APPARATUS FOR METALIZING FILAMENTS OF GLASS

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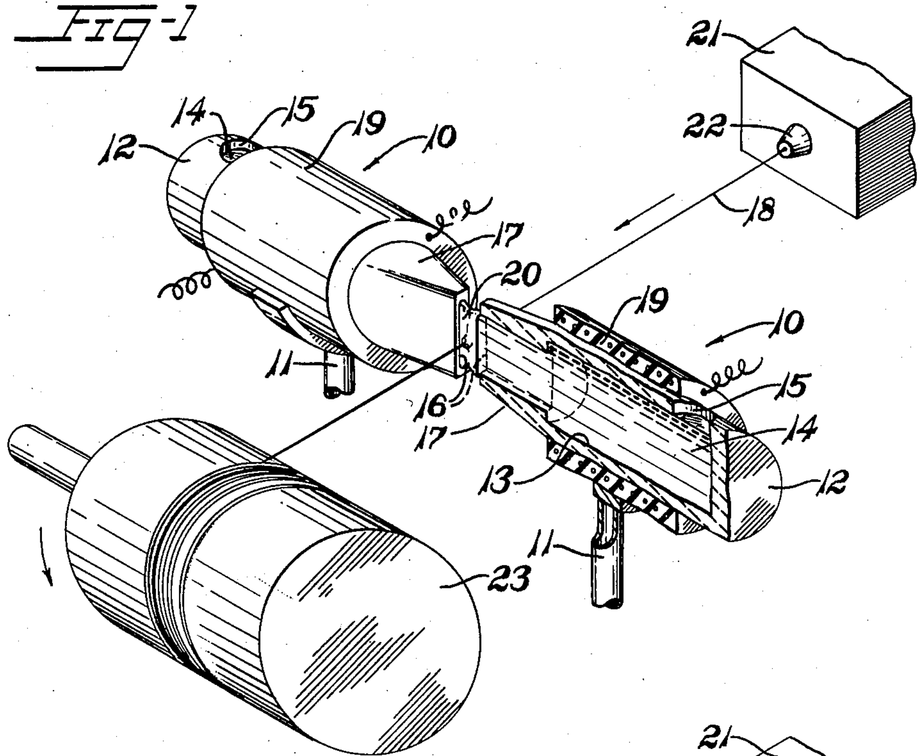
FIG-1



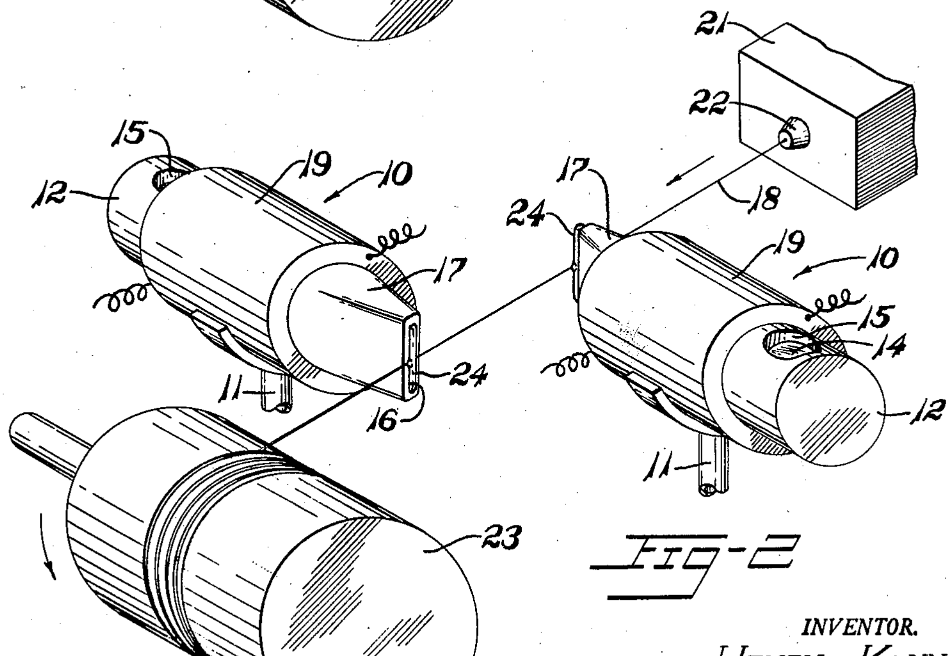


FIG-2

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APPARATUS FOR METALIZING FILAMENTS OF GLASS

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5 Claims. (Cl. 118—401)

This invention relates to processing filaments of glass and pertains more particularly to metalizing glass filaments.

While the properties of glass filaments indicate that textile materials fabricated thereof would be greatly superior to most textile materials presently used, it has been observed that textile materials formed of glass filaments normally are unable to withstand severe working or flexing. Consequently, the applications for which glass filament textile materials are used are somewhat limited. It is believed that this weakness in a glass filament textile construction is associated with the high coefficient of friction between adjacent filaments of the structure at their points of glass-on-glass contact. Recently, it was discovered that the difficulty can be essentially eliminated if the individual filaments of the structure are coated with metal.

The application of a thin coating of metal to a glass filament which is so fine that it is barely visible obviously presents a very difficult problem. The perplexity of the coating operation is increased because of the high speeds at which the glass filaments are produced. Since for convenience and economy it normally is desirable that molten metal be applied to the glass filament in the metalizing process, extreme care must be exercised to prevent the glass filament from being heated to too high a temperature during the coating operation or the filament will break.

Considering that commercial apparatus for forming glass filaments normally produces a number of glass filaments simultaneously, it is advantageous to coat a plurality of filaments at the same time using a single coating device, so that the coated filaments can be formed directly into a yarn before being wound on a spool or reel.

The objectives of this invention are to provide apparatus and a convenient and economical process for applying a coating of metal to a glass filament as it is being advanced at a relatively high speed. The objectives are accomplished by providing apparatus having opposing coating applicators each of which is adapted to supply through an orifice of capillary dimension an approximately constant ridge or bead of molten metal through which the glass filament or filaments are advanced.

Illustrative embodiments of apparatus suitable for the practice of this invention are shown in the accompanying drawings in which:

Fig. 1 represents an enlarged perspective view partly broken away and in section of a device for coating glass filaments with metal; and

Fig. 2 represents an enlarged perspective view of a second device for metalizing glass filaments.

Referring to the embodiment of this invention shown in Fig. 1, the coating apparatus comprises a pair of coating heads or applicators 10, 10 mounted in a suitable support or frame 11 in directly opposed closely-spaced face-to-face relation. Each applicator 10 comprises a housing 12 having a chamber 13 for confining molten coating metal 14. A charging opening 15 communicating with chamber 13 provides means for supplying metal to chamber 13. A slot orifice 16 of capillary dimensions, for example an orifice having a slot width of about 0.02 inch, extends into chamber 13 of the applicator 10 providing a passageway through which the molten metal confined in chamber 13 is permitted to flow. However, the surface tension force of the molten metal prevents the metal from flowing freely out of the slot orifice. In this modification of the invention the slot orifices 16 of the applicators, 10, 10 directly oppose each other. Preferably, the end portion 17 of each applicator 10 which opposes the other applicator of the coating device is tapered, as shown in Fig. 1, so that the glass filament 18 does not contact the applicators 10, 10 as the filament is advanced through the coating station.

Housing 12 of each applicator 10 preferably is made of graphite since this material not only is able to withstand the relatively high temperatures to which the applicator will be subjected but, also, is practically completely resistant to chemical attack. However, it will be understood that other materials may be used which are capable of withstanding the temperature of the molten coating metal confined in the applicator, such as high melting point metals or metal alloys which are not attacked by the coating metal, as well as certain ceramic materials, for example porcelain.

To maintain the metal confined in the applicators molten at all times during the coating operation, housing 12 of each applicator 10 is heated in a convenient manner, such as by an electric heater 19 or by direct flame heating, to a temperature above the solidification temperature of the metal coating material.

Coating metal is charged through opening 15 into chamber 13 of each applicator 10, normally in the form of small pieces of the metal although coating metal already in a molten state can be charged, until the metal when molten reaches a level just above the uppermost reach of slot orifice 16. The molten metal will flow from chamber 13 of the applicator through slot orifice 16 and would normally present itself as a minute ridge or bead of molten metal at the slot orifice except that the two applicators 10, 10 are positioned in such closely spaced relation, for example about 1/64 inch apart, that the beads of molten metal from each applicator 10 join to form a continuous bridge 20 of molten metal spanning the distance between the two applicators 10, 10, as shown in Fig. 1. The spacing between the opposed applicators 10, 10 can vary depending upon the metal coating material used, but must not be of such magnitude that the beads of molten metal projecting from each applicator do not join to form a bridge of molten metal between the applicators.

To illustrate the operation of the coating device shown in Fig. 1, reference will be made to the following specific example.

As shown in Fig. 1, a platinum bushing 21 having a nozzle 22 projecting from a closed-end of the bushing is employed in the fabrication of the glass filament 18. The nozzle 22 is provided with a small-diameter opening in its end face to allow a small stream of molten glass to flow therethrough, a nozzle opening of about 0.02 inch diameter commonly being used.

The bushing is charged with glass, which may be in the form of small spheres of glass about one-half inch in diameter, and is heated in a convenient way (not shown), for example by an electric heating device, to a temperature at which the glass is maintained in a freely fluid state. The molten glass in this condition readily flows through the opening in the nozzle of the bushing. As the molten glass flows from the nozzle it is drawn manually into the filament 18 which is wound around a rapidly revolving spool or reel 23 driven in a conventional way (not shown). As the reel 23 revolves, the filament 18 is continuously formed from the molten glass and is attenuated to extreme fineness, the filament normally being drawn to a diameter of about 0.0003 to 0.0004 inch. A number of glass filaments can be drawn simultaneously from a single bushing, the number of filaments formed at one time depending upon the number of nozzles 22 on the bushing. Commonly a bushing having over two hundred nozzles is used, but for clarity of illustration a single nozzle bushing is shown.

Zinc metal is charged into each applicator 10, 10 of the coating apparatus, and the applicators 10, 10 are each heated to a temperature of about 500° C. and maintained at this temperature while in use. Sufficient zinc metal is charged to each applicator 10 until the slot orifice 16 of each applicator 10 is filled with molten metal and a bridge 20 of molten metal spans the gap between the opposed applicators 10, 10.

The coating apparatus is positioned so that the glass filament 18 is drawn transversely between the opposed slot orifices 16, 16 of the applicators 10, 10 and through the bridge 20 of molten metal extended between the applicators 10, 10; preferably the filament 18 is not permitted to contact either of the applicators 10, 10 as it is advanced therebetween. As the filament 18 is advanced rapidly for example at a rate of about 5000 feet a minute through the bridge 20 of molten metal and is withdrawn therefrom a thin coating of zinc metal is observed to have been deposited on the filament. The metal coating was found to be extremely thin, being about 0.00004 inch in thickness.

The coating apparatus, for convenience, is placed immediately adjacent the glass filament forming bushing, so that the drawing and coating can be part of a single operation. When this arrangement is used, the filaments are coated with metal before any deterioration of the glass filament can occur, such as deterioration in strength of the filament due to absorption of moisture from the atmosphere.

It is necessary from time to time to charge additional metal to each applicator to replenish the metal used in coating so that sufficient metal is maintained in the applicators to constantly retain the bridge 20 of molten metal extended between the applicators.

While the above example exemplifies the formation and coating of a single glass filament, it will be understood that normally a great number of glass filaments are formed at the same time by utilizing a multi-nozzle bushing, and that all of the glass filaments so formed can be metalized simultaneously by advancing the filaments in spaced relation to each other through the bridge 20 of molten metal. When a number of glass filaments are coated at the same time it is important that the filaments are maintained spaced from each other during the coating operation and for a time thereafter until the metal coating on the individual coated filaments has solidified, so that each filament is entirely coated and does not become fused with adjacent coated filaments after the coating operation.

The coating of a number of glass filaments at the same time by use of a single coating apparatus facilitates the formation of yarn from the coated filaments, since the coated filaments can be twisted into a yarn essentially immediately after being coated and before being wound on the reel or spool 23, the coated filaments having cooled substantially to room temperature after being advanced but a few inches past the coating apparatus.

The coating operation is continuous as long as sufficient molten metal is maintained in the applicators 10, 10 to maintain a bridge of molten metal extended between the applicators. The filaments can be coated with metal at rates varying over a wide range, coating rates from a few feet per minute to over 9,000 feet per minute normally being employed.

It will be understood that although zinc metal was mentioned in describing the above illustration, other metals, such as lead, tin, aluminum, and various alloys, may be used when suitable changes in the temperature of operation are made.

If metals having relatively high melting points are used as the coating material, high melting temperature glass filaments should be employed so that the filaments will remain substantially solid during the coating operation.

The coating apparatus shown in Fig. 2 of the drawings is the same as the apparatus shown in Fig. 1 except that the applicators 10, 10 do not directly oppose each other, but are arranged in opposed tandem relationship along the path of advance of glass filament 18. The slot orifice 16 of each applicator 10 is transverse to the path of advance of the filament 18 and parallel to the slot orifice 16 of the other applicator 10.

Since the applicators 10, 10 of the apparatus shown in Fig. 2 are positioned in tandem relation, the molten metal flowing from chamber 13 through slot orifice 16 of each applicator 10 presents itself as a minute ridge or bead 24 of molten metal at the external opening of slot orifice 16.

As the filament 18 is drawn past the applicator 10 positioned immediately adjacent bushing 21, the filament passes through the bead 24 of molten metal and receives a coating of metal.

If the surface tension force of the molten coating metal is high, the bead 24 of molten metal may not completely encompass the entire filament unless extreme care is exercised to maintain the filament submerged in the molten metal and, as a result, the filament will not be entirely coated with metal. However, as the filament 18 is advanced through the bead 24 of molten metal emitted from the second applicator 10, complete coating of the filament is insured.

It is clear that many modifications and variations of this invention may be made without departing from the spirit and scope of the appended claims.

I claim:

1. Apparatus for coating a glass filament with metal comprising a pair of opposed spaced coating applicators, each said applicator comprising a housing having a chamber for confining molten metal, having a charging opening communicating with said chamber through which metal coating material is charged into said chamber, and having a slot orifice of capillary dimensions communicating with said chamber and with a coating station through which said glass filament is advanced, the upper reach of said slot orifice being positioned below the level of the molten metal normally maintained in said chamber during the coating operation whereby said slot orifice constantly is maintained filled with molten coating metal during the coating operation and whereby a quantity of molten metal constantly is maintained at said coating station.

2. Apparatus for coating a glass filament with metal comprising a pair of applicators disposed in an opposed tandem spaced relation, each said applicator comprising a housing having a chamber for confining molten metal, having a charging opening communicating with said chamber through which metal coating material is charged into said chamber, and having a slot orifice of capillary dimensions communicating with said chamber and with a coating station through which said glass filament is advanced, the upper reach of said slot orifice being positioned below the level of the molten metal normally maintained in said chamber during the coating operation whereby said slot orifice constantly is maintained filled with molten coating metal during the coating operation and whereby a bead of molten metal constantly is maintained at said coating station.

3. Apparatus for coating a glass filament with metal comprising a pair of opposed spaced coating applicators, each said applicator comprising a housing having a chamber for confining molten metal, having a charging opening communicating with said chamber through which metal coating material is charged into said chamber, and having

a slot orifice of capillary dimensions communicating with said chamber and with a coating station through which said glass filament is advanced, the upper reach of said slot orifice being positioned below the level of the molten metal normally maintained in said chamber during the coating operation whereby said slot orifice constantly is maintained filled with molten metal during the coating operation and whereby a quantity of molten metal constantly is maintained at said coating station, the end portion of said housing of each said applicator which is adjacent the other said applicator being tapered so that said glass filament does not contact said housing as the filament is advanced through said coating station, and means for heating said housing of each said applicator to a temperature above the solidification temperature of said metal coating material.

4. Apparatus for coating a glass filament with metal comprising a pair of applicators disposed in directly opposed closely-spaced face-to-face relation, each said applicator comprising a housing having a chamber for confining molten metal, having a charging opening communicating with said chamber through which metal coating material is charged into said chamber, and having a slot orifice of capillary dimensions communicating with said chamber and with a coating station through which said glass filament is advanced, the upper reach of said slot orifice being positioned below the level of the molten metal normally maintained in said chamber during the coating operation whereby said slot orifice constantly is maintained filled with molten coating metal during the coating operation and whereby a bridge of molten metal constantly is maintained extended between said opposed applicators, the end portion of said housing of each said applicator which is adjacent the other said applicator being tapered so that said glass filament does not contact said housing as the filament is advanced between the said applicators and through the bridge of molten metal extended therebetween, and means for heating said housing of each said applicator to a temperature above the solidification temperature of said metal coating material.

5. Apparatus for coating a glass filament with metal comprising a pair of applicators disposed in opposed tandem spaced relation, each said applicator comprising a housing having a chamber for confining molten metal, having a charging opening communicating with said chamber through which metal coating material is charged into said chamber, and having a slot orifice of capillary dimensions communicating with said chamber and with a coating station through which said glass filament is advanced, the upper reach of said slot orifice being positioned below the level of the molten metal normally maintained in said chamber during the coating operation whereby said slot orifice constantly is maintained filled with molten coating metal during the coating operation and whereby a bead of molten metal constantly is maintained at said coating station, the end portion of said housing of each said applicator which is adjacent the path of advance of said glass filament being tapered so that said glass filament does not contact said housing as the filament is advanced, and means for heating said housing of each said applicator to a temperature above the solidification temperature of said metal coating material.

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