J. A. HEANY.

METHOD OF INSULATING ELECTRICAL CONDUCTORS.

APPLICATION FILED FEB. 4, 1913.

1,071,676. **Patented Aug. 26, 1913.**

2 SHEETS—SHEET 1.

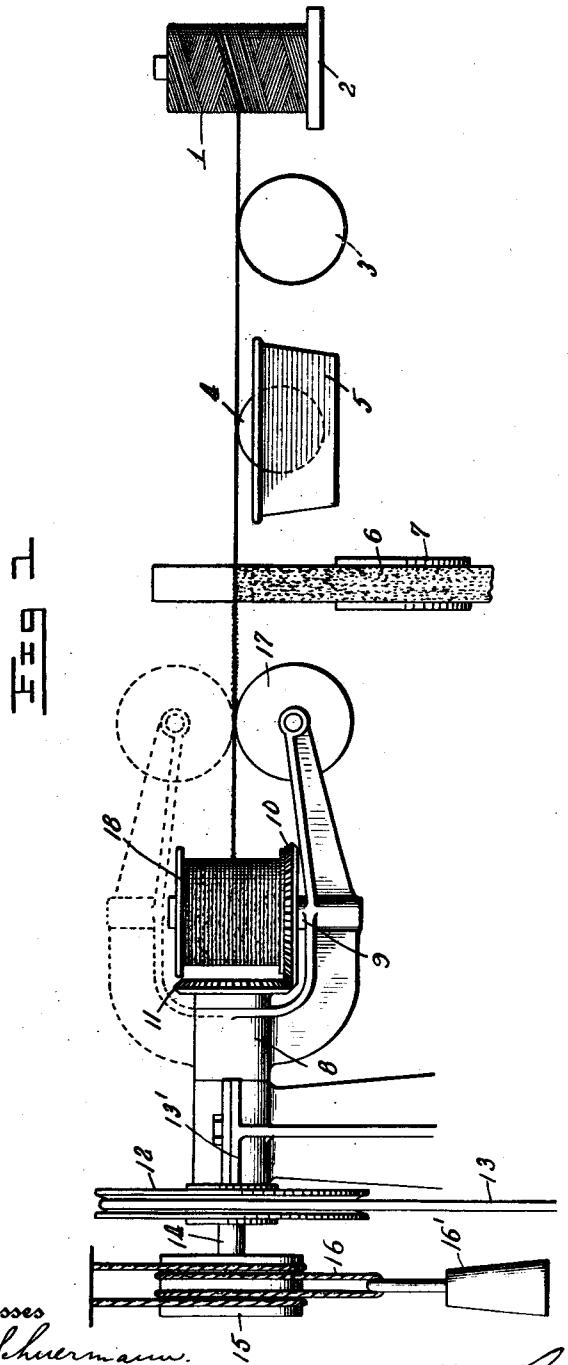


Fig. 1.

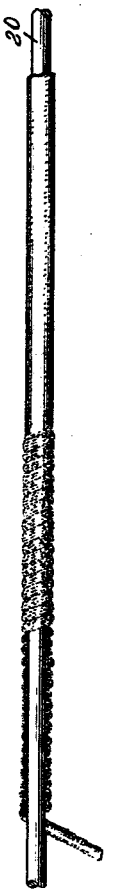


Fig. 2.

Witnesses

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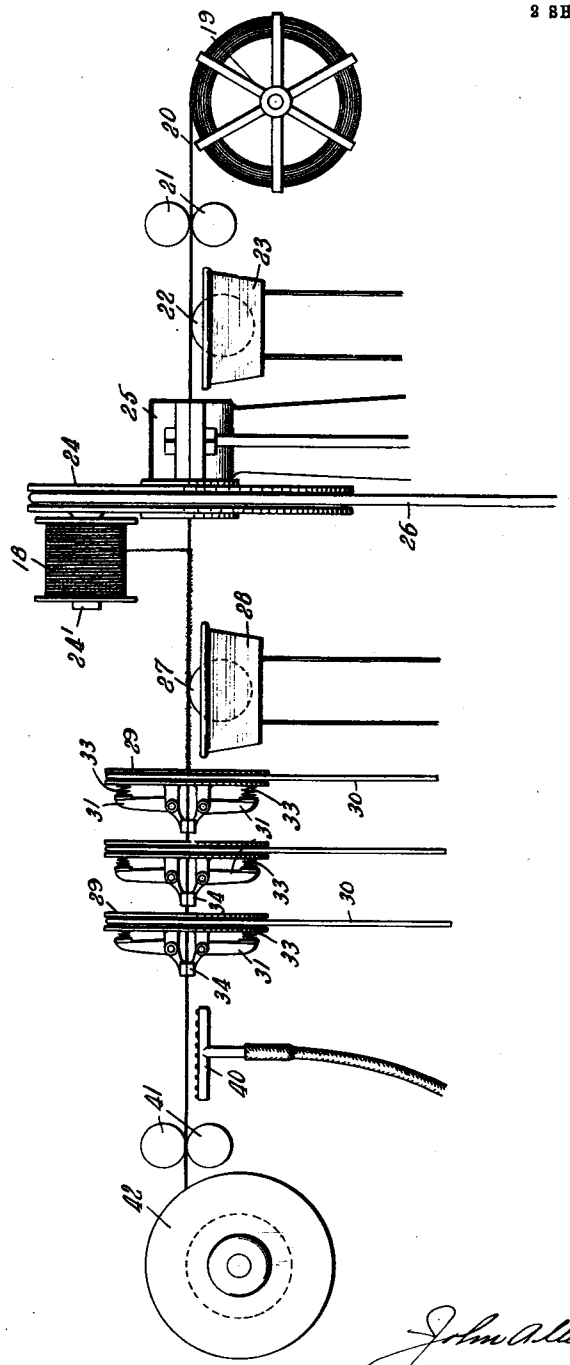


Fig 2

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UNITED STATES PATENT OFFICE.

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METHOD OF INSULATING ELECTRICAL CONDUCTORS.

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To all whom it may concern:

Be it known that I, JOHN ALLEN HEANY, a citizen of the United States, residing in the city of Washington, District of Columbia, have invented certain new and useful Improvements in Methods of Insulating Electrical Conductors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to a method of applying fibrous insulating material to conductors in the form of a smooth, uniform, homogeneous fire-proof or water-proof sheath of any desired degree of thickness, and is especially applicable for the insulation of conducting wires, ribbons and the like with asbestos or similar fibrous material in the form of relatively short fibers, ordinarily incapable of being spun into threads or yarns, so applied to the conductor as to provide a regular and uniform covering or sheath to produce a smooth surfaced insulated conductor of uniform diameter or thickness, possessing a substantially uniform insulating factor throughout.

It has been proposed heretofore to apply asbestos or similar material to electrical conductors, as an insulating medium, either in the form of spun threads or yarns made up of relatively long fibers, or, in the alternative, to apply such fibrous material directly to the wire by means of an adhesive, the fibers being distributed over the adhesive coated wire and then matted down as far as possible to produce an enveloping sheath. The first method involving the use of spun threads or yarns has not proved altogether satisfactory, because of the fact that short fibers cannot be employed for the purpose, which renders it necessary to use the relatively expensive long fibers, and furthermore, in the case of asbestos, it is practically impossible to produce a regular uniform thread or yarn even from the long fibers. Again, the use of relatively hard spun threads or yarns as an insulating covering has been found objectionable in that it is difficult to effect a homogeneous, uniform sheath or covering, inasmuch as the spaces or interstices between the successive convolutions of the thread or yarn are necessarily irregular and have to be filled with some character of cementitious material which therefore renders the insulating character of the sheath irregular. The second method referred to, namely coating the conductor with the fiber or flock applied directly to the wire through the agency of an adhesive is likewise objectionable, for the reason that it is impossible to produce a uniform coating, either as to thickness or insulating qualities.

The present invention is designed to overcome all of the objections and difficulties hereinbefore referred to, and at the same time to admit of the employment of the relatively cheap, short fibers of asbestos, cotton, jute, hemp, or other suitable fibrous material, to produce a highly efficient, uniform and homogeneous insulating sheath upon wires of even the smallest diameter, by first applying the fibrous material in the form of a matted or felted covering to a relatively small thread or filamentary body, and then applying the thread or filamentary body thus coated to the conductor to be insulated, preferably by winding the fiber-coated thread about the conductor and working the same down to a uniform thickness, as will be hereinafter more particularly described.

A simple form of apparatus for carrying out the method is illustrated in the accompanying drawings, in which—

Figure 1 is a diagrammatic representation of mechanism for the preliminary covering of a thread or filamentary body with the fibrous insulating material. Fig. 2 is a similar view of apparatus for applying the fiber-coated thread to the conductor. Fig. 3 shows a section of the conductor with the insulating material being applied thereto.

Referring to Fig. 1 of the drawings, 1 indicates a ball, spool or cop of thread or yarn which may be of any desired size, but which is preferably as fine or of as small diameter as the exigencies of the work will permit. Said ball or cop 1 is mounted upon a spindle 2, which may, if desired, be rotated in a direction at right angles to its axis, but which as shown is capable of rotation about its longitudinal axis. As the thread or yarn is paid off of the ball or cop 1, it passes over and around a tension roller 3, thence around a roller 4 which is immersed in a tank 5 containing an adhesive, such as water, glue, paste, albumen, sodium silicate, or any other gelatinous or sticky substance, appropriate to coat the thread or yarn to cause fibrous materials coming in

contact with the thread or yarn to adhere thereto. From the adhesive applying roller 4, the thread passes directly over the doffer of a carding machine or the like, said doffer being represented as a belt 6 of usual and appropriate form, passing over a roller 7 and serving to draw out the elements of the fibrous material in lines parallel with the run of the doffer belt, as will be understood. Beyond the doffer 6, the thread passes around a pulley 17 mounted on the lateral arm of a rotary flier 8 which in turn is rotated on its horizontal axis by a pulley 12 by means of a belt 13, the flier 8 and pulley 12 being journaled in a suitable bearing 13′. Carried by the flier 8 is a spindle 9 adapted to receive a spool 18 upon which the fiber-coated thread is wound, rotary motion being imparted to said spool 18 by means of a bevel pinion 10 on spindle 9, which meshes with a bevel gear 11 mounted on the spindle 14 concentric with the axis of flier 8, to the outer end of which spindle 14 is attached a brake drum 15 about which is looped several turns of a cord or rope 16, anchored at its upper ends to a stationary abutment and provided at its lower looped end with a pendent weight 16′, the parts being so disposed that as the flier rotates about its horizontal axis, the coaction of pinion 10 with gear 11 will cause the spindle 9 to rotate and wind the thread on the spool 18. The action of the brake drum 15 and its associated cord and weight 16 and 16′ admits of the spool 18 being rotated with just sufficient force to wind the thread regularly and evenly on the spool 18. By regulating the amount of the weight 16′, the degree of tension on the spool rotating mechanism may be nicely adjusted.

The apparatus as thus described affords a simple and efficient means for carrying out the first step of the method involved in the present invention, to wit, the preparation of the fibrous material to form the main element of the insulating sheath as a loosely matted or felted mass wound about the relatively light foundation thread for yarn, and preferably secured to the latter by means of a suitable adhesive. It will be understood that the mechanism is merely exemplary and that the operations performed thereby can be produced by other forms of mechanism, or if desired, even by hand.

The operation of the apparatus is as follows: When the thread or yarn is drawn off of the cop 1 and passes around the roller 3 and thence through the other parts of the mechanism to the spool 18, the thread is given a rapid rotation about its longitudinal axis, so that when the thread passes in contact with the doffer belt 6, it takes up the straightened threads or fibers of the material carried by the belt and causes said fibers to be wrapped about its body in a loosely matted condition, the fibers however adhering to the thread, first because of the twisting action imparted thereto by the rotation of the thread, and second, because of the cementing effect of the adhesive applied to the surface of the thread by the roller 4. The travel of the thread through the machine may be quite rapid, and by regulating the relative speeds of the doffer 6 and the flier 8, any desired thickness of the fibrous material wound and matted on the thread may be readily accomplished. As the thread leaves the doffer 6, the fibrous coating thereon is more or less fluffy and irregular in appearance, but is nevertheless distributed over the surface of the thread with exceptional regularity, and in passing around the guide roller 17 on the flier head 8, the fibrous coating is more or less compacted, so that when the fiber coated thread is ultimately wound upon the spool 18, it can be laid up in compact regular convolutions. After all of the thread has been unwound from the cop 1, coated with the adhesive and fibrous material and wound upon the spool 18, the latter is removed from the flier head for subsequent use and the operation repeated with another supply of thread and an empty spool 18.

When this or a similar apparatus is employed for coating the foundation thread of filament with asbestos, it is found convenient and preferable to use the cheap, short-fibered asbestos of commerce, which lends itself readily to the carding operation of an ordinary carding machine and is delivered to the doffer in a multiplicity of short filaments which are engaged by the rotating thread and wound and matted thereon in a relatively loose but uniform mass. The thickness of the covering of asbestos fiber on the thread will, as heretofore indicated, depend upon the width of the doffer and the relative speeds of travel of the doffer and the thread. If it is desired to apply a substantially thin but regular coating of asbestos to the thread, a comparatively narrow doffer belt may be employed, or the thread may be fed across the same at a relatively higher rate of speed and correspondingly, if a thicker and heavier coating of asbestos or the like is desired, a wider doffer belt may be employed, or the doffer may be driven at a higher rate of speed, or in the alternative, the thread may be fed more slowly across the doffer. What is true of the asbestos fiber, applies likewise to other fibrous materials which may be employed, and in any case, the result of the operations is a relatively small foundation thread or yarn of any appropriate material completely covered with a mass of twisted and matted fibers, uniformly distributed over the surface of the thread and affixed to the latter by a suitable adhesive, which fiber-

coated thread is wound upon a spool for subsequent use. If it is found undesirable to impart any extra twist to the foundation thread, but nevertheless to cause the thread to take up the fibers from the doffer and dispose the same in a uniform matted layer about its surface, the spindle 2 of the cop 1 may be given a rotary motion in the same direction and at the same speed as the flier head 8, so that the whole body of the thread and its supports will be rotated without twisting any intermediate portion of said thread.

To apply the fiber-coated thread to its intended purpose, to wit, as an insulating sheath or covering for conductors, an apparatus such as illustrated in Fig. 2 may be conveniently employed, said apparatus comprising a reel 19 upon which the conductor in the form of a wire, ribbon or the like is wound, a pair of straightening and guiding rollers 21 adjacent the reel, an adhesive applying roller 22 mounted in a receptacle 23 over which roller 22 the wire passes, a rotary flier 24 journaled in a suitable bearing 25 provided with a longitudinal opening through which the wire travels, said flier having one or more studs or pintles 24' upon which are secured one or more spools 18 containing the fiber-coated thread, prepared in accordance with the preliminary method hereinbefore described. The flier 24 is preferably in the form of a pulley driven by a belt 26, as will be understood. Beyond the flier 24, the conductor 20 having the fiber-coated thread wound thereon in spiral convolutions passes over a roller 27 mounted in a receptacle 28 which contains a coating composition and which applies such composition to the fiber-coated thread. If it is desired to water-proof the insulating sheath, the composition contained in the receptacle 28 may consist of paint or varnish, composed of asphaltum, or gums, or resins, or any suitable synthetic plastic resistant substance. If it should be desired to render the insulation fire-proof, then the composition applied by roller 27 may consist of sodium silicate, silicate of lime, kaolin, a metallic oxid, such as oxid of alumina, or a lime product, such as sulfate of lime, or if desired, any admixture of the foregoing ingredients worked up to a gluey cohering consistency and which will ultimately form with the fiber-coated thread a smooth, uniform, coherent, flexible sheath. After leaving the composition applying roller 27, the coated wire is passed through a series of smoothing and finishing devices, which may be of any preferred form and which are effective to smooth and reduce the composite coating to a homogeneous layer of uniform thickness and continuity. As shown in the drawings, said smoothing and finishing devices comprise a series of rotary disks 29 through the center of which the covered wire passes, which disks are driven by belts 30. Upon the rear face of each disk is mounted a pair of bell crank levers 31 having at their free ends clamping jaws 34 which surround the conductor and are held in contact therewith by means of pressure springs 33 disposed between the outer ends of the bell crank levers and the carrying disks. The circular openings formed by the mating grooves in the adjacent faces of the jaws 34 are preferably of successively decreasing diameter in the several devices so that as these jaws are carried around the wire by the movement of the rotary disks, they successively smooth, compact and reduce the coating on the conductor to an enveloping sheath or layer that is uniform throughout and presents a closely adherent shell-like sheath for the conductor. After passing the smoothing and surface-finishing devices, the covered conductor may be subjected to the influence of heat or moisture, as the case may be, for the purpose of setting the coating, as for example, by means of the burner or spraying device 40. The finished wire then passes between guide rollers 41 to a storage reel or bobbin 42.

If desired, the foundation thread carrying the fibrous material may be removed from the sheath before the final finishing operation by subjecting the conductor having the fiber-coated thread wound thereon, to sufficient heat to incinerate the thread-like core, without however disturbing the relation of the coating fibers, after which the regular impregnating and finishing operations can be performed. Of course, the removal of the core is possible only in cases where the fiber coating the thread-like core would not itself be destroyed by the core removing agent. Likewise, if it is found desirable, the thread-like core may be rendered fire-proof and water-proof, or it may be initially formed of fire-proof or water-proof material, such as cellulose, artificial fiber or the like.

By the application of the novel method hereinbefore disclosed, a conductor of any shape or size may be covered in whole or in part with an efficient sheath of effective insulation, either fire-proof or water-proof in character and of any desired degree of thickness, and while the initial fiber coating applied to the foundation thread or filament is fluffy and apparently, but not actually irregular in its disposition on the foundation thread, the ultimate insulating sheath is extremely compact and homogeneous and uniform in disposition and insulating properties, so as to more nearly resemble a coating of plastic material rather than a fibrous sheath. An insulating sheath of this character is especially efficacious for conductors to be wound in coil form on electrical apparatus in which it is desired to have the con-

volutions as close to each other as possible, consistent with the high degree of insulation which the cellular character of the fibrous material affords.

What I claim is:—

1. The method of insulating conductors, which consists in covering a thread or filamentary body with a coating of fibers, applying the fiber-coated thread to the surface of the conductor, and reducing the fiber-coated thread to a layer of substantially uniform thickness.

2. The method of insulating conductors, which consists in coating a thread or filamentary body with an adhesive, then with a sheath of fibers, applying the fiber-coated thread to the surface of the conductor, and reducing the fiber-coated thread to a layer of substantially uniform thickness.

3. The method of insulating conductors, which consists in rotating a thread in contact with a body of fibrous material to coat the thread with fibers, applying the fiber-coated thread to the surface of the conductor, and reducing the fiber-coated thread to a layer of substantially uniform thickness.

4. The method of insulating conductors, which consists in rotating a thread in contact with a body of fibrous material to coat the thread with fibers, winding the fiber-coated thread about the conductor, and reducing the fiber-coated thread to a layer of substantially uniform thickness.

5. The method of insulating conductors, which consists in treating a thread or filamentary body with an adhesive or binder, coating the thread thus treated with a body of loose fibers twisted and matted thereon, applying the fiber-coated thread to the surface of the conductor, and reducing the fiber-coated thread to a layer of substantially uniform thickness.

6. The method of insulating conductors, which consists in coating a thread with an adhesive or binder, rotating the thread in contact with a body of loose fibers to coat the thread with said fibers, winding the fiber-coated thread about the conductor, impregnating the winding with a suitable binder, and finally reducing the coating to the desired thickness.

7. The method of insulating conductors, which consists in carding or straightening a mass of loose fibrous material, applying said straightened fibers in a twisted and matted layer about an adhesive coated thread, winding said fiber-coated thread upon the conductor, and reducing the fiber-coated thread to a layer of substantially uniform thickness.

8. The method of insulating conductors, which consists in carding or straightening a mass of loose fibrous material, applying said straightened fibers in a twisted and matted layer about an adhesive coated thread, winding said fiber-coated thread upon the conductor, impregnating the fibrous coating of the conductor with a binder, and finally smoothing and finishing the impregnated coating.

In testimony whereof I affix my signature, in presence of two witnesses.

JOHN ALLEN HEANY.

Witnesses:
ARTHUR L. BRYANT,
CHAS. J. O'NEILL.