No. 728,183. PATENTED MAY 12, 1903.

R. VARLEY.

PROCESS OF WINDING ELECTRICAL COILS.

APPLICATION FILED FEB. 4, 1903.

NO MODEL.

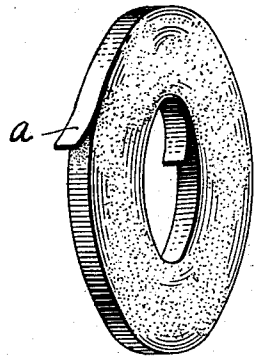


Fig. 1.

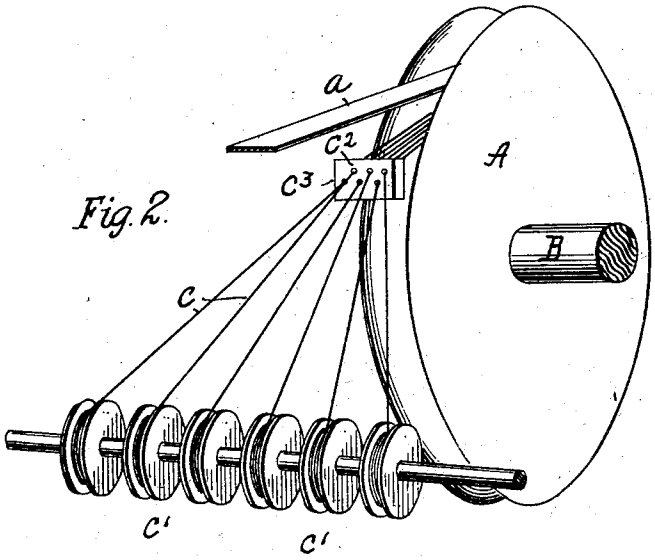


Fig. 2.

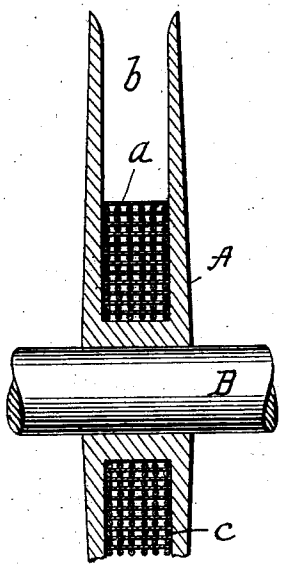
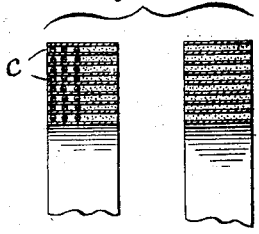


Fig. 3.

Fig. 4.



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No. 728,183. Patented May 12, 1903.

UNITED STATES PATENT OFFICE.

RICHARD VARLEY, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO VARLEY DUPLEX MAGNET CO., A CORPORATION OF NEW JERSEY.

PROCESS OF WINDING ELECTRICAL COILS.

SPECIFICATION forming part of Letters Patent No. 728,183, dated May 12, 1903.

Application filed February 4, 1903. Serial No. 141,857. (No specimens.)

To all whom it may concern:

Be it known that I, RICHARD VARLEY, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Processes of Winding Electrical Coils, of which the following is a full, clear, and exact description.

This invention relates to processes of winding coils for electrical purposes; and it consists of a special process for winding coils of the character described in a companion application filed of even date, Serial No. 141,856. The coil described in said application consists in general of a unit of winding in the form of a disk or flat spiral, the convolutions being wound successively over each other and being all in the same plane, substantially at right angles to the axis of the coil. The wire is in the form of flat ribbon, the turns of which are insulated from each other by an enamel or vitreous material.

The process hereinafter described and claimed consists in general in simultaneously winding the ribbon wire and a mechanical separator, the latter thus being interposed between the turns of the wire. When the winding operation is finished, a portion of the mechanical separator is removed, and the open space left thereby is filled with a plastic material adapted to become enamel or of a vitreous nature when heated, after which the remainder of the mechanical separator is removed and the space left thereby also filled with the said plastic material. The coil is then placed in an oven and baked at a suitable temperature for a given time to transform the plastic material into a hard vitreous material, which thus becomes an insulator capable of withstanding high temperatures adapting the coil to carry abnormally-high currents which would destroy cotton, silk, or other ordinary kinds of insulating material. Such a coil is eminently adapted for arc-lamps, transformers, and other apparatus where the electromagnets are subjected at times to excessive currents.

My improved process will now be described with reference to the accompanying drawings, in which—

Figure 1 is a perspective view of one of the finished units of winding. Fig. 2 illustrates conventionally the essential apparatus for winding the units. Fig. 3 shows a section of the winding-spool and a portion of the coil thereon, and Fig. 4 illustrates the manner of applying the permanent insulating material.

As before stated, the wire is in the form of ribbon, and the first step of the process (although not an essential one) preferably consists in rolling round wire of known gage into flat form, so that the cross-sectional area of the ribbon will correspond with that of the round wire, the carrying capacity of which is known. As one of the objects of the invention is to be able to wind as large a number of turns as possible in a given cubical space, the flat wire is preferred, and for the same reason it is preferable, if possible, to wind this wire bare, and either simultaneously or after the winding operation apply an insulating material which will occupy much less space in the coil than would be occupied by the insulation if applied to the wire previous to the winding operation. Hence in carrying out my process I lead the bare flat wire (indicated by *a*) from a suitable reel (not shown) to a winding-spool A on a driven shaft B. This spool has a winding-space *b* between its flanges of such width as to just admit the flat wire. Having properly secured the end of the wire to the hub of the spool, and, possibly, wound one or more initial turns, a number of silk threads *c*, leading from as many spools *c'*, are threaded through eyes c^2 in a guide-plate c^3, and thence with their ends all secured together side by side by a bit of wax or equivalent material are inserted under the wire at the tangent point and the shaft then rotated. This operation simultaneously winds the threads and the wire upon the spool, there being a number of threads arranged side by side between every two convolutions of wire, the thread thus acting as a mechanical separator. The number and thickness of the threads will

of course depend upon the requirements. The thickness is more important, because it determines the thickness of the permanent insulating material, whereas the number of threads can be two or more, provided they are distributed across the space from edge to edge of the wire in a manner to evenly support the turns. The six threads shown are of very fine silk and are used with a flat wire of about three thirty-seconds of an inch in width. The winding-shaft can be driven at high speed and the actual winding operation accomplished very quickly. When completed, the ends of the strands are severed and secured in any convenient manner, after which the coil is removed from the spool. Then by means of a hooked needle one-half of the threads between the turns are drawn out from one side of the coil. For instance, where six threads are used side by side the three on one side of the coil are drawn out laterally, leaving an empty space between the wires throughout one side of the coil, the convolutions being still supported by the other three threads. This empty space is then filled with material, as shown to the left in Fig. 4, preferably in a plastic state, but capable of being reduced to a vitreous condition or to an enamel by the application of a proper amount of heat. The plastic material can be rubbed in with the finger, or it can be forced in by suitable mechanical appliances. Having applied the plastic material to one side of the coil, the three threads on the other side are then withdrawn, thus leaving the convolutions separated and supported by the plastic material in the first half. Then plastic material of the same character is inserted into the empty space left by the last three threads, as shown to the right in Fig. 4, and the coil is then ready for baking. The baking of the coil at comparatively low temperatures drives out the moisture and reduces the plastic material to a vitreous mass, which while effectually separating and insulating the turns of wire from each other also solidifies and strengthens the structure.

The coil thus constructed will stand a temperature which will almost melt the copper without destroying or injuring the insulation.

In place of the silk threads referred to cotton, paper, or other material may be used. In fact, my invention includes the use of any temporary mechanical separator which is substituted afterward by the permanent enamel. It is also pointed out that in so far as this idea of using a temporary separator between the turns of a coil to be afterward displaced by a permanent insulating material is concerned the invention extends to the formation of electric coils of ordinary character and is not necessarily confined to those coils which are made up as flat spirals.

Having described my invention, I claim—

1. The process of winding and insulating electrical coils which consists in simultaneously winding a conductor and a separating medium for the turns thereof, then removing the separating medium and substituting permanent insulating material therefor.

2. The process of winding and insulating electrical coils which consists in simultaneously winding a conductor and a separating medium for the turns thereof, then removing a portion of the separating medium and substituting permanent insulation therefor and then removing the remainder of the separating medium and substituting permanent insulation therefor, as set forth.

3. The process of winding and insulating electrical coils which consists in simultaneously winding a conductor and a separating medium for the turns thereof into a flat spiral or disk in which the turns are all in one plane at right angles to the axis, then removing the separating medium and substituting permanent insulating material therefor.

4. The process of winding and insulating electrical coils which consists in simultaneously winding a conductor and a separating medium for the turns thereof into a flat spiral or disk in which the turns are all in one plane at right angles to the axis, then removing a portion of the separating medium and substituting permanent insulation therefor and then removing the remainder of the separating medium and substituting permanent insulation therefor.

5. The process of winding and insulating electrical coils which consists in simultaneously winding a conductor and a separating medium for the turns thereof, then removing the separating medium and substituting permanent insulating material in a plastic state but adapted to become hard.

6. The process of winding and insulating electrical coils which consists in winding bare wire into a coil and then inserting an insulating material between the convolutions thereof.

7. The process of winding and insulating electrical coils which consists in winding bare wire into a coil and then inserting an insulating material between the convolutions thereof, said insulating material being in a plastic state and adapted to become vitreous when subjected to heat.

8. The process of winding and insulating electrical coils which consists in winding bare wire into a flat spiral or disk in which the turns are all in one plane at right angles to the axis, then inserting an insulating material in plastic state between the turns of the coil, said material adapted to become vitreous when subjected to heat and then baking the coil, substantially as described.

9. The process of winding and insulating electrical coils which consists in simultaneously winding a flat wire and a plurality of strands or threads, so that the strands or

threads will alternate with the turns of wire and separate the same, the said turns of wire being located in one plane at right angles to the axis of winding, then successively removing one or more of the threads from the coil and substituting for each removed thread or threads a permanent insulating material until finally all of the threads have been removed and substituted by the said insulating material.

In witness whereof I subscribe my signature in presence of two witnesses.

RICHARD VARLEY.

Witnesses:
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