UNITED STATES PATENT OFFICE.

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METHOD OF INSULATING ELECTRIC CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 477,732, dated June 28, 1892.

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To all whom it may concern:

Be it known that I, ARTHUR V. ABBOTT, a citizen of the United States, and a resident of Closter, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Methods of Insulating Electrical Apparatus and in the Apparatus so Insulated, of which the following is a specification.

My invention relates to improvements in insulating electrically the various parts of electrical machinery. It is well known that it is customary to make the armatures for dynamos and motors of a number of thin plates of iron, which are separated electrically from each other by some non-metallic insulating substance, such as a thin sheet of paper, shellac, varnish, or the like. The same method is frequently used in the construction of field-magnets. In the manufacture of commutators the copper segments to which each of the armature-coils are connected are separated from each other by thin plates of mica, and the commutator is held in place by rings of hard rubber, vulcabeston, or vulcanized fiber. The spools or metallic frames on which the field-coils are wound are covered with varnished canvas, fuller-board, or thin sheets of vulcabeston. The wire used for field-coils and armature-windings is protected by one or more thicknesses of cotton. With the exception of the commutator construction, the insulating materials used are more or less organic in their origin, and are consequently liable to injury or destruction from the inevitable rise of temperature to which dynamo machinery is liable. Furthermore, the insulating substances above named, with the exception of mica, are more or less hygroscopic and are liable to absorb both moisture and oil, the presence of which impairs their insulating qualities and eventually leads to their destruction. In the case of the use of mica in the construction of commutators the expense of suitable sizes and quality and the difficulty of obtaining the mineral of appropriate degrees of hardness are serious objections.

By means of my invention the above objections to the former methods and means of insulating are overcome, and I am enabled to apply an insulating material that is at once fire and water proof, cheap, and easy of application, and which may be made of any desired degree of hardness. I prepare a paste composed of fusible silicates, chiefly those of potash and soda in varying proportions, depending upon the hardness that is requisite in the insulating material. If softness is desired, the proportion of silicate of soda is to be increased, whereas a greater proportion of silicate of potash will increase insulating properties and hardness. The silicates by grinding are first reduced to an impalpable powder and are then mixed with a sufficient quantity of water to which a small proportion of gum and of various metallic oxides have been added in order to form a paste having about the consistency of cream. The paste is then applied in any appropriate manner to the articles it is desired to insulate. For the laminations of armature-cores and field-magnets and for the spools or bobbins for carrying coils it is sufficient to dip the plate or piece into the paste. After the paste has dried each piece is placed in a muffle and heated sufficiently to fuse the silicates, thereby forming a vitreous enamel, covering the entire surface, which is both non-hygroscopic and highly insulated.

In order to cover and insulate the wire employed in winding the bobbins and coils, I have invented a special process. By the present method a copper wire is covered with one or more layers of cotton tightly wound or braided onto the wire. In my process I cover the wire with a single layer of cotton wound on as loosely as possible, and instead of employing a tightly-twisted thread I use a loose cotton yarn, which is made as fluffy as possible. After this covering of cotton the covered wire is passed through a bath containing the liquid enamel above stated, to which a proportion of fibrous asbestus is preferably, but not necessarily, added to give additional body. On emerging from the bath of enamel the wire is passed through a drier having a temperature not exceeding 250° Fahrenheit, which serves to consolidate the paste. The wire is now covered with a second layer of cotton which binds the unvitrified paste in place and prevents it from being knocked off, chipped, or

broken during subsequent operations. If desired, the wire may receive a number of successive coats of cotton and enamel, and in this way an insulating of any desired thickness can be built up. After the requisite insulation is thus produced and the wire has received its exterior coating of cotton it may be wound upon the armature-core or upon bobbins previously prepared by being coated with the enamel and fired, so as to be thoroughly vitrified. After the armature or bobbins have received the requisite quantity of wire they are placed in a suitable receptacle filled with paste and connected with a hydraulic press or other apparatus, whereby the paste will be forced into all the interstices between the successive layers or strands of wires. On removal from the press the completed armature or coil is placed in the furnace and fired. By means of the second firing the paste with which the wires are covered is vitrified, and at the same time the cotton-covering is burned away, leaving each separate wire inclosed in a continuous tube of vitrified enamel—that is, both fire and water proof. The cotton also serves the additional purposes of affording a slight space between the wire and the enamel, which is sufficient to absorb the difference in expansion between the wire and the enamel, thereby obviating danger of cracking. In this process I do not confine myself to the use of cotton fiber. Any other suitable material may be employed which will serve to hold the unvitrified enamel in place and which will be burned away and destroyed by the subsequent firing.

It is obvious that the above-described processes may be used in the construction of rheostats or any electrical apparatus.

I claim—

1. In the construction of electrical apparatus or machinery, the method of insulating the wire or other parts, consisting in applying one or more coats of a vitreous enamel, holding the same in place by a wrapper of organic substance, and vitrifying the enamel and destroying the organic material by firing, substantially as specified.

2. In the construction of electrical apparatus or machinery, the method of insulating the wire or other parts thereof, consisting in coating the same with a vitreous enamel in plastic or paste-like condition, holding the same in position by a wrapper of organic material, then giving the wire or part the desired shape and position, and then vitrifying the enamel and destroying the organic material by firing, substantially as and for the purposes set forth.

3. A wire or other part of an electrical machine or apparatus insulated by a coating of vitrified enamel, separated by a space from said part, substantially as set forth.

Signed at Baltimore, in the State of Maryland, this 7th day of March, A. D. 1892.

ARTHUR V. ABBOTT.

Witnesses:

S. RUSSELL, Jr.,

G. E. REARDON.