June 24, 1969 McCLEERY B. CUNNINGHAM ETAL 3,451,433

FORMING TUBE FOR GLASS FIBERS

Filed May 24, 1967

Sheet 1 of 2

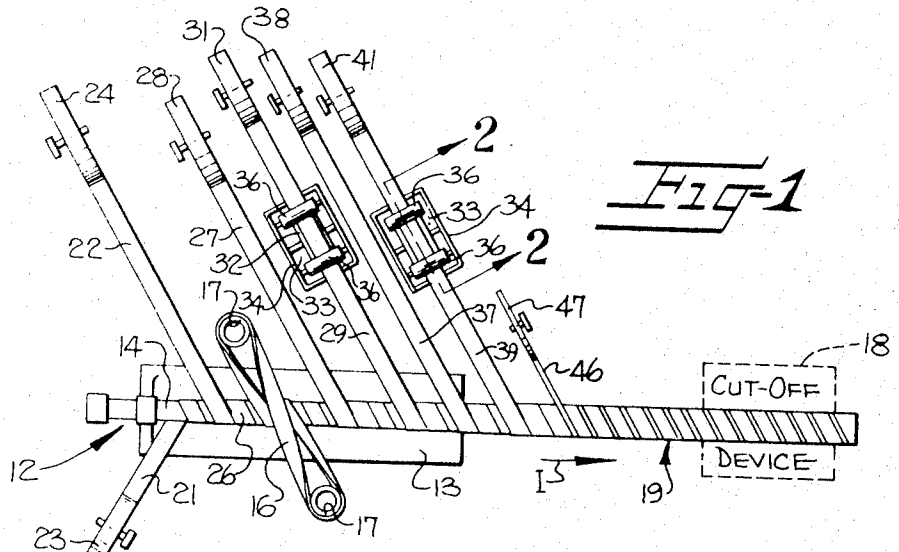


Fig-1

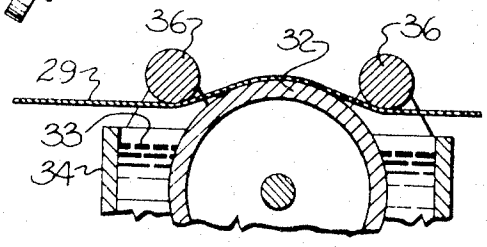


Fig-2

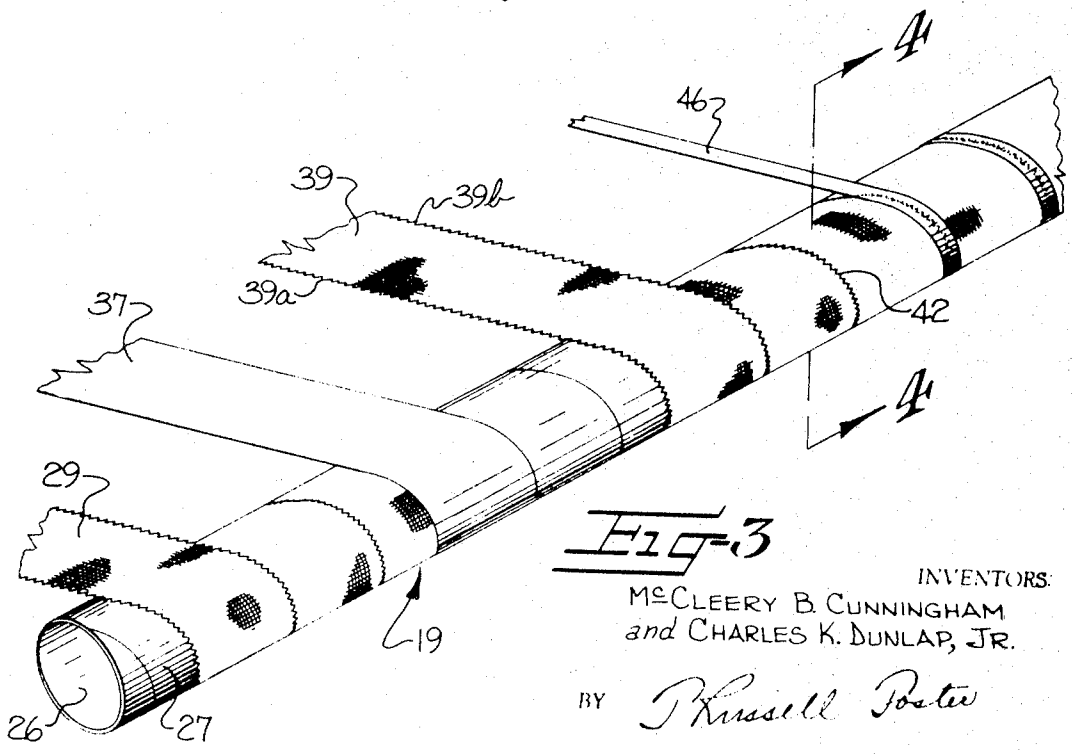


Fig-3

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Filed May 24, 1967 Sheet 2 of 2

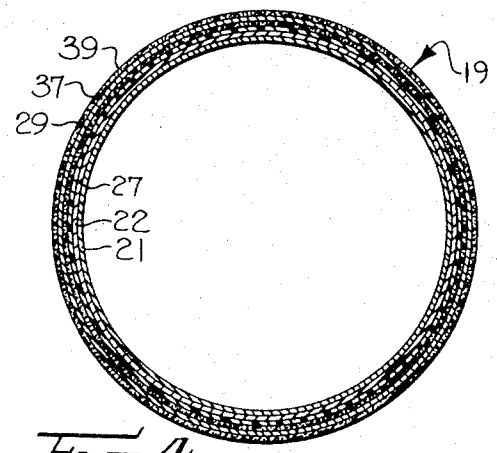


Fig-4

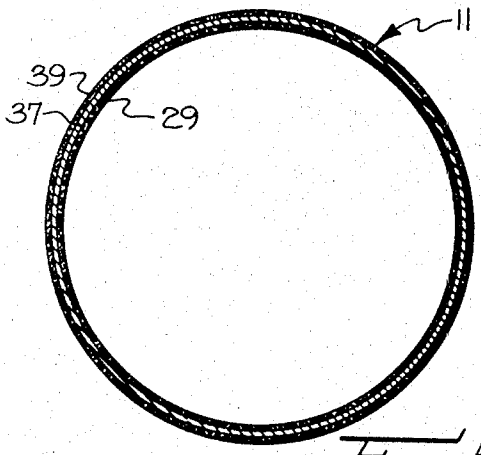


Fig-5

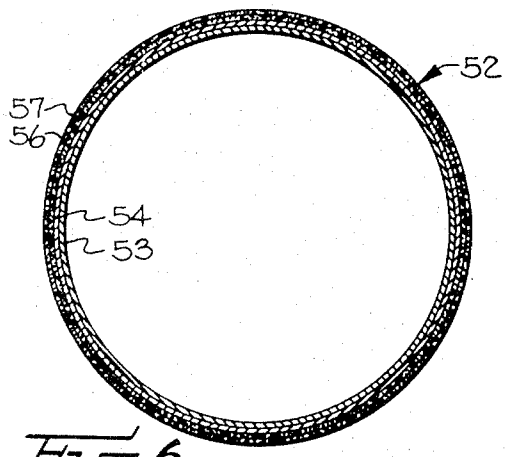


Fig-6

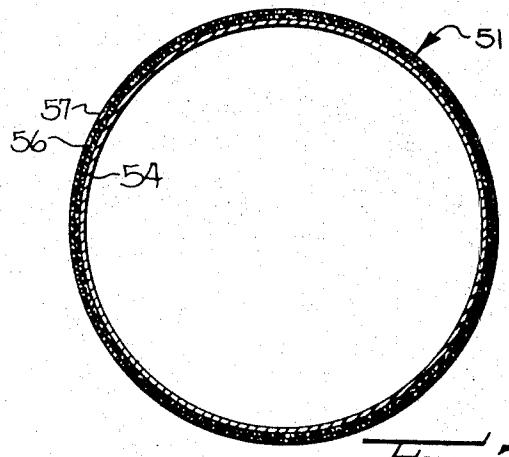


Fig-7

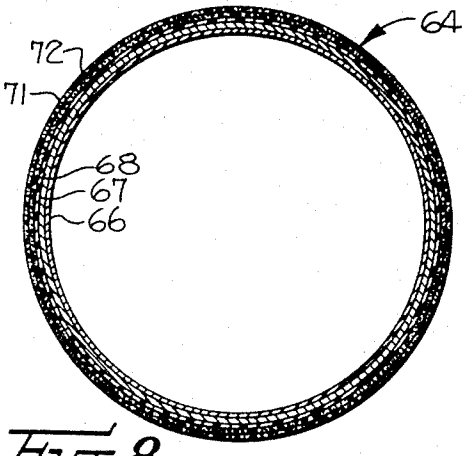


Fig-8

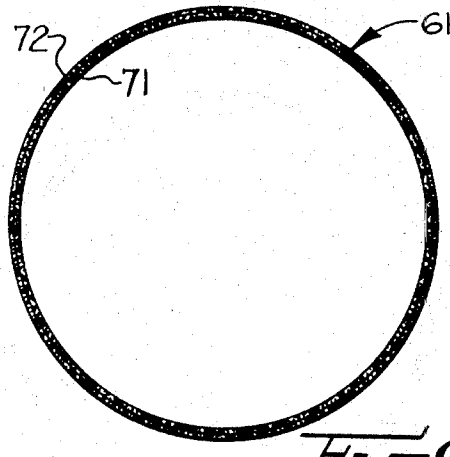


Fig-9

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3,451,433

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3,451,433

FORMING TUBE FOR GLASS FIBERS

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Int. Cl. F16l 9/16

U.S. Cl. 138—144

2 Claims

ABSTRACT OF THE DISCLOSURE

A spirally wound forming tube for glass fibers which includes at least two spirally wound plies of resin impregnated textile material and a spirally wound paper ply bonded to at least one of the textile material plies by means of the resin impregnant.

This invention relates to apparatus for the spinning of glass fibers and more particularly to a forming tube for use in the winding of freshly spun glass filaments or fibers.

In the spinning of glass fibers to be processed into textile material such as yarn and the like, glass in a molten condition is drawn through small openings or orifices in a plate commonly referred to as a spinneret into the form of continuous filaments which solidify upon contact with the air. These continuously drawn filaments are wound onto a tubular carrier in the form of a cylindrical sleeve which is generally referred to as a "forming tube." In a glass fiber spinning operation, this forming tube is slipped onto a spindle or the like which is rotated at very high speeds, frequently around 8,000 to 10,000 r.p.m. and up, as the glass filaments are drawn from the spinneret and wound on the tube at a relatively high linear speed generally 10,000 to 12,000 feet per minute and more.

Due to the high speed at which the forming tube is rotated and the rugged conditions of use to which it is subjected, these tubes must meet rigid standards and preferably should be of a suitable design and material so as not only to be inexpensive in initial cost but to be capable of repeated use. These forming tubes must also have a smooth peripheral surface to permit the glass filaments to be readily unwound from the tube and at the same time this peripheral surface should be sufficiently rough so that satisfactory winding of the filaments on the tube may be accomplished. In addition, these tubes should also be of light weight to avoid deformation by centrifugal force which at the speeds referred to above is of a substantial magnitude. Furthermore, these forming tubes should be highly resistant to compression by the filaments wound tightly on the tube so that the tube maintains its shape after removal from the winding spindle and the tubes should have sufficient flexibility and elasticity to permit their ready removal from the wound package of glass filaments when the tube is to be reused.

Two commonly employed materials in use today for making such forming tubes are paper and plastic such as polyethylene both of which have some objectionable features. Although a forming tube composed of paper generally performs satisfactory the first time it is used, it deteriorates rapidly when reused and forming tubes of fibrous material such as fiberboard are generally discarded after a few uses adding considerably to the manufacturing cost even though their initial cost is low. Forming tubes of plastic have also been used with some success but the severe stresses to which plastic forming tubes are subjected frequently causes plastic tubes to explode during use primarily as a result of centrifugal force not only creating a hazard but adding considerably to manufacturing costs considering the high initial cost of such plastic tubes.

Accordingly, a primary object of this invention is to provide a new and improved forming tube for use in the winding of glass filaments or fibers.

Another object of this invention is to provide a new and improved forming tube for winding glass fibers which employs a minimum amount of various materials in various combinations all which produce a tube having a strength not heretofore obtainable.

A further object of this invention is to provide a new and improved spirally wound forming tube for winding glass fibers which utilizes readily available inexpensive material to obtain a low initial tube cost and at the same time may be used repeatedly with a minimum of deterioration.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings.

In general, the objects of the invention and other related objects are accomplished by spirally winding at least one strip of fibrous material such as paper into a foundation tube preferably on a mandrel such as is used in conventional spiral tube winding apparatus. A plurality of strips of resin impregnated textile material with an inner strip of fibrous material such as paper positioned adjacent one of the strips of resin impregnated textile material are then wound onto the foundation tube and the resin in the textile material partially penetrates the paper inner strip. A release surface is provided between the foundation tube and the resin impregnated textile material which in one embodiment may be a spirally wound strip of release material such as Mylar which does not adhere to the resin. The resin is then cured and the foundation tube and release material are subsequently stripped from the multi-ply structure to provide a multi-ply forming tube comprising plies of resin impregnated textile material and the paper inner strip bonded together.

The novel features which are believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation may be best understood by reference to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 illustrates one form of apparatus for winding a forming tube with the method of the invention;

FIGURE 2 is an enlarged sectional view taken substantially along line 2—2 of FIGURE 1 in the direction of the arrows;

FIGURE 3 is an enlarged isometric view of a portion of a tube wound in accordance with one embodiment of the invention in the apparatus of FIGURE 1;

FIGURE 4 is an enlarged sectional view taken substantially along line 4—4 of FIGURE 3 in the direction of the arrows;

FIGURE 5 is a view similar to FIGURE 4 illustrating one embodiment of the forming tube of the invention produced from the tube structure of FIGURE 4;

FIGURE 6 is a sectional view similar to FIGURE 4 of a tube from which another embodiment of the forming tube of the invention is formed;

FIGURE 7 is a view similar to FIGURE 5 illustrating the forming tube produced from the structure of FIGURE 6;

FIGURE 8 is a sectional view similar to FIGURE 4 of a tube from which still another embodiment of the forming tube of the invention is formed; and

FIGURE 9 is a view similar to FIGURE 7 of a forming tube produced from the structure of FIGURE 8.

Referring now to the drawings and to FIGURES 1

through 3 and 4, 5, there is shown in diagrammatic form in FIGURES 1, 2, an apparatus for forming forming tubes for glass fibers constructed in accordance with the invention. The forming tube for glass fibers produced as shown in FIGURES 1 through 3 is designated generally in FIGURE 5 by the numeral **11**. As has been previously referred to, the forming tube **11** is of the type which is employed in the winding of freshly spun glass filaments or fibers drawn from the spinneret of a glass furnace.

Referring now specifically to FIGURE 1, there is shown, in operation, a conventional spiral tube winding apparatus, designated generally by the numeral **12**, used to produce the forming tube **11**. As well known, the spiral tube winding apparatus **12** comprises a frame **13**, a stationary mandrel **14** supported on the frame, a flexible endless belt **16** driven by a pair of pulleys **17** for rotating and advancing the tube forming in the winding apparatus and a cutoff device **18** for cutting the wound multi-ply tube, designated in FIGURES 1, 3 by the numeral **19**, into sections of selected uniform length. As is well known, the spirally wound multi-ply tube **19** is continuously formed and advanced in the direction of the arrow I to be trimmed into sections by the cutoff device **18**.

In the winding of the tube **11** of FIGURE 5, a pair of strips of fibrous material such as paper **21**, **22** unwound from supply rolls **23**, **24** respectively are brought in from opposite directions and wound as shown in FIGURE 1 on the tube making mandrel **14** with no adhesive therebetween. These two paper strips **21**, **22** are hereinafter referred to as a foundation tube designated in FIGURE 1 by the numeral **26** on which the forming tube of the invention is formed and which is discarded subsequently as will be explained hereinafter.

The belt **16**, which is wrapped around the foundation tube **26**, moves the foundation tube in the direction of the arrow I in the well-known manner and a strip **27** of release material such as Mylar or the like unwound from a supply roll **28** is spirally wound in overlying relationship as shown on the foundation tube **26**.

Following the winding of the release material strip **27**, a strip **29** of textile material such as woven cotton cloth, non-woven material and the like unwound from a supply roll **31** is impregnated with a resinous material and it is spirally wound as shown in overlying relationship with the release material strip **27**. The impregnation of the cloth strip **29** is carried out in the manner similar to that shown in FIGURE 2 by passing the cloth strip **29** over an impregnating roll **32** which is freely rotatable in a resinous bath **33** contained within a receptacle or tank **34**. In order to guide the cloth strip **29** over the roll **32** for proper impregnation, guide rollers **36** are provided so that the strip **29** passes between the roll **32** and the rollers **36**.

The preferred resinous material with which the cloth strips **29** are impregnated is an acrylic resin which is provided in the form of an aqueous emulsion. The curing of this resinous material may therefore be accomplished by evaporation of the water vehicle from the acrylic resin and water mixture.

A strip **37** of fibrous material such as paper unwound from a supply roll **38** is then spirally wound in overlying relationship with the impregnated cloth strip **29** so as to be sandwiched between the underlying cloth strip **29** and a second resin impregnated cloth strip **39** spirally wound in overlying relationship with the paper strip **37** as shown.

The cloth strip **39** is unwound from a supply roll **41** and is similarly impregnated with a resin such as acrylic resin in a manner similar to the impregnation of cloth strip **29**. Thus, impregnation of strip **39** is carried out by means of the apparatus shown in FIGURE 2 and described with reference to cloth strip **29**. The resin with which the cloth strips **29**, **39** are impregnated penetrates into the inner paper strip **37** sandwiched therebetween so that the three strips **29**, **37**, **39** form the forming tube **11** of one embodiment of the invention.

In order to achieve one novel result of the invention, the outer cloth strip **39** is provided with continuous serrated or pink edges **39***a*, **39***b* as shown best in FIGURE 3 and the edges of adjacent convolutions of the cloth strip **39** are overlapped slightly along a spiral seam **42** as shown in FIGURE 3 so that there is an intermingling of the material of the edges **39***a*, **39***b* of the adjacent convolutions. It has been found that this intermingling of the serrated edge fibers add considerably to the strength of the tube and aid in producing a more uniform outer surface on the forming tube of the invention.

Subsequently, a narrow strip **46** of release material such as cellophane, Mylar or the like unwound from a supply roll **47** is spirally wound in overlying relationship with the outer cloth strip **39** along the seam **42**. This strip **46** retains the acrylic resin material within the underlying tube plies and additionally aids in providing a smoother exterior surface on the forming tube.

As the continuously formed composite tube structure **19**, which is shown in section in FIGURE 4, moves in the direction of the arrow I, it is cut into selected uniform sections or lengths in the cutoff device **18** which are removed for curing. Preferably these tube sections are formed approximately 8 feet in length.

The curing of these sections of the composite tube structure **19** is then carried out so that the water vehicle in the resin-water mixture will be evaporated and the resin with which the tube **19** is impregnated will set permanently within the tube. Using an aqueous acrylic resin mixture for impregnation of the tube plies permits the curing to be accomplished under normal room temperatures over a relatively short period of time. However, if the curing time is to be shortened by the application of heat, means such as an oven can be utilized.

After the curing step has been completed, the foundation tube comprising the strips **21**, **22**, the release material strip **27** and the outer release material strip **46** are then removed from the composite tube structure of FIGURE 4 so as to leave the forming tube **11** of FIGURE 5 of somewhat greater length than desired comprising the resin impregnated cloth plies **29**, **39** and the inner paper ply **37** permanently bonded together in a multi-ply tubular structure. If desired, the outer surface of the long forming tube **11** may be lightly ground to remove trash in the resin impregnated cloth outer surface and to smooth the seams.

The long forming tube **11** is then cut into a plurality of shorter lengths, preferably lengths of approximately 8 inches to provide forming tubes of a length suitable for use in the glass fiber winding operation. The resin impregnated cloth plies **29**, **39** give the forming tube **11** strength and durability and the inner paper ply **37** provides further tube strength and sufficient flexibility for the purpose for which the forming tube is used.

The invention lends itself to other embodiments and, as shown in FIGURES 6, 7, another embodiment of the forming tube is shown, which is designated generally in FIGURE 7 by the numeral **51**. The composite tube structure, designated generally in FIGURES 6 by the numeral **52** and similarly produced in the apparatus of FIGURE 1, comprises a foundation tube composed of spirally wound strips of fibrous material such as paper which are preferably two in number and which are designated by the numerals **53**, **54**.

The paper strips **53**, **54** are wound on the mandrel **14** in the manner described above and two strips of resin impregnated cloth **56**, **57** are spirally wound as described above in overlying relationship with the upper paper strip **54** down from the belt **16**. Thus the composite tube structure **52** consists of two plies of paper **53**, **54** and two plies of resin impregnated cloth **56**, **57** with no intervening paper strip between the cloth plies **56**, **57**.

After cutting to length and curing, the inner paper

strip **53** is readily removed as there is no adhesive between the strips **53**, **54**. Remaining in the forming tube **51** comprising the resin impregnated cloth plies **56**, **57** and the paper ply **54** adhering thereto in a permanent bond as a result of the penetration of the resin of the ply **56** into the fibrous material of the paper ply **54**. The exterior surface of the forming tube **51** may then be ground if desired and further cut into the proper lengths as previously described.

Still another embodiment of the novel method of the invention is shown in FIGURES 8, 9 wherein a forming tube designated generally by the numeral **61** in FIGURE 9 is produced comprising two plies **71**, **72** of resin impregnated cloth only. The composite tube structure designated generally in FIGURE 8 by the numeral **64** is formed by winding a foundation tube comprising the two strips of paper **66**, **67** onto the mandrel **14** in the manner described together with a layer of release material **68** in overlying relationship with the paper strip **67** down from the belt **16**. Two strips of textile material or cloth **71**, **72** impregnated with resin as explained above are then spirally wound in overlying relationship with the release material **68** to form the composite tube structure **64**. After cutting to length and curing, the paper plies **66**, **67** and release material ply **68** are removed leaving the forming tube **61** with the permanently bonded together cloth plies **71**, **72**. The exterior surface of the forming tube **61** may then be ground, if desired, and further cut into the proper lengths as previously described.

It can be seen that with the novel construction of this invention, a forming tube for winding glass fibers or filaments has been provided which not only has the desired unusual physical characteristics required of such tubes but at the same time is low in initial cost and may be reused many times before replacement is necessary. The

forming tube of the invention may be made in a simple and easy manner using inexpensive materials and conventional winding apparatus and is capable of being wound in a plurality of forms in accordance with the end result desired.

While there has been described what at present is considered to be the preferred embodiment of the invention, it will be understood by those skilled in the art that various changes and modifications may be made therein without departing from the invention.

Having thus described the invention, what is claimed is:

1. A forming tube for glass fibers comprising, in combination, at least two plies of resin impregnated textile material spirally wound into a tubular form and a spirally wound flat ply of fibrous material bonded with said resin to the innermost of said plies of resin impregnated textile material.

2. A forming tube for glass fibers comprising, in combination, at least two plies of resin impregnated textile material spirally wound into a tubular form and a spirally wound flat ply of fibrous material bonded with said resin to at least one of said plies of textile material, said outed ply of said resin impregnated textile material having continuous serrations along both edges and wound with said serrated edges in overlapping relationship.

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