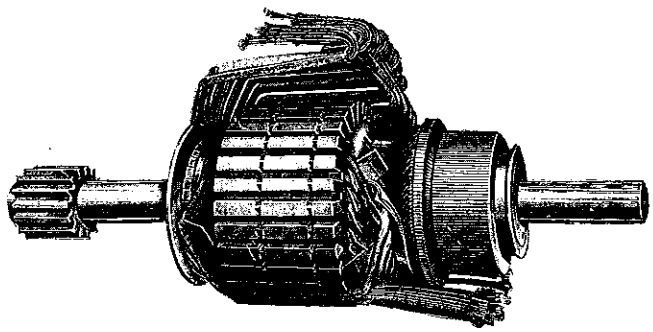
The Repair of 600-Volt Railway Motor Armatures



G-E Railway Motor Armature, Partially Wound

Railway motor armatures are subject to duty of the most severe character, and with the best of care will ultimately fail in service. The purpose of this publication is to outline the correct methods of repairing armatures, insulated with varnished cambric and cotton tape, in such a way that satisfactory results will be assured.

Inspection

First, inspect the armature to determine the cause of failure so as to avoid a repetition of the trouble. The next steps are to determine the extent of the damage and how the repairs are to be made. If there is no external indication of failure, an insulation test of 1000 volts, alternating current, should be made between conductors and core. If this test shows that a ground exists, disconnect the commutator, if not, apply a bar to bar test of 125 volts, direct current, with a 125-volt lamp in series, to ascertain if there are any short circuits. If there is a short circuit but no ground, only part of the following operations will be necessary, depending upon the nature of the difficulty. The directions given in the following paragraphs cover the complete rewinding and reinsulating of an armature.

Disconnecting the Commutator

Remove the binding bands over the conductors at the commutator end and take off the outside head insulation over the coils. Then disconnect the coil leads from the commutator (this may be done by the "cold method" using a wedge shaped drift to force the leads out of the cups; or by the "hot method" using a soldering copper). If the "cold method" is used, the drift should be slightly narrower than the slot in the commutator bar so that the copper will not be damaged. After all of the leads have been disconnected from the commutator, the ground may be located. Each coil and each commutator segment can be tested for insulation from ground.

Repair of the Commutator

If the trouble is found in the commutator, clean the exposed surfaces thoroughly and examine for defective bars. Repairs may then be made in accordance with the specific instructions given on Descriptive Sheet 64405. Apply a bar to bar test of 125 volts, direct current, with a lamp in the circuit, after making repairs to the commutator.

Stripping the Armature

If the trouble is found in the coils, strip them from the core, proceeding as follows:

Raise all the top members of the coil out of the slots first, and then pull them back one at a time, thereby removing the bottom members in succession around the core.

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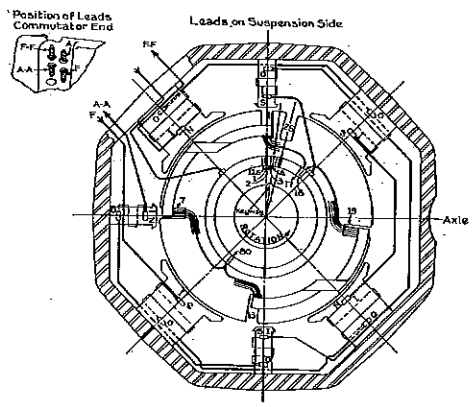
Insulating the Core

The core head insulation need not be removed if found in good condition, but should be given a few coats of G-E No. 458 air drying black insulating varnish. If the insulation is damaged or badly charred, remove it and replace with new core insulation. This core insulation may be obtained ready-cut to shape and in the exact quantity of pieces necessary for reinsulating the armature core of any G-E railway motor. Use G-E No. 462 black insulating varnish when cementing to the core the pieces of cut insulation and the layers of binding tape used in building up the space in forming the coil seat. Finish the surface with at least two applications of G-E No. 458 varnish as directed above. Thoroughly inspect the laminations which constitute the core proper, and repair any uneven or damaged portions so that the slots are perfectly smooth. Any projections of metal into the slots may injure the insulation of the coils when they are assembled on the core.

Rewinding the Armature

Before starting to assemble the coils on the core, locate a commutator bar, the center of which lines up with the center of a slot: call these "bar No. 1" and "slot No. 1" respectively. If, however, the center line of the slot falls on a mica segment, call the bar to the right (facing the commutator) "bar No. 1." Counting to the right from bar No. 1, make the lead connection for the bottom coil in slot No. 1, as shown in the connection diagram furnished for all G-E railway motors. *Be sure to mark this bar,* since the lead of the coil to be placed in slot No. 1 must be connected to it. If the number of conductors per coil is odd, middle lead should be called lead No. 1. In the case of an even number of conductors per coil, the right hand middle lead (facing commutator) will be lead No. 1.

When assembling the coils on the core, place the bottom side of the first coil in slot No. 1 and the top side of the same coil in its respective slot to the left. Then place lead No. 1 in the commutator bar marked as described in the preceding paragraph. Next assemble the coils in succession around the coil, setting the bottom sides of the coils down into the bottoms of the slots and pulling the top sides of the coils back into their proper slots but not setting them all the way down. After about 40 per cent of the coils have been assembled, all of them may be set into the slots as far as they will go.



Typical Connection Diagram for G-E Railway Motor Armature

While assembling the coils on the core, place pieces of G-E standard cut insulation between the end windings at both the commutator and pinion ends of the coils. Place other pieces of cut insulation provided for the purpose between the bottom leads and end windings. If necessary, place strips of insulation between the coils in the slots as they are assembled on the core to bring them up slightly higher than the tops of the slots. This is desirable in order that the binding operations as described in the subsequent paragraphs may be readily performed.

Test after Rewinding

After all the coils have been assembled on the core with the bottom leads connected to the commutator, apply a high potential test to ground of approximately 2200 volts, alternating current, for a period of one minute, to the top leads and the commutator. Apply a second bar to bar test of 125 volts, direct current, with a lamp in the circuit, for a period of five seconds and a lead to lead test between the top leads to ascertain that both the windings and the commutator are free from short circuits before proceeding to connect the top leads to the commutator. After making this test, insert the correct pieces of insulation between the top leads and the end windings. Then connect the top leads to the commutator. Follow this operation by soldering all bottom and top lead connections.

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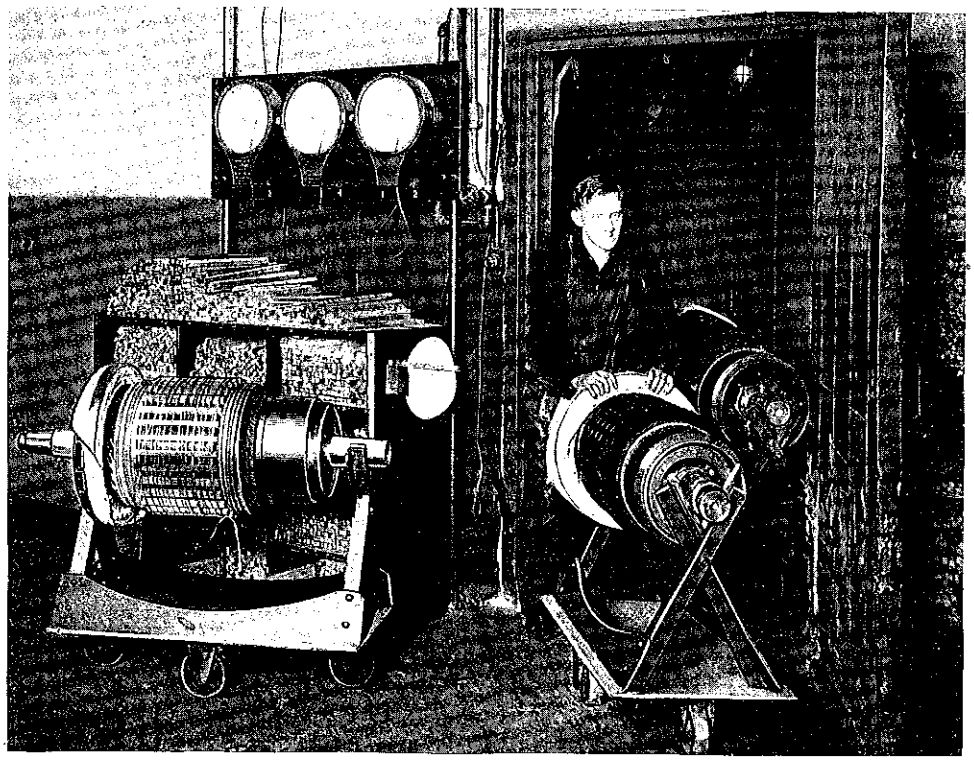

G-E Railway Motor Armature Ready for Temporary Banding

Temporary Binding

In order to insure a tight final binding, it is first essential that a temporary binding be placed on the armature, proceeding as follows:

Place the armature in an oven and heat it to a temperature of approximately 110 degrees Centigrade (230 degrees Fahrenheit). Provide a suitable number of wooden sticks, cut approximately square the width of the coils and as long as the slot portion of the coils. While the armature is hot, wind a temporary band of steel wire over the sticks on the slot portion of the coils at a tension of about 200 pounds, depending upon the diameter of the armature. This operation is clearly shown in the illustration on the following page. Wind another spiral band at a tension of 150 pounds over temporary pieces of pressed board .060 of an inch thick placed over the end windings. The tension should be sufficient to draw the coils down flush with the bottoms of the bar recesses. After the armature has cooled to room temperature, subject it to a high potential test between windings and core of 2000 volts, alternating current, for a period of five seconds.

Dipping the Armature

To obtain the best results it is recommended that when rewinding railway motor armatures two dippings of G-E No. 458 black insulating varnish be given before the final binding is applied, unless the armature is to be bound open over the end windings, i.e., the canvas head dressing left off so that the ends of the coils are exposed, except for the insulation directly under the end bands. In this case the armature may be completely bound before dipping. If the armature is not to be bound open, remove the temporary binding before dipping so that the varnish may thoroughly penetrate the end windings and the solvent evaporated when the armature is baked.

Providing the dipping process described in the preceding paragraph is used, operations should proceed as follows:

Heat the armature in an oven to a temperature of approximately 110 degrees Centigrade and while hot dip it in the varnish either in a vertical position with the commutator end up, or

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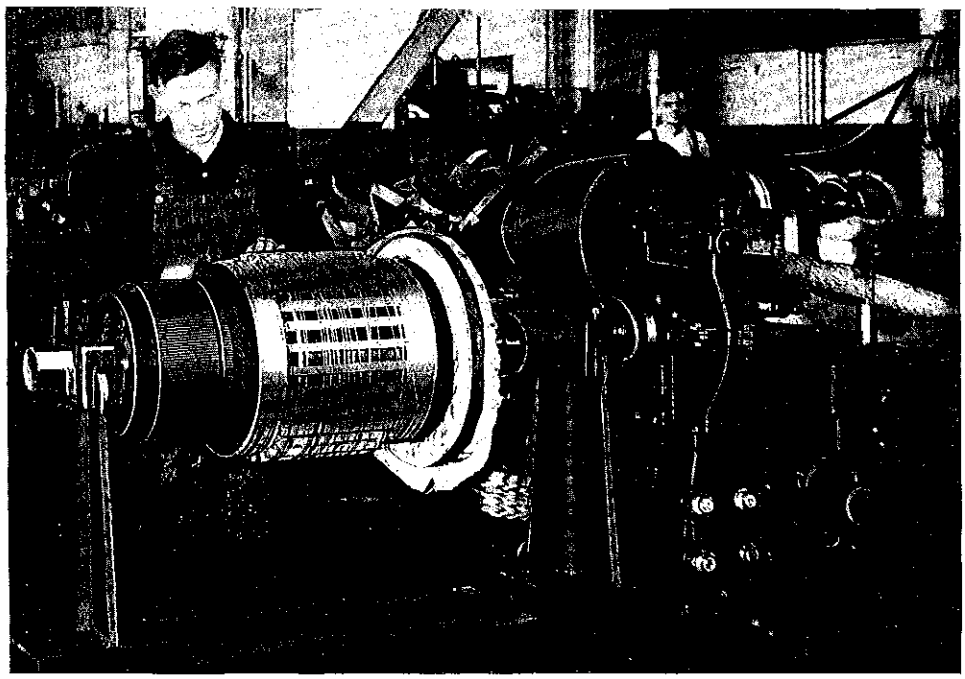

G-E Railway Motor Armature Showing Temporary Banding

revolve it in a pan of varnish in a horizontal position. After dipping, return the armature to the oven and bake it for a sufficient length of time to thoroughly dry out the varnish. An insulation resistance of at least one-half megohm should be obtained before removing the armature from the oven. After baking, allow the armature to cool to room temperature, then turn and groove the commutator as described in detail on Descriptive Sheet No. 64405. The armature is now ready for the permanent dressing and binding.

Permanent Binding

Wind strips of duck over both ends of the armature coils. This insulation should extend from the ends of the slot portion of the coils well down to the ends of the coils and be held in place by several turns of tape. Wind one band of varnished cambric tape, one-half lapped, over the end windings. This cambric tape should extend from the straight portion of the coils over the entire end windings, and be held in place by a few turns of Acme tape. Next, place the cloth head dressing over the end windings, pull it tight and hold it in place with binding cord. Wind bands of tinned steel wire over both the head dressing and also over horn fiber strips placed in the band recesses of the core. Apply a tension of about 200 pounds depending upon the diameter of the armature. Fold two clips over each band to hold the wire secure, and solder all bands with pure tin solder. The size of the wire, the number of turns of wire per band, and the number of bands used should be the same as on the original armature.

Finishing

If the front cone of the commutator has been disturbed while making repairs, give its extended surface a brushing of shellac and one wrapping of cotton webbing. Brush this webbing with shellac and iron out dry. Wind the webbing with a treated cord band and brush the whole with G-E No. 462 black insulating varnish, ironing dry with a hot iron. Apply two or three coats of G-E No. 458 air drying varnish and allow to dry. After all winding and binding operations, give the entire armature two or three final coats of G-E No. 458 varnish and allow it to dry thoroughly before assembling in the motor.