Jan. 7, 1941. J. W. GREENLEAF 2,227,931

MAGNET WIRE

Filed Sept. 10, 1938

Fig. 1.

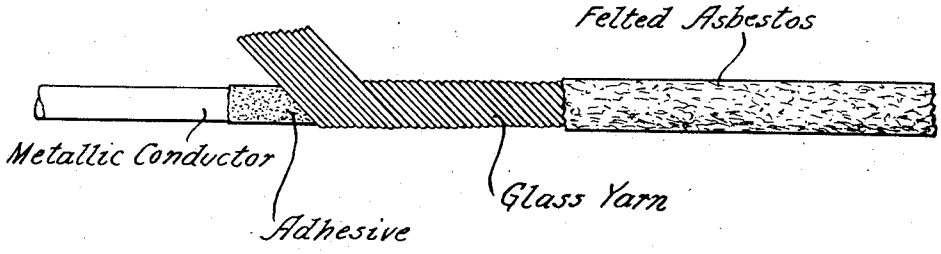
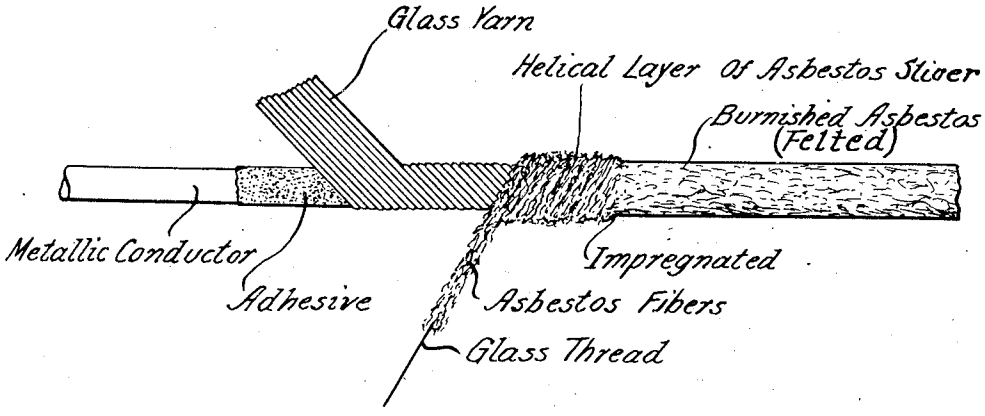


Fig. 2.



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UNITED STATES PATENT OFFICE

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MAGNET WIRE

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Application September 10, 1938, Serial No. 229,337

2 Claims. (Cl. 174—122)

This invention relates to magnet wire. The invention aims to provide a magnet wire surrounded with an insulating layer of glass yarn (grouped filaments or fibers of spun glass) and a contacting layer of felted asbestos. The asbestos layer is in such intimate contact with the yarn that it serves as a supporting or reenforcing medium, enabling the conductor to be bent and subjected to abrasive or disruptive forces without appreciable injury to the yarn, even after the conductor had been heated to relatively high temperatures. The insulation of the invention may be applied to conductors of various diameters, either single or multiple, but is particularly advantageous for forming magnet wire because of its relative thinness and its ability to resist high temperatures, abrasion and bending.

Glass yarn has been used heretofore as an insulating medium for wire. Glass yarn is relatively brittle, and will not withstand compression, sharp bending, abrasion or other disruptive forces. While it is a very good insulating medium, it has not been advantageously or satisfactorily used in insulating conductors of the aforementioned character because of these objectionable physical properties. In the conductors produced, heretofore, the physical weaknesses of the yarn have been overcome, to some extent, by saturating and coating the layer or wrapping of glass yarn with an insulating varnish (generally of an organic base) or with synthetic compounds of resinous nature which are later heat cured, if necessary, to produce a fairly tough outer surface and to bind the fibers together. These covering or impregnating materials enable the wire to be bent and subjected to abrasion only so long as they remain on the yarn and unimpaired. Conductors used for magnet wire, motor and coil windings, etc., frequently are subjected to such high temperatures that the varnishes or resins are destroyed, thus leaving the yarn unprotected. The impregnation or saturation of the yarn with such materials reduces the allowable operating temperatures of the conductor, since the upper limit must be that of the material rather than the glass. Glass yarn is especially desirable because of the high temperatures it withstands, but the use of coating or impregnating materials which decompose below the useful high operating temperature of glass nullifies the main reason for using glass yarn.

The insulation of conductors requiring thin walls of insulation (such as magnet wire) with asbestos alone has been practiced in the art for some years, and while the wire so produced has given a reasonably satisfactory performance, there have been weaknesses due to lack of uniformity in dielectric strength, wall thickness, and homogeneity which are now overcome in the wire of my invention. Asbestos, being a product of nature, varies in some of its characteristics and often contains inclusions of conducting materials such as iron oxide which are very difficult to detect and remove. Glass, on the other hand, being a synthetic material, is subject to more exact control insofar as these properties are concerned and were it not for the inherent weaknesses previously outlined it would provide an ideal insulation for electrical conductors requiring thin walls of insulation capable of operating under conditions of high temperature.

This invention is based upon my discovery that the mechanical or physical weakness of glass yarn can be remedied, and its dielectric properties augmented, as an insulating medium for conductors which may be heated to relatively high temperature ranges and also subjected to bending, and abrasive forces. The magnet wire of the invention, based upon the foregoing discovery, comprises a metallic conductor covered with a surrounding layer of glass yarn and a layer of interlocked felted asbestos fibers over the glass yarn and in intimate contact therewith. The asbestos may be in a very thin layer and is preferably applied in the form of sliver having a reenforcing glass thread wound over the glass yarn so as to present a continuous and homogeneous structure. A sliver is understood to be a relatively loose mass of fibers intermingled and indiscriminately arranged. It is the same as an untwisted roving, but is not the same as twisted roving resembling yarn. It is further understood that a sliver having a very slight twist which does not fundamentally change the fluffy character of the fibers thereof is not a twisted roving or yarn. A twisted roving or yarn in which the fibers are bound together and given a direction of lay due to the twisting is not a sliver as the term is used herein.

In the accompanying drawing:

Fig. 1 illustrates a magnet wire embodying the novel features of the invention; and

Fig. 2 is a diagrammatic illustration of various stages in the formation of the magnet wire of the invention.

As illustrated in the drawing, the magnet wire comprises a metallic conductor or wire sur-

rounded with a continuous layer of glass yarn. The glass yarn is preferably in the form of grouped continuous filaments and is preferably helically wound around the conductor to form a layer of sufficient thickness to give the required dielectric effect. The layer of glass yarn may comprise one or more independent wrappings of glass yarn. For certain purposes, it has been found advantageous to coat the conductor with a suitable adhesive material before applying the glass yarn. The adhesive serves to secure the yarn filaments to the conductor and facilitate the subsequent application of the asbestos. The felted asbestos layer is applied over the layer of glass yarn and in direct or intimate contact therewith. It is preferably applied so as to provide a continuous, homogeneous and relatively thin layer of interlocked fibers reenforced with a glass thread helically wound over the conductor and embedded in the layer of asbestos. After the asbestos is applied it may be impregnated with an insulating compound and burnished to a smooth uniform finish.

In manufacturing the magnet wire of the invention, a metallic conductor comprising single, or multiple strands of wire is preferably first covered with a thin coating of a suitable adhesive, for example, a solution of resin such as cumar resin dissolved in naphtha. Other materials found suitable for this purpose include gums dissolved in suitable solvents. A continuous layer of glass yarn is then applied over the conductor, or over the adhesive, as the case may be. The yarn is preferably in the form of grouped glass filaments and is helically wound either single end or several ends parallel over the metal conductor by means now well known in the art. The layer of glass yarn is applied to the thickness necessary to give the required dielectric effect, and this may be accomplished by applying one or more separate wrappings of yarn. A layer of felted asbestos is then applied over the yarn. It is important that the asbestos layer comprise interlocking fibers and provide a continuous and homogeneous structure in order that the dielectric properties and heat resistance of the glass be augmented and a suitable support and protection for the glass filaments assured. The asbestos is preferably applied in the form of a sliver as best shown in Fig. 2. The sliver may be applied as a helical wrapping which is burnished to a smooth finish. It is desirable to impregnate the asbestos with an insulating compound such, for example, as insulating varnish, or a solution of resin to facilitate the burnishing and the formation of a uniform smooth finish. A solution of styrone (cinnamyl alcohol) is especially suitable for this purpose.

Asbestos slivers as heretofore used for insulating purposes contain a carrier thread of cotton. When such roving is heated even to temperatures as low as 300° F. the cotton loses its strength and the wall or layer of asbestos is weakened. I use an asbestos sliver having a carrier or reenforcing thread of glass, such as is described and claimed in my copending application, Serial Number 201,662, filed April 13, 1938. The sliver of my said application has relatively great strength, and will withstand heating to temperatures in the neighborhood of the melting point of the glass without losing its supporting strength.

The said sliver comprises a reenforcing glass thread and a surrounding fluffy mass of asbestos fibers condensed around the glass thread. While the fibers are sufficiently intertwined and condensed to form a self-adhering or self-supporting structure, permitting the sliver to withstand winding and ordinary handling, without the use of adhesive material to bind them to the glass thread, they are sufficiently fluffy that when the sliver is wrapped around a conductor, the adjacent convolutions may be pressed together into a continuous felted layer. The felted layer has the glass thread embedded therein, i. e., covered with interlocking fibers of asbestos. The glass thread of the sliver binds the asbestos to the underlying layer of glass reenforcing the layer of asbestos and increasing its ability to withstand disruptive forces.

The magnet wire of the invention has many advantages over magnet wire insulated entirely with glass yarn. The outer layer of interlocked felted asbestos fibers presents a more continuous and homogeneous surface which permits bending of the conductor without opening up or cracking (parting). The outer asbestos layer acts as a cushion, protecting the glass yarn from mechanical damage during coil winding and installation of the wire, and makes unnecessary the heavy varnish coating now used to protect the glass yarn. The asbestos outer layer permits higher allowable temperatures and protects and holds the glass in place even after the adhesive or impregnating materials have been dissipated. The asbestos outer layer will absorb more coil impregnating compound where this feature is desirable. The outer asbestos layer, being continuous, protects the bad spots that commonly occur where the glass yarn breaks, or runs out on the machine and a new package is started.

The magnet wire of the invention has advantages over magnet wire insulated entirely with asbestos. A layer of asbestos having the necessary dielectric effect would have to consist of very high grade material containing a minimum of conducting particles which would later have to be detected and removed by means now practiced in the art which greatly increases its cost. The invention permits the use of readily available asbestos which need not be subjected to expensive grading and treating for the removal of conducting materials because the glass layer next to the conductor provides the necessary dielectric strength and prevents any contact between the conducting particles in the asbestos and the conductor.

My copending application Serial No. 271,481, filed May 3, 1939, describes and claims an insulated electrical conductor having a layer of felted asbestos and a glass thread embedded in the asbestos.

I have explained my invention by illustrating and describing certain specific embodiments thereof, but it will be understood that the invention may be embodied in many other forms than that shown and described. I, accordingly, do not wish to be restricted to the particular forms and constructions disclosed herein by way of example for the purpose of setting forth my invention in accordance with the patent statutes. The terms of the appended claims are, therefore, not restricted to the precise structures disclosed but are intended to cover all changes and modifications within the spirit and scope of my invention.

I claim:

1. A magnet wire comprising a metallic conductor insulated with a surrounding layer of glass

yarn, and a relatively thin layer of felted asbestos over the glass yarn, said layer of asbestos being compacted and the fibers of asbestos intermingled, said layer of asbestos having been formed of a sliver of asbestos having a reenforcing core of glass thread free of adhesive, and the asbestos thereof being slidable on the reenforcing glass thread.

2. A magnet wire comprising a metallic conductor covered with a continuous layer of glass yarn, and a relatively thin continuous layer of felted asbestos over the glass layer, said layer of asbestos having been formed of an asbestos sliver having a reenforcing core of glass thread free of adhesive and upon which the asbestos is slidable, said layer of asbestos having relatively great strength due to the intermingling of the asbestos fibers and to the reenforcing glass thread, whereby the magnet wire may be sharply bent without parting the layer of asbestos.

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