamber.

Each of the seals 79 and 80 is fairly stiff so that almost all of the flexing of the seal takes place on a line extending around the seal adjacent to the shell to which the seal is secured. This is illustrated in FIGURE 9. The seals 79 and 80 each are generally arcuate in a cross section taken from the shell to the central hole in the seal, this portion of the seal having a predetermined radius of curvature. This radius of curvature is substantially the same at all radial cross sections taken around the seal, since almost all of the flexing of the seal takes place at the point where the seal joins the shell. This fact permits the elimination of the guides used in other embodiments of the invention.

The line 82 (FIGURE 10) along the seals illustrates the path followed by the tow. At the point where the tow first engages the seal, this line or path is outside the chamber and fully exposed to engage the tow. A guide (not shown) is used to direct the tow 24 onto the line or path 82. As the chamber is rotated, the line or path 82 passes to the inside of the chamber, since the shells are inclined relative to each other. It will be noted that the lower portion of the line or path 82 defines a circle concentric with the axes of the tubular supports 75 and 76 and the shells 73 and 74. The tow passes across a chord of the circle defined by the line of contact of the seals and then moves back to the outside of the chamber as the chamber is turned further. Thus, no guides are needed. Thick layers 83 and 84 of soft rubber cover the seals 79 and 80 to prevent steam leakage as the tow passes into and out of the chamber.

The circle 86 in FIGURE 10 represents the line of contact of the seals 79 and 80. The area inside the circle 86 is exposed to the steam in the chamber, while the area outside the line 86 is open to the outside of the chamber. In actual practice the line 86 will be a band of contact rather than a line of contact, since the soft rubber layers 83 and 84 will be engaged to widen the line of contact of the seals.

It will be noted that the line of contact 86 defines a circle which is eccentric to the axis of rotation of the shells 73 and 74, the lines 82 and 86 intersecting each other at points 89 and 90. Since the area inside the circle defined by the line 86 is exposed to the steam in the chamber, the tow will be exposed to the steam as it moves from the point 89 to the point 90.

The tow 24 is fed into the junction of the seals 79 and 80 at point 87, the point 87 lying outside the line of contact 86. It can be readily seen that, as the chamber rotates, the line of contact 86 moves outward past the line 82 on which the tow lies until the line or band of contact 86 is completely outside the line 82. At this point the tow is exposed to the steam in the chamber. The tow remains exposed to the steam until, upon further rotation of the chamber, the line 82 representing the tow path is again outside the band of contact 86.

This invention provides a continuous annealer which is fast, efficient and virtually leak-proof. Strands and filaments other than tow can be readily annealed or treated by steam or other gases in this apparatus.

It is to be understood that the embodiments disclosed herein merely illustrate the invention and that numerous other embodiments can be contemplated which will fall within the spirit and scope of the invention.

What is claimed is:

1. An apparatus for treating a strand, comprising a pair of rotatable shells positioned in facing relationship and which shells are open centrally thereof defining an annealing chamber, a pair of seals secured to the shells having radially extended contiguous flanges, and means for rotating the shells, and means adjacent to the seals for guiding the strand between said seals into and out of said chamber formed by the shells.

2. An apparatus for treating a strand, comprising a base, a pair of shells rotatably mounted on the base in facing relationship, a pair of seals secured to the shells and having radially-extended contiguous flanges, means connected to the shells for rotating said shells, first guide means adjacent to the flanges for inserting a strand between said flanges, and second guide means spaced from the first guide means for removing the strand from the flanges.

3. An apparatus for treating a strand, comprising a base, a pair of shells mounted on the base in facing relationship and which shells are open centrally thereof defining an annealing chamber, said shells being mounted for

rotation about axes positioned at angles to each other, a pair of generally hemispherical seals secured to the shells and in engagement with each other, and means adjacent to the seals for guiding the strand between the seals into and out of said chamber formed by the shells.

4. Apparatus for treating a strand; comprising a base; a pair of shells rotatably mounted on the base in facing relationship and which shells are open centrally thereof defining an annealing chamber; a pair of seals secured to the shells in engagement with each other along a line of contact, said seals having central openings therein; means for rotating the shells; said shells being inclined to each other so that said line of contact defines a circle eccentric to the axis of rotation of said shells, and means adjacent to the seals for guiding the strand between said seals into and out of said chamber formed by the shells.

5. An apparatus for treating a strand; comprising a base; a pair of shells rotatably mounted on the base in facing relationship; a pair of flexible, generally hemispherical seals secured to the shells in engagement with each other along a line of contact defining generally a circle; said seals having central openings; means for rotating the shells; and means for directing a strand into the nip of the seals so that said strand travels along a generally circular path concentric with the axes of rotation of the shells; said shells being positioned at angles to each other so that said circle of contact intersects said circular path.

6. An apparatus for treating a tow; comprising a base; a pair of shells rotatably mounted on the base in facing relationship; a pair of flexible generally-hemispherical seals secured to the shells in engagement with each other along a line of contact defining generally a circle; said seals having central openings therein; means for rotating the shells; means for directing the tow into the nip of the seals so that said tow travels along a generally circular path concentric with the axes of rotation of the shells; said axes being positioned at angles to each other so that said circle of contact intersects said circular path; and means for introducing a treating medium into the shells.

7. An apparatus for treating a strand; comprising a base, a pair of shells rotatably mounted on the base in facing relationship and having flexible flanges extending radially inward in engagement with each other, means on the base for rotating the shells, a first guide positioned adjacent to the flanges for directing a strand into a position between said flanges, a second guide mounted inside the shells and spaced peripherally from the first guide for withdrawing the strand into the chamber formed by the shells, a third guide mounted inside the shell at a point spaced from the second guide for directing the strand from the chamber into a position between said flanges, a fourth guide mounted outside the chamber at a point spaced peripherally from the third guide for withdrawing the strand from said flanges, and means for introducing a treating medium into the chamber.

8. An apparatus for annealing a tow, comprising a base, a pair of shells rotatably mounted on the base in facing relationship to form a chamber, a pair of seals secured to the shells and having resilient flanges extending radially inward in engagement with each other, means for rotating the shells around an axis extending through the shells, and a pair of tapered rolls mounted in engagement with each other and extending into a position between the flanges for separating said flanges for the introduction of the tow into a position between the flanges.

9. An apparatus for annealing a tow, comprising a base, a pair of shells rotatably mounted on the base in facing relationship to form a chamber, means on the base for rotating the shells around an axis extending through the shells, a pair of seals secured to the shells and having resilient flanges extending radially inward in engagement with each other for sealing the chamber, and a roll mounted on the base and having a portion thereof extending into a position between the flanges, said roll having a groove in the periphery thereof for carrying the tow into a position between said flanges.

10. An apparatus for annealing a tow, comprising a base, a pair of shells positioned in facing relationship and having secured on the remote ends thereof tubular support members, means on the base engaging said tubular support members for rotatably supporting the shells, a pair of seals secured to the shells and having flexible flanges extending radially inward in engagement with each other, a first tube mounted on the base and extending through one of said tubular support members for directing steam into the chamber formed by the shells, a second tube mounted on the base and extending through the other tubular support member and into said chamber for withdrawing condensate therefrom, a first guide positioned adjacent to the flanges for directing a tow into a position between said flanges, a second guide mounted inside the chamber and spaced peripherally from the first guide for withdrawing the tow from said position between said flanges and directing said tow into said chamber, a third guide mounted inside the chamber at a location spaced peripherally from the second guide for directing the tow from the chamber into a position between the flanges, a fourth guide mounted adjacent to the flanges at a location spaced from the third guide for withdrawing the tow from said position between said flanges, and means for rotating the shells.

References Cited by the Examiner

UNITED STATES PATENTS

1,102,662	7/14	Hobbs	34—129
2,974,512	3/61	Carter	34—155
3,018,514	1/62	Salgado.	
3,084,448	4/63	Dungler	34—155

FOREIGN PATENTS

525,085	4/55	Italy.

NORMAN YUDKOFF, *Primary Examiner.*