Feb. 20, 1962 W. L. MORGAN ET AL 3,021,564

PRODUCTION OF FIBERS IN INTIMATE ASSOCIATION WITH METAL

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FIG. 1.

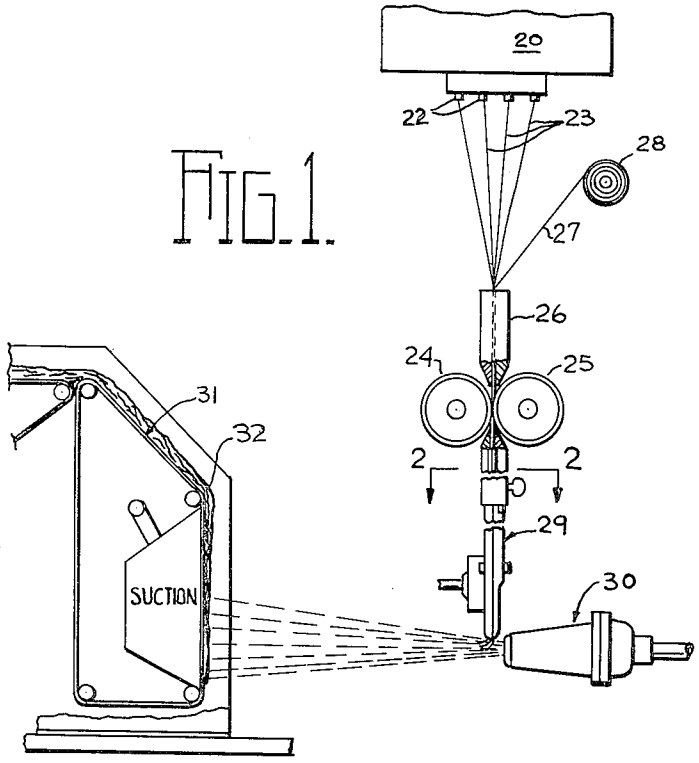


FIG. 2.

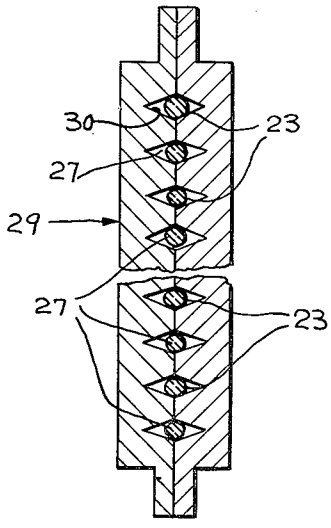
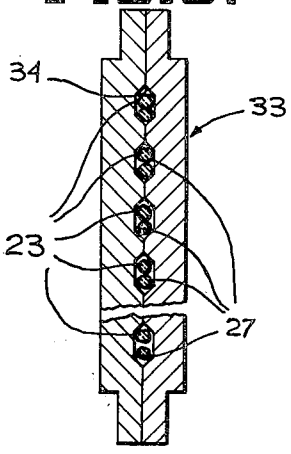


FIG. 3.



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FIG. 4.

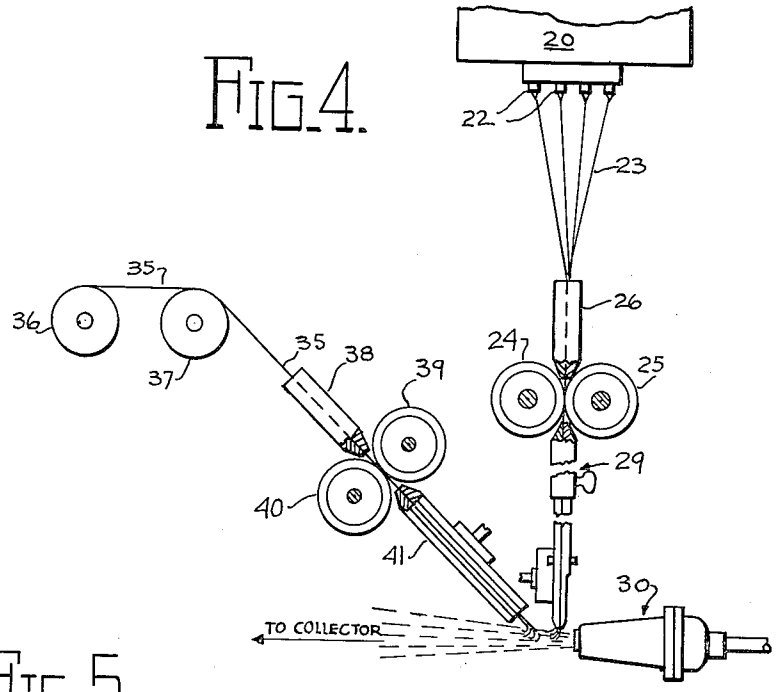


FIG. 5.

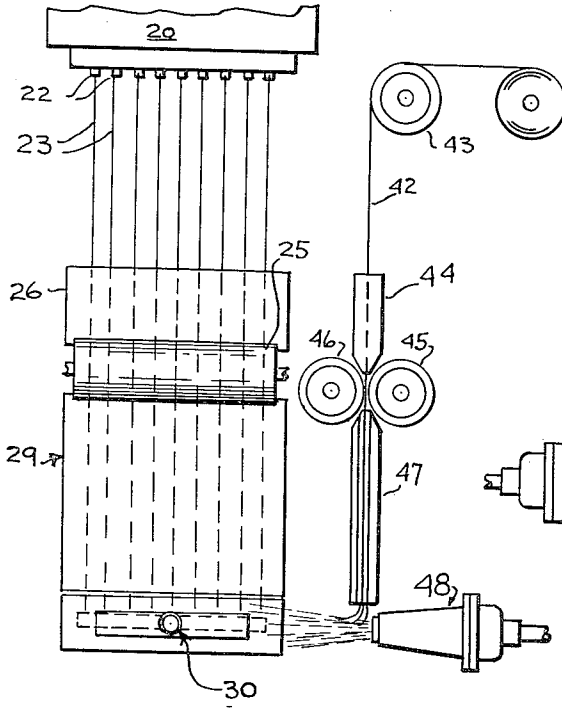
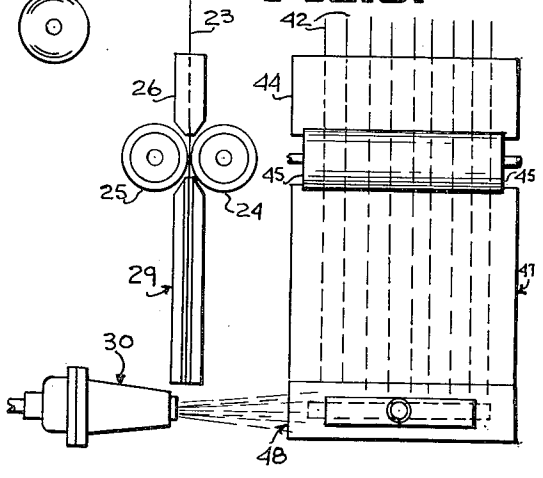


FIG. 6.



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PRODUCTION OF FIBERS IN INTIMATE ASSOCIATION WITH METAL

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FIG. 7

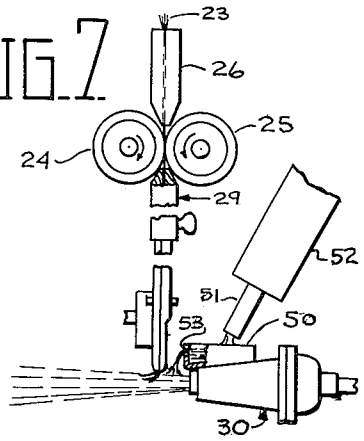


FIG. 9

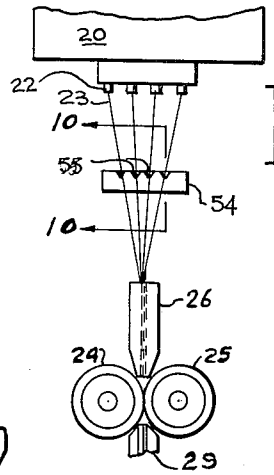


FIG. 12

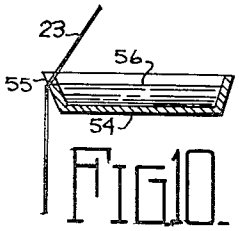
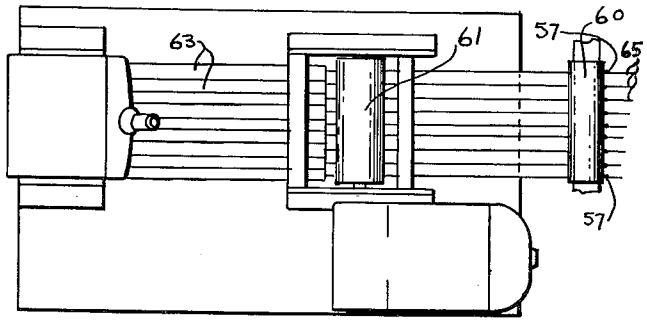


FIG 10



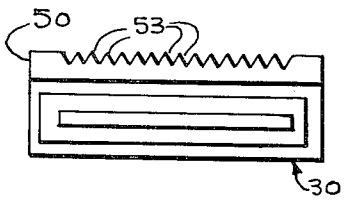


FIG. 8.

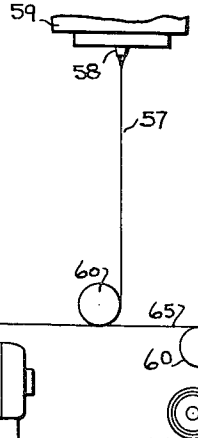


FIG 11

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PRODUCTION OF FIBERS IN INTIMATE ASSOCIATION WITH METAL

Filed Dec. 28, 1956

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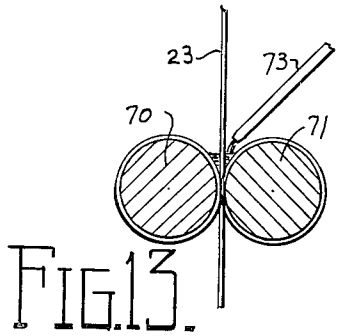


FIG. 13.

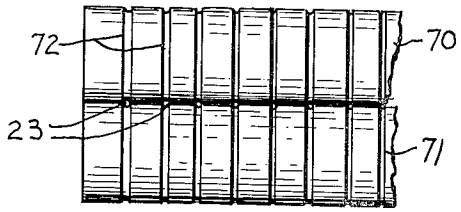


FIG. 14

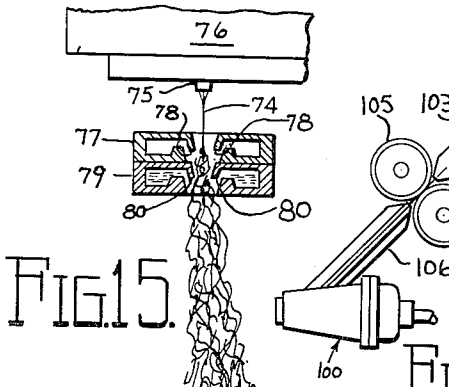


FIG. 15.

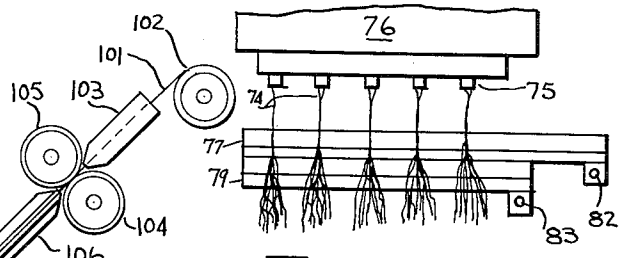


FIG. 16.

FIG. 20.

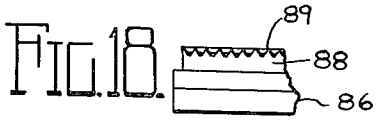


FIG. 18.

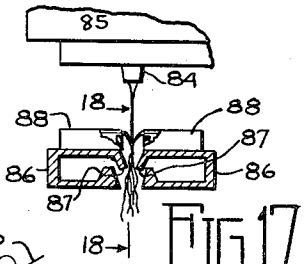


FIG. 17.

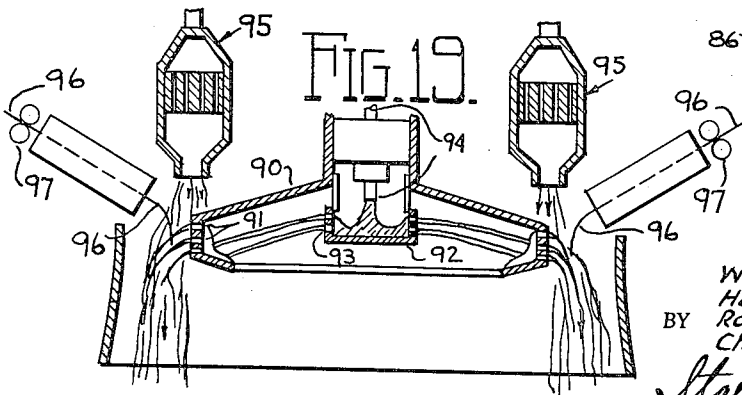


FIG. 19.

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United States Patent Office 3,021,564 Patented Feb. 20, 1962

3,021,564

PRODUCTION OF FIBERS IN INTIMATE ASSOCIATION WITH METAL

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Filed Dec. 28, 1956, Ser. No. 631,340
5 Claims. (Cl. 18—47.3)

This invention relates to the production of fibers in intimate association with metal, and, more particularly, to the production of fibers of glass or other fusible, fiberizable material, in intimate association with metal, whether the metal is in the form of a coating on the fibers, or of globules of metal, either separate from the fibers, or at least partially adhered thereto.

The desirability of reinforcing certain metal articles with fibers of glass or other similar material has been recognized for some time. The reasons for the desirability of such reinforcement are based upon the high strengths of such fibers, and upon their retention of relatively high strengths at temperatures substantially above room temperature. As specific examples of instances where such reinforcement would be desirable, mention can be made of aluminum and other light metal parts, and lead and other corrosion resistant articles, where the high tensile strength of fibrous glass reinforcement could be of great benefit. Aluminum, for example, has an ultimate tensile strength of about 12,000 pounds per square inch, and some aluminum alloys have ultimate tensile strengths as high as about 35,000 pounds per square inch. Reinforcement of aluminum or aluminum alloys with fibrous glass having a tensile strength of 200,000 pounds per square inch should obviously be capable of increasing substantially the strength at room temperature of any part fabricated from the reinforced metal or alloy. Chemical lead has an ultimate tensile strength of about 2000 pounds per square inch, and a yield point that may be as low as about 1000 pounds per square inch, so that, when used in the lining of chemical storage tanks, its own weight may often subject the lead to a stress above its yield point, with the result that the lining "creeps," or gradually changes its shape. Reinforcement of chemical lead with fibrous glass should readily enable the production of a chemically resistant material which will support its own weight, and, also, substantial additional weight, without creep.

Aluminum and aluminum alloys melt at comparatively low temperatures, and have substantially reduced tensile strengths and yield points even at temperatures well below their melting points. In certain jet aircraft applications these characteristics have necessitated the substitution of titanium and titanium alloys for aluminum, even though the density of titanium is more than one and a half times the density of aluminum. Glass fibers should be capable of reinforcing aluminum or aluminum alloys sufficiently for satisfactory use at the temperatures involved.

Numerous difficulties have been encountered, however, in practical attempts to reinforce metals with fibers of glass or other similar material. It has been found that glass surfaces tend to deteriorate after even a relatively short time of contact with ordinary atmospheric air. It is believed that such deterioration involves the adsorption of a layer of air several molecules thick around the glass fibers, and attack on the glass, at the surface, by alkali leached from the fibers and dissolved in the moisture present in such adsorbed layer. It has been suggested that this difficulty can be overcome by applying an inorganic material, in the form of a coating, to "nascent" glass fiber surfaces, by which term is meant surfaces

that have not yet been attacked in the manner explained above. The suggestions that have heretofore been made, however, do not include an economical way for applying such coatings, whether of metal or other inorganic material, on a commercial scale.

It has also been found that, regardless of surface condition of the glass, it is often extremely difficult, if not impossible, to achieve good adhesion between fine glass fibers and metal. For example, fabric made of small glass fibers has been immersed in molten aluminum; upon removal therefrom a coating of aluminum has been found on the surfaces of the fabric, but after the aluminum has solidified and cooled it has been found that the adhesion between the fibers and the aluminum is so poor that the aluminum film can be pulled manually from the cloth. This phenomenon has been observed regardless of the precautions taken to prevent deterioration of the surfaces of the fibers, and is believed to indicate clearly that preservation of what has been denominated a "nascent" surface is, at least, less than the whole solution to the problem of producing metal articles reinforced with fibers of glass or other similar material.

It has also been found that molten aluminum adheres to and readily coats glass fibers having diameters of about six mils, for example when such fibers are immersed in the molten aluminum. However, it is extremely difficult to immerse fibers of small diameter in molten aluminum to provide an aluminum coating thereon.

The present invention is based upon the discovery that articles of manufacture useful for the production of glass fiber reinforced metal masses can be produced by intermingling molten metal with streams of glass, while the glass streams are being attenuated to produce fibers. The resulting articles of manufacture can be described broadly as masses of fibrous glass intimately associated with metal, and may comprise metal-coated fibers, partially metal-coated fibers, or masses of fibers and intimately associated masses of metal, with the metal usually at least partially adhered to some parts of a fiber or to some parts of several fibers.

It is, therefore, an object of the invention to provide an improved method for producing masses of glass or other fibers intimately associated with metal.

Other objects and advantages will be apparent from the description which follows, reference being had to the accompanying drawings, in which—

FIG. 1 is a partially schematic, fragmentary view in elevation showing one form of apparatus adapted for producing glass or other fibers in intimate association with metal.

FIG. 2 is a sectional view along the line 2—2 of FIG. 1 showing details of a guide member constituting a part of the apparatus.

FIG. 3 is a horizontal sectional view similar to FIG. 2 showing a modified type of guide member.

FIG. 4 is a fragmentary view in elevation showing, partially schematically, modified apparatus similar to that of FIG. 1 for producing fibers and metal, in intimate association.

FIG. 5 is a view in elevation similar to FIG. 4, but showing a modified form of apparatus for introducing molten metal into intimate association with attenuating streams of glass.

FIG. 6 is a view in side elevation of the apparatus of FIG. 5.

FIG. 7 is a view in elevation showing still further modified apparatus for intermingling molten metal with attenuating streams of glass.

FIG. 8 is a side view of a burner and metal supply pot constituting a part of the apparatus of FIG. 7.

FIG. 9 is a fragmentary view in elevation showing apparatus for producing a metal coated primary filament from which glass fibers intimately associated with metal can be produced.

FIG. 10 is a view in section along the line 10—10 of FIG. 9 showing details of a metal applicator which constitutes a part of the apparatus of FIG. 9.

FIG. 11 is a partially schematic, fragmentary view of another form of apparatus for producing glass fibers intimately associated with metal.

FIG. 12 is an enlarged plan view of a portion of the apparatus of FIG. 11.

FIG. 13 is a fragmentary view in elevation of modified apparatus for producing metal coated primary glass fibers.

FIG. 14 is a plan view of a part of the apparatus of FIG. 13.

FIG. 15 is a view in elevation showing apparatus for attenuating streams of molten glass by means of a blast of steam or other gas, and for introducing molten metal in intimate association with the attenuating streams of glass.

FIG. 16 is a side view of a part of the apparatus of FIG. 15, showing details of the construction thereof.

FIG. 17 is a view in elevation showing apparatus similar to that of FIG. 15, but modified with respect to the means for introducing molten metal.

FIG. 18 is a side view taken generally from the position indicated by the line 18—18 of FIG. 17, showing further details of the apparatus.

FIG. 19 is a sectional view showing apparatus for producing fibrous glass or other material by what has been denominated a "rotary" technique, and for introducing molten metal into a burner blast used to attenuate the fibers.

FIG. 20 is a view in elevation showing a metalizing burner which can advantageously be employed in practicing the invention.

Referring now in more detail to the drawings, a glass melting tank is indicated generally at 20 in FIG. 1 and is shown having bushing tips 22 through which relatively large diameter streams 23 of molten glass of a desired composition flow. The streams 23 are attenuated into glass filaments by cooperating rolls 24 and 25, which are driven in any suitable manner, and are positioned below an upper guide 26. Lengths of wire 27, of aluminum, lead, bismuth, zinc, or other suitable metal or alloy are unrolled from coils 28 and passed between the cooperating rolls 24 and 25 in spaced relationship with the glass. Disposed below the rolls 24 and 25 is a lower guide plate indicated generally at 29, which is supported in any suitable manner, and is represented as being of the type shown in FIG. 1 of U.S. Patent 2,763,100. As can be seen in FIG. 2, the lower guide plate 29 is composed of two mating halves which are shaped to form a plurality of slots 30' in which the glass fibers 23 and wires 27 are received. Glass fibers and wires pass downwardly in alternate slots. The upper guide 26 is similar to the lower guide plate 29. Disposed below the guide plate 29 is a burner indicated generally at 30, so positioned that flame and combustion products discharged therefrom play upon fibers 23 and wires 27 just below the guide plate 29. The burner 30 is of the type which establishes a high velocity blast of combustion products, and can be, for example, of the kind disclosed in detail in Slayter et al. Patent 2,489,242 or in Stalego Patent 2,489,243. The high velocity blast of flame and combustion products melts the metal of the wires 27. The molten metal then flows around the glass fibers or primaries 23, to provide thereon a metal or metal oxide coating. The burner blast also reheats the glass fibers 23 to a temperature above their softening temperature and projects them to the left in FIG. 1 against a foraminous conveyor which is schematically represented and generally designated 31. The blast of flame and combustion products also projects, with the fibers, any excess of metal, above the amount which forms the indicated coating, onto the conveyor 31 in intimate association with the coated fibers of glass. A mass 32 of glass fibers intimately associated with metal is collected on the conveyor 31 and cooled and packaged or otherwise used in any suitable manner.

A modified guide plate which can be substituted for the plate 29 is indicated generally at 33 in FIG. 3. The plate 33 is composed of two mating halves which are so shaped as to form a plurality of separate elongated pockets 34 in each of which both a length of metal wire 27 and a glass fiber 23 are received. The fibers and wires are delivered into the blast from the burner, as described.

Referring now to FIG. 4, the apparatus fragmentarily shown is similar to that of FIG. 1. Primary strands 23 of glass or other similar material are attenuated by cooperating pulling wheels 24 and 25, are passed downwardly through slots in the lower guide plate 29, and are discharged into the blast from the burner 30, in the manner described. The wires 27, however, are not introduced between the cooperating pulling wheels 24 and 25, so that either more strands 23 can be accommodated by the guide plate 29, or part of the slots can be left vacant. Wires 35 of aluminum, lead, bismuth, zinc, or other metal or alloy are passed from a spool 36 over a guide wheel 37 through an upper guide 38, between pulling wheels 39 and 40, through a lower plate 41 and into the blast from the burner 30, generally in the manner previously described. The wires 35 are melted by the burner blast, and an intimate association of molten metal and the attenuating glass fibers is formed. Fluid beads of the metal are projected against the glass filaments to provide a metal or metal oxide coating thereon. Any excess of metal, intimately associated with the coated fibers, is collected on a suitable conveyor, for example of the type shown in FIG. 1.

The apparatus shown in FIGS. 5 and 6 is similar to that of FIG. 4 except that each of a plurality of wires 42 is passed over a guide roll 43, through an upper guide 44, between a pair of cooperating feed rolls 45 and 46, downwardly through a lower guide plate 47, and into the blast of a burner indicated generally at 48, which is similar to the burners 30. The wires 42 are melted by the blast from the burner 48, and molten metal therefrom is projected by the blast into a blast from the burner 30 in which attenuating fibers are being introduced in the manner previously described. As a consequence, the attenuating fibers coated with a metal or a metal oxide, and the coated fibers are formed into an intimate admixture with molten metal. Such admixture can be collected on a conveyor, as described.

In the apparatus shown in FIGS. 7 and 8, a blast of combustion products from a burner 30 containing attenuating fibers of glass or other similar material is produced in the manner described previously, and molten metal is introduced into such blast from a pot 50 which is welded or otherwise attached to the top of the burner 30. A desired level of molten metal is maintained in the pot 50 by introduction thereof from a pipe 51 which is suitably insulated as indicated at 52, and may be steam jacketed, or electrically heated, if desired, to maintain the metal in a molten condition. As will be apparent from FIG. 8, the upper forward edge of the pot 50 has a plurality of teeth or serrations 53 between which the molten metal flows in discrete streams for introduction into the blast from the burner 30. The pot 50 could also be supported at a level substantially above the top of the burner 30. This would, in fact, be advantageous since streams of molten metal would then penetrate the burner blast further and the metal would be more thoroughly atomized and more uniformly distributed in the blast.

The apparatus shown in FIGS. 9 and 10 is similar to that of FIG. 1 in that relatively large diameter streams

of glass 23 are flowed through bushing tips 22 from a glass tank 20, are passed through an upper guide 26, and attenuated by cooperating pulling wheels 24 and 25 and passed through the lower guide plate 29 and into the blast from a suitable burner (not illustrated). The primary fibers 23 are coated with molten metal by means of a metal pot 54 having a plurality of teeth or serrations 55 along the upper edge of its forward face (FIG. 9) with corresponding pockets at the bottoms of the teeth or serrations through which the primary strands 23 pass. A desired level of molten metal 56 is maintained in the pot 54 in any suitable manner (not illustrated) to cause the metal to flow onto the primary strands or fibers as they pass through the pockets between the teeth 55. This apparatus then introduces into the high velocity blast from the burner a metal coated primary glass fiber which is heated and attenuated by the blast. As shown in FIG. 10, the metal pot 54 can be mounted in such a position relative to the bushing tips 22 that the primary filaments 23 are drawn against the pot, and pass with a wiping action through the stream of molten metal flowing through the depressions between the teeth 55.

Referring now to FIGS. 11 and 12, relatively large diameter streams 57 of glass flow downwardly from bushing tips 58 at the bottom of a glass melting tank 59. The solidified glass streams are passed around a guide 60 and between cooperating pulling wheels 61 and 62. The primary glass fibers so formed are fed through a plurality of spaced guide tubes 63 and into a high velocity blast from a pair of burners 64 which can be, for example, of the type described in detail in Slayter et al. Patent 2,489,242. Lengths of wire 65 are also fed from reels 66, and passed over a guide 67, between the pulling wheels 61 and 62, and through guide tubes 63 into the blast from the burners 64. The high velocity blast from the burners 64 softens and attenuates the primary glass fibers 57 and melts the wires 65, thus forming attenuating glass fibers in intimate association with molten metal. The fibers, after attenuation, and with them the associated metal, can be collected in any suitable manner, for example on a conveyor of the type shown in FIG. 1.

Apparatus shown in FIGS. 13 and 14 may be considered to be a modification of the apparatus of FIGS. 9 and 10. Relatively large diameter streams 23 of molten glass pass downwardly from bushings in the manner described, and pass between cooperating attenuating rolls 70 and 71 which also serve as metal applicators. As can be seen in FIG. 14, a series of grooves 72 cut in the faces of the rolls 70 and 71 produce slots therebetween through which the fibers 23 pass. Molten metal is flowed from a suitable pipe 73 onto the top of one of the attenuating applicator rolls at a rate sufficient to form a pool thereof in the nip between the rolls. The molten metal tends to flow downwardly through the slots with the fibers 23, and is squeezed against the fibers by the rolls to provide a metal coating thereon. The coated fibers then pass downwardly from the discharge side of the rolls 70 and 71, through a guide, and into an appropriate burner blast, as described, to produce attenuating glass fibers in intimate association with molten metal.

As shown in FIGS. 15 and 16, molten metal can also be admixed with glass fibers which are being attenuated by the force of a high velocity stream of steam or other gas. Streams 74 of molten glass are flowed through bushing tips 75 disposed in the bottom of a glass melting tank 76, and between blowers 77 which can be of the type shown in Slayter et al. Patent 2,206,058. Blasts of steam or other gas are directed downwardly from surfaces 78 of the blowers 77 to attenuate the glass streams 74. Metal applicators 79 are disposed below the blower 77. The metal applicators 79 are similar to the blowers 77, except that molten metal rather than steam or other gas is introduced thereinto, and discharged through openings in surfaces 80 for intimate association with the attenuating fibers. The fibers and metal are collected on a suitable conveyor indicated generally at 81, and further processed in any desired manner or packaged. As can be seen in FIG. 16, the blowers 77 have an inlet 82 for steam or other gas, and the metal applicators 79 have an inlet 83 for molten metal.

Apparatus is shown in FIGS. 17 and 18 for producing, in a manner similar to that used in the apparatus of FIGS. 15 and 16, glass fibers in intimate association with metal. Primary streams of glass are flowed through bushings 84 in the bottom of a glass tank 85, and between two blowers 86 from which a blast of steam or other gas is discharged downwardly from surfaces 87 to attenuate the glass streams. A metal pot 88 is disposed on each of the blowers 86, and a suitable level of liquid metal is maintained in each of the pots 88 in any suitable manner (not illustrated). As can be seen in FIG. 18, the forward edge of each of the metal pots 88 is provided with a series of teeth or serrations 89, with corresponding grooves or channels therebetween, through which the molten metal flows in more or less discrete streams into the high velocity blast from the blowers 86 in intimate association with attenuating fibers. The resulting composite glass fiber and metal product can be collected in any suitable manner.

Apparatus shown in FIG 19 for producing a composite glass and metal article comprises a centrifuge 90 having a plurality of radially disposed openings 91, and with a basket member 92 welded or otherwise attached to the interior thereof. The basket 92 has radial openings 93 extending through generally cylindrical side walls thereof. A stream 94 of glass from a suitable melting tank is introduced into the basket 92 while the centrifuge and basket are being rotated at a relatively high velocity, for example of the order of about 3000 revolutions per minute, so that the glass is thrown centrifugally from the basket 92 through the openings 93 and to the extremity of the centrifuge 90 where it passes through the openings 91. Burners indicated generally at 95, which can be, for example, of the type shown in Stalego Patent 2,489,243, are positioned to direct a high velocity blast of flame and combustion products against the outer extremity of the centrifuge 90, and also to establish a downwardly directed attenuating blast which is generally annular in configuration and disposed generally outwardly from the extremity of the centrifuge 90. Metal wires 96 are fed by cooperating feed rolls 97 and 98 through guides 99 and into the annular blast from the burners 95, where the metal is melted and projected downwardly in intimate association with the attenuating fibers. The resulting composite metal and glass product can be collected in any suitable manner, for example on a conveyor of the type represented in FIG. 15, and packaged or further processed in any desired manner.

It will be appreciated that various changes and modifications can be made from the specific details shown in the attached drawings and discussed herein, within the scope of the invention, and within the spirit and scope of the attached claims. For example, a roll of relatively narrow metal foil could be substituted for each of the coils 28 of wire shown in FIG. 1, and such narrow strip or sheet of foil could be fed into the upper guide 26, between the cooperating rolls 24 and 25, through the lower guide 29, and into the burner blast. In accordance with this method, each narrow sheet or strip of metal foil would preferably be wrapped around one of the glass primaries, so that the product discharged from the lower end of the guide plate 29 would be similar to a coated primary discharged from the lower extremity of the guide plate in the FIGS. 9 and 10 apparatus, except that the foil sheet would probably not be tightly adhered to the glass primary. A single sheet of metal foil can also be employed in place of the wires 27 in the FIG. 1 apparatus. In such instance, the sheet should have substantially the width of the guides 26 and 29, and could merely be fed therethrough positioned between the glass fibers or primaries and one of the guide halves. It will be appreci-

ated that, when the invention is practiced in such way, at least the guide surface which contacts the metal foil is preferably generally flat. A second sheet of metal foil can also be provided between the glass primaries and the other of the guide halves. The thickness of the metal foil sheets can be varied within relatively broad limits, and the numbers of glass primaries drawn from the melting tank can also be varied, to change within relatively broad limits the ratio of glass to metal delivered into the hot blast of flame and combustion products from the burner 30. Also, if desired, appropriate pockets can be provided in the sheet metal foil before they are delivered to the guides and feed rolls, and the glass primaries can be positioned in these pockets.

Either one or two sheets of metal foil could also be fed, if desired, into the apparatus shown in FIGS. 13 and 14, each sheet being fed between the glass primaries 23 and one of the rolls 70 or 71. A metal could also be added through the inlet 73, if desired and could be the same metal as that from which the foil is produced, or could be a different metal.

Similarly, the ratio of metal to glass in the various other methods in accordance with the invention which have been described herein, with reference to the attached drawings, can be varied within relatively broad limits. For example, in the apparatus of FIGS. 1, 4, 5 and 6, 11 and 12, and 19 the rates at which metal and glass are fed into the high velocity blast of flame and combustion products can be varied independently. The diameters of the glass fibers and of the wires employed can be the same or different, and either more or fewer wires than glass primaries can be employed.

Reference has previously been made to the use of aluminum, lead, bismuth, zinc and other suitable metals or alloys in practicing the method of the invention. When it is desired to use lead, it is ordinarily preferred to employ an alloy of lead with zinc or cadmium, or with zinc and cadmium. In addition, metals such as iron, copper, Monel, nickel and other high melting metals and alloys can be intimately associated with glass fibers or filaments by the method of the invention. By previously known methods for coating glass fibers or filaments with metal it has been extremely difficult if not impossible to apply such higher melting metals.

A particularly advantageous way for intimately associating molten metal with attenuating fibers involves the use of apparatus such as that shown in FIG. 20. The apparatus of FIG. 20 comprises a burner 100 which is generally similar to the previously described burner 30 (FIG. 1). A series of openings is provided in the upper surface of the burner 100, and wires 101 are passed from spools 102 through an upper guide 103, cooperating pulling rolls 104 and 105, and a lower guide 106, and through the openings into the interior of the burner 100. The wires 101 are delivered in this manner to the interior of the high velocity blast of flame and combustion products emerging from the burner 100, where the heat melts the wire and forms it into discrete globules of molten metal which are projected with the blast. Such a burner can advantageously be employed in producing fibrous glass intimately associated with metal in the apparatus of FIGS. 1–12 and 19. If desired, such a burner can supply all of the metal that is associated with the fibers, or additional metal can be supplied in any of the ways previously discussed. An advantage of using the burner 100 to supply molten metal resides in the position of the metal relative to the flame. The wires 101 are delivered to the interior of the flame, with the result that they avoid the highly oxidizing flame boundaries, and oxidation of the metal is minimized, which may be advantageous in some instances.

The apparatus of FIG. 19 can also be modified in various other ways. For example, streams of molten metal can be introduced into the blast from the burners 95, or a stream of molten metal can be passed through a central opening provided in the basket 92, so that the molten metal is thrown centrifugally into the blast from the burners 95 in intimate association with the fibers of glass therein. If it is desired to introduce a stream of molten metal into the burner blast, such stream can merely be directed against an appropriate baffle plate which will throw particles of molten metal into the blast, or the force of a hyraulic head of molten metal can be used to force a stream thereof through an orifice appropriately positioned closely adjacent the stream, or a suitable restricting member can be provided to give, from the blast, a Venturi effect to draw molten metal from a body thereof maintained adjacent the restricted passage.

It is an important feature of the instant invention that an economic method is provided for intimately associating molten metal with attenuating fibers of glass or other similar material. The finished product which results may be a wool-like insulating material where the solidified metal bonds the various fibers together into a composite mass, or may be a mass of fibers coated with metal, which can be formed into a glass-reinforced metal article by application of heat and pressure, by centrifugal casting techniques, or in other ways.

Glass fibers intimately associated with metal can also be produced in accordance with the invention by using jets of molten metal to attenuate streams of molten glass as they emerge from a bushing tip. Such method is disclosed in detail in Robert G. Russell application Serial No. 506,816, filed May 9, 1955, now Patent No. 2,919,970. Also, fibers intimately associated with metal can be produced by heating to a temperature above its softening point an exposed surface of a mass which is composed of a fusible fiberizable material and a metal while the mass is being rotated at a velocity sufficiently high that the softened material is thrown off centrifugally in fiber-forming streams. Such method is disclosed in detail in Charles J. Stalego application Serial No. 606,762, filed August 28, 1956, now Patent No. 2,987,773.

What we claim is:

1. In producing filaments of a fusible, fiberizable, material by a method which includes the steps of flowing molten streams of the fusible material from a mass thereof to form primary filaments, introducing the primary filaments so produced into a high velocity blast of combustion products discharged from a burner, projecting and attenuating the primary filaments by the combustion products blast, and collecting the attenuated filaments, the improvement which comprises: concurrently with the introduction of the primary filaments, introducing separately therefrom into the combustion products blast a metal which is in solid form and is inert with respect to said blast, said metal being melted, disintegrated and projected by the blast; and collecting the attenuated filaments intimately associated with the projected metal.

2. In producing filaments of a fusible, fiberizable, material by a method which includes the steps of flowing primary streams of the fusible material from a mass thereof, extending the primary streams longitudinally and effecting attenuation into filaments, introducing the filaments so produced into a high velocity blast of combustion products discharged from a burner, projecting the filaments by the blast, and collecting the projected filaments, the improvement which comprises: introducing the primary streams of the softened fusible material into the combustion products blast and, concurrently with the introduction of the softened streams, introducing separately therefrom into the blast a metal which is in solid form and is inert with respect to said blast, said metal being melted, disintegrated and projected by the blast; and collecting the attenuated filaments intimately associated with the projected metal.

3. In producing filaments of a fusible, fiberizable, material by a method which includes the steps of flowing molten streams of the fusible material from a mass thereof to

form primary filaments, introducing the primary filaments so produced into a high velocity blast of combustion products discharged from a burner, projecting and attenuating the primary filaments by the combustion products blast, and collecting the attenuated filaments, the improvement which comprises: concurrently with the introduction of the primary filaments, introducing separately therefrom into the combustion products blast a liquid metal which is inert with respect to said blast, said metal being disintegrated and projected by the blast; and collecting the attenuated filaments intimately associated with the projected metal.

4. In producing filaments of a fusible, fiberizable, material by a method which includes the steps of flowing primary streams of the fusible material from a mass thereof, extending the primary streams longitudinally and effecting attenuation into filaments, introducing the filaments so produced into a high velocity blast of combustion products discharged from a burner, projecting the filaments by the blast, and collecting the projected filaments, the improvement which comprises: introducing the primary streams of the softened fusible material into the combustion products blast and, concurrently with the introduction of the softened streams, introducing separately therefrom into the blast a liquid metal which is inert with respect to said blast, said metal being disintegrated and projected by the blast; and collecting the attenuated filaments intimately associated with the projected metal.

5. In producing filaments of a fusible, fiberizable, material by a method which includes the steps of flowing primary streams of the fusible material from a mass thereof, extending the primary streams longitudinally and effecting attenuation into filaments, introducing the filaments so produced into a high velocity, high temperature blast of a compressible fluid which is inert with respect to the filaments, projecting the filaments by the blast, and collecting the projected filaments, the improvement which comprises: introducing the primary streams of the softened fusible material into the blast and, concurrently with the introduction of the softened streams, introducing separately therefrom into the blast a liquid metal which is inert with respect to said blast, said metal being disintegrated and projected by the blast; and collecting the attenuated filaments intimately associated with the projected metal.

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