Our invention relates to molded V-ring caps for motor commutators; and in particular, our invention relates to a more suitable means for taking the place of the string-bands or wrappings which have been commonly utilized on the extending ends of insulating V-rings for approximately four decades, or even since there has been any occasion for retaining these ends against centrifugal force. These string-bands have had a number of objectionable features, being somewhat costly to apply, subject to breakage if but a single strand of the string is broken, and somewhat difficult to coat with a smooth, glossy, insulating paint-surface so that it can be easily wiped off and will not so readily accumulate dirt which would impair the insulating crease page surface. In the case of a motor-flash, between one of the commutator-bars and the metal clamping V-ring under the insulating V-ring, a slight damage to a string-band allows all of it to come loose. Many corrective proposals have been brought forward and tried out, during the course of the years, but in spite of its obvious disadvantages, the string-band has so far proven to be the most successful and acceptable binding-means for the free end of the insulating V-rings, up until the time of our present invention.

The object of our present invention is to provide a novel method and means for retaining the free ends of insulating V-rings, utilizing a rigid insulating cap which has sufficient mechanical strength to resist centrifugal forces, and which is slid on axially over the end of the insulating V-ring, in substantial contact with the large end thereof, after which, the space between the cap and the extended portion of the insulating V-ring is substantially filled with a plastic heat-hardenable insulating cement, which is finally hardened by means of a suitable heat-treatment.

With the foregoing and other objects in view, our invention consists in the combinations, systems, structures, parts, and methods hereinafter described and claimed, and illustrated in the accompanying drawings, wherein.

Figure 1 is a fragmentary view of a portion of a motor embodying our invention, on a slightly reduced scale, and

Fig. 2 is a considerably enlarged detail of the commutator cap assembly.

In Fig. 1, we have shown our invention applied to a commutator-type dynamo-electric machine in the form of a direct-current railway traction-motor, comprising a stator-member 3 and a rotor-member 4, the latter being mounted on a shaft 5 and carrying a commutator-assembly 6 embodying our invention. The commutator-assembly is made up of a number of copper commutator-bars 7 separated by mica or other insulating bars 8, the two kinds of bars being of similar size and shape, except that the insulating bars are thinner and commonly project back about one-eighth of an inch behind the commutator-bars, as indicated by the numeral 8, that is, the mica bars 8 are longer than the copper bars 7. The bars 7 and 8 are provided with V-grooves 9 in the ends thereof, said V-grooves having inclined, an inner, arch-binding surface 11, usually at a 30° angle, and an outer surface 12, usually at a 3° angle, or sometimes a 6° angle.

The V-grooves 9 are insulatingly engaged by clamping V-rings 13 and 13', usually of steel, having conical surfaces inclined at the same angles as the surfaces of the V-grooves. The insulating engagement is provided through the intermediary of insulating V-rings 14, preferably made of sheet-mica of sufficient thickness to withstand the maximum voltage which is applied to the commutator-member.

At least the outer clamping V-ring 13', or the one at the end of the machine, has an outer conical surface 15 which extends out of the associated V-groove 9, beyond the end of the commutator-bars 7. The corresponding insulating V-ring 14 likewise has an extended outer conical portion 16 which fits against the extended portion 15 of the clamping V-ring, and which preferably extends out substantially to the large end of the outer conical surface 15 of the clamping V-ring 13'. It is this free or extended portion 16 of the insulating V-ring 14 which was formerly held down by a string-band.

The clamping-rings 13 and 13' are held in clamping-position by means of a bolt 17 applied to the ring 13' so as to hold the inner conical surface 15 of each clamping-ring in arch-binding clamping-engagement with the corresponding surface 11 of the respective V-grooves.

The commutator-bars 7 are provided with armature-connections 20 which cause the commutator-bars to operate at such voltage as to involve the danger of flashovers to ground, under operating conditions of the machine, particularly when the machine is utilized as a street-car or electric-locototive motor which is operated close to the ground, in wet, dirty weather. Such flashovers may take the form of arcs from the free ends of one or more commutator-bars 7, to any adjacent grounded surface, such as the end of the associated clamping V-ring 13', or, as shown, we provide flashing-sectors 21 which are carried...
by the bearing-cartridge 22, between the brushholder-supporting structures 25 which support the brushholders 26 for carrying the brushes 27 which bear on the cylindrical surface of the commutator 21.

In accordance with our invention, the free extending ends 16 of the insulating V-rings 14 are held down, and at the same time protected against flashings, by means of a rigid insulating cap 30, which is preferably molded of layers of impregnated asbestos paper, as to provide a rigid structure of sufficient mechanical strength to resist centrifugal forces. Said cap 30 has a substantially cylindrical portion 31 which extends over said extending portion 16 of the insulating V-ring 14. The cap also has a radial flange-portion 32 which extends over the end of the associated clamping V-ring 13. Preferably, the substantially cylindrical portion 31 of the cap 30 is of such diameter that its inner surface is substantially in direct contact with the end-portions or largest end of the extended portion 16 of the insulating V-ring, or at least in contact in spots, or in certain motors, in case of variation in the diameter of the insulating V-rings in different motors.

In utilizing our invention, the cap 30 is slid on axially over the extended end 16 of the insulating V-ring 14. If the insulating V-ring end 16 is of too large a diameter, as by reason of a slight roughening of the mica sheet-material or surface, its outer surface may be first sandpapered slightly in order to admit of the application of the cap 30. The inside of the cap or ring 30 is first smeared with cement, and then the cap is pushed in place, so that after it is in place, the space underneath its cylindrical portion 31, between the same and the inclined or conical outer surface of the extended portion 16 of the insulating V-ring 14 is substantially filled with a plastic heat-hardenable insulating cement, such as a polymerizing cement 33. This operation is preferably performed before the usual dipping and baking operation which is applied to the armature 35 of the machine. The entire machine, or just the rotor-member thereof, is then subjected to a suitable heat-treating operation, such as baking for several hours, which sets or hardens the cement 33 at the same time that it sets the dipping-compound with which the armature 35 is treated.

It will be obvious from the foregoing description, that our invention has several advantages, among which may be mentioned the following:

1. It is simple, thus differing markedly from many other elaborate schemes which have been suggested for avoiding some of the difficulties of the string-bands.

2. Our cap 30 provides increased creepage-distance to ground, because of its end-flange 32 which extends downward over the end of the metal V-ring 14. This permits a more compact commutator-design, by making it possible to use a shorter axial distance between the end of the commutator and the end of the metal V-ring.

3. It has ease of application. The labor of cementing the cap or ring 30 in place requires much less time than the application of a string-band.

4. It is effective. The centrifugal force of the motor-revolution does not loosen the cap, as it often does the string-bands, because the cap is all one solid piece. This makes it possible to successfully operate the motor under modern conditions of high-speed street-car service.

5. The outside of the cap provides a smoother surface than is provided by a string-band, even though the string-band is covered with a thick application of glossy paint. The surface of the cap can be painted with a smooth glossy finish of insulating paint, which can be applied more easily, and which provides a much better insulating creepage-surface than formerly.

6. In case of motor-flash, the only possibility of damage to the cap will be a slightly damaged surface, but the flash will seldom burn the cap sufficiently to necessitate its replacement, it may be smoothed with sandpaper and repainted and will be practically as good as new. On the contrary, with the old string-band construction, a slight damage to a string-band allows all of it to come loose.

We claim as our invention:

1. A V-ring commutator-assembly of commutator-bars and insulating bars separating the commutator-bars, said bars having V-grooves in the ends thereof, insulating V-rings, clamping V-rings having a conical surface tightly engaging a corresponding surface of the V-grooves, with the insulating V-rings interposed in between, at least one of said clamping V-rings having an outer conical surface which extends out of the associated V-groove, beyond the end of the commutator-bars, the outer conical portion of the corresponding insulating V-ring likewise having an extended portion fitting against the extended portion of the clamping V-ring, a separately formed rigid insulating cap having sufficient mechanical strength to resist centrifugal forces, said cap having a substantially cylindrical portion extending over said extended portion of the insulating V-ring and further having an integral flange-portion extending over the end of the associated clamping V-ring, whereby said flange-portion mechanically stiffens and strengthens said cylindrical portion and electrically extends the insulating creepage surface of said cylindrical portion radially inwardly along said flange-portion, and a filling of a hard insulating cement substantially filling the space between said cylindrical portion and said extended portion of the insulating V-ring, characterized by the extended portion of the insulating V-ring extending substantially out to the end of the insulating V-ring, and further characterized by the substantially cylindrical portion of the cap being substantially in direct contact with the end-portion of the extended portion of the insulating V-ring, whereby the cap and the intervening cement constitute the sole encompassing means around said extended portion of the insulating V-ring for holding the latter against radial displacement due to centrifugal force, and whereby the insulating V-ring and the intervening cement and the close fit between the substantially cylindrical portion of the cap and the end-portion of the extended portion of the insulating V-ring constitute the sole means for holding the flange-portion of the cap against axial displacement away from the end of the clamping V-ring.

2. A commutator-type dynamo-electric machine characterized by having a V-ring commutator-assembly of commutator-bars, and insulating bars separating the commutator-bars, said bars having V-grooves in the ends thereof, insulating V-rings, clamping V-rings having a conical surface tightly engaging a corresponding surface of the V-grooves, with the insulating V-rings interposed in between, at least one of said clamping V-rings having an outer conical sur-
face which extends out of the associated V-groove, beyond the end of the commutator-bars, the outer conical portion of the corresponding insulating V-ring likewise having an extended portion fitting against the extended portion of the clamping V-ring, a separately formed rigid insulating cap having sufficient mechanical strength to resist centrifugal forces, said cap having a substantially cylindrical portion extending over said extended portion of the insulating V-ring and further having an integral flange-portion extending over the end of the associated clamping V-ring, whereby said flange-portion mechanically stiffens and strengthens said cylindrical portion and electrically extends the insulation creepage surface of said cylindrical portion radially inwardly along said flange-portion, a filling of a hard insulating cement substantially filling the space between said cylindrical portion and said extended portion of the insulating V-ring, and armature-connections to said commutator-bars for causing the same to operate at such voltage as to involve the danger of flash-overs to ground, under operating conditions of the machine, except for the presence of said cap, characterized by the extended portion of the insulating V-ring extending substantially out to the end of the clamping V-ring, and further characterized by the substantially cylindrical portion of the cap being substantially in direct contact with the end-portion of the extended portion of the insulating V-ring, whereby the cap and the intervening cement constitute the sole encompassing means around said extended portion of the insulating V-ring for holding the latter against radial displacement due to centrifugal force, and whereby the insulating V-ring and the intervening cement and the close fit between the substantially cylindrical portion of the cap and the end-portion of the extended portion of the insulating V-ring constitute the sole means for holding the flange-portion of the cap against axial displacement away from the end of the clamping V-ring.

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