E. A. HALBLEIB & T. L. LEE.

COMMUTATOR AND THE METHOD OF MANUFACTURING THE SAME.

APPLICATION FILED JUNE 26, 1915.

1,274,411. Patented Aug. 6, 1918.

Fig. 3.

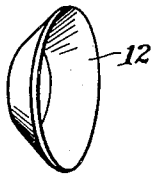


Fig. 4.

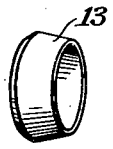


Fig. 1.

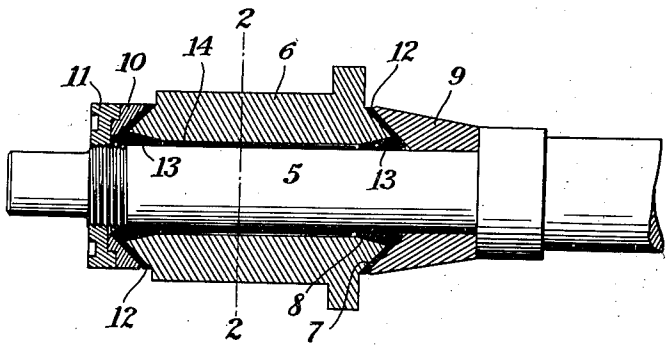
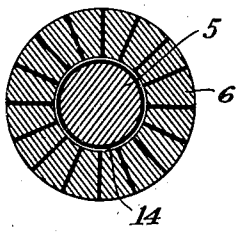


Fig. 2.



Inventors:
Edward A. Halbleib
Thomas L. Lee
by their attorneys
Davis & Dorsey

UNITED STATES PATENT OFFICE.

EDWARD A. HALBLEIB AND THOMAS L. LEE, OF ROCHESTER, NEW YORK, ASSIGNORS TO NORTH EAST ELECTRIC COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

COMMUTATOR AND THE METHOD OF MANUFACTURING THE SAME.

1,274,411. Specification of Letters Patent. Patented Aug. 6, 1918.

Application filed June 26, 1915. Serial No. 36,519.

To all whom it may concern:

Be it known that we, EDWARD A. HALBLEIB and THOMAS L. LEE, citizens of the United States, and residents of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Commutators and the Methods of Manufacturing the Same, of which the following is a specification.

This invention relates to improvements in the structure and the manufacture of the commutators of electric motors, generators, or other machines.

A commutator, as ordinarily constructed, comprises a series of conductive bars which are mounted, with interposed insulating material, around a shaft, the bars being clamped in place by collars fixed on the shaft and cooperating with the ends of the bars, while insulating material is interposed between the bars and the collars, and usually between the bars and the shaft also, to prevent short-circuits between the bars. The mechanical strength of a commutator so constructed depends upon the accuracy and firmness with which the bars are seated against the insulating material by which they are held in place and separated from each other, and the object of the present invention is to facilitate the manufacture of such commutators, and to produce a commutator in which the bars are, in every instance, securely held against accidental displacement both in the course of manufacture and in the subsequent use of the commutator.

It is common, in the manufacture of a commutator, to provide outwardly-directed, and usually inclined, bearing-surfaces at the ends of the commutator-bars which cooperate, through the intermediation of thin bushings of mica or other insulating material, with the clamping-collars. When these collars are screwed up to engage the bars firmly, the bars are all forced inwardly, that is, toward the axis of the shaft, so as to compress the insulating material interposed between the adjacent bars, this material consisting usually of mica, wholly or in part. Where the bars are provided only with outwardly-directed bearing-surfaces, as just described, security against inward displacement of any one of the bars, as a result of an accidental blow or any other cause, is afforded only by the pressure, against the slightly converging lateral surfaces of the bar, exerted by the insulating material which is interposed between the adjacent bars. Since this material is usually more or less compressible, especially when heated, as it may be either in use or in the course of manufacture, sufficiently to soften such cement as may constitute a part of the insulating material, it has been found in practice that in the arrangement just described the support against such inward displacement of the bars is not always sufficient. In some cases, accordingly, the commutator-bars have been provided, in addition, with inwardly-directed bearing-surfaces, either at their ends, or extending from one end to the other, these inwardly-directed bearing-surfaces being forced into engagement with insulating material interposed between the bearing-surfaces and either the clamping-collars or the shaft. While such an arrangement, when carefully and accurately constructed, affords adequate support for the bars, it is difficult to construct a commutator in this manner with such accuracy that all of the several parts of the insulating material shall be brought simultaneously to the proper degree of compression. That is to say, it is difficult to insure that, in the exact position in which the bars have been moved inwardly enough to suitably compress the insulating material between them, they shall also have been brought to a firm seat against the insulating material engaging both their inwardly-directed and their outwardly-directed bearing-surfaces.

In accordance with the present invention the commutator-bars are provided with bearing-surfaces both inwardly directed and outwardly directed, and insulating material is arranged to engage both of these surfaces, but in order to eliminate the necessity for extreme accuracy in the bars and in the thickness of the insulating bushings, insulating material of different characteristics is employed at different points in the structure. In the preferred embodiment of the invention the material engaging the outwardly-directed bearing-surfaces may be comparatively firm and unyielding in character, and its thickness need not be gaged with extreme accuracy, because the material engaging the

inwardly-directed bearing-surfaces has originally a comparatively yielding character. Accordingly, when the clamping-collars are forced against the ends of the commutator the bars are positioned with reference to their outwardly-directed bearing-surfaces and to the compression of the insulating material interposed between the bars, while the insulating material engaging the inwardly-directed surfaces yields, at this time, so much as may be necessary to permit the bars to move inwardly in coming to firm bearings. The material employed in engagement with the inwardly-directed surfaces is such, however, that it subsequently acquires a comparatively firm and unyielding character, so that eventually the bars are rigidly supported against inward movement, as well as against movement outwardly or in an endwise direction.

The material which we have found to be best adapted for the purpose in question is a composition consisting either wholly or in part of a phenolic resin such, for example, as one of the well known phenol-condensation products. This synthetic resin may be compounded with more or less paper-fiber, or other material of permanent characteristics, but the composition as a whole possesses to a substantial degree the characteristics of the resinous material, that its hardness and rigidity depends upon the degree to which it has been cured or seasoned by heat. Accordingly, the material which engages the inwardly-directed bearing-surfaces is only partially cured prior to the assembling of the elements of the commutator, so that it has still the capacity to yield when subjected to a moderate degree of pressure. After the commutator has been assembled, however, the partly cured material is completely cured by subjecting the assembled commutator to heat, thus preventing further yielding of the material, and securing the bars against movement in any direction.

In the accompanying drawings:

Figure 1 is a longitudinal sectional view of a commutator constructed in accordance with the present invention;

Fig. 2 is a section on the line 2—2 in Fig. 1, looking from right to left in the latter figure;

Fig. 3 is a perspective view of one of the insulating bushings which engages the outwardly-directed bearing-surfaces of the commutator-bars; and

Fig. 4 is a perspective view of one of the bushings which engage the inwardly-directed bearing-surfaces on the bars.

In the illustrated commutator the central shaft 5, which may be the armature-shaft of an electric generator or motor, is surrounded in the usual manner by commutator-bars 6, of copper or other conductive material, and each of these bars is provided, at its ends, with outwardly-directed bearing-surfaces 8, which are preferably machined to constitute elements of a conical surface in the usual manner. The shaft is also provided with the usual clamping-collars 9 and 10, the collar 10 being movable along the shaft by means of a nut 11.

Thin strips of insulating material are interposed between the adjacent bars, as shown in Fig. 2, and a bushing 12 of conical form is interposed between the clamping-collar and the bearing-surface 7 in the usual manner. This bushing 12 may be formed of any ordinary or suitable insulating material of a comparatively unyielding character. It may, in fact, be formed of a composition characterized by the presence of a phenolic resin, provided this resin be completely cured so as to be firm and unyielding.

The present invention resides particularly in the use of bushings 13 interposed between the bearing-surfaces 8 and the shaft 5. These bushings are formed, as above described, of composition including partially cured material. When the parts of the illustrated commutator are assembled, the bushings 13 are forced, in the manner of wedges, into the angular spaces between the ends of the bars and the shaft 5, and are thus pressed against the bars. At the same time, however, the bushings 12 force the bars inwardly, and since these bushings are comparatively unyielding, the final position of the bars is determined by the pressure of the bushings 12, as opposed by the resistance to compression of the insulating-material interposed between the bars, and at this time, accordingly, the bushings 13 yield and flow sufficiently to accommodate themselves to the inward movements of the bars. The surplus material of the bushings 13 may flow into the space between the bars and the shaft beyond the bearing-surfaces 8, sufficient space being left for this purpose, although a sleeve 14 of insulating-material may be interposed between the bars and the shaft, provided it is not of such length or thickness as to interfere with the movements just described.

After the commutator has been assembled as just described it remains only to heat the bushings 13, in order to completely cure them and prevent any further yielding. This heating may conveniently be accomplished in connection with the operation of soldering the conductors to the commutator-bars, or the commutator may be heated for the express purpose of curing the insulating material. Even if the commutator be subjected to no heating operation, however, as an incident to its manufacture, the bushings 13 may eventually be cured as a result of the heat which occurs in the commutator when it is in use.

A further advantage which we have found particularly in the use of insulating material comprising a phenolic resin, resides in the fact that when this material is heated and cured, as above described, it expands slightly, this expansion being permanent and not merely the temporary result of the rise in temperature. This expansion forces the material into any slight irregularities in the bearing-surfaces of the bars, and into the spaces between the adjacent bars, and it also increases the outward pressure against the bars, so that the structure is rendered very firm and rigid.

While the material particularly described is the best which has yet been found for the purpose in question, it will be apparent that other materials may be employed which are capable of yielding when the commutator is assembled, and of being subsequently hardened either by the action of heat or otherwise, and accordingly the invention is not limited to the particular materials described, or to the particular form of the parts of the commutator, or to the use of heat for the purpose of hardening the insulating material.

We claim:—

1. The method of making commutators which consists in clamping commutator-bars against a body of yielding insulating material, with a pressure sufficient to impress them into said body and then subjecting said material to a hardening treatment.

2. The method of making commutators which consists in clamping commutator-bars against a body of yielding insulating material, and then subjecting said material to a treatment by which it is hardened and permanently expanded.

3. The method of making commutators which consists in clamping commutator-bars against a body of insulating-material which is in a yielding condition but comprises a substance subject to hardening by the agency of heat, with a pressure sufficient to impress them into said body and then heating the commutator to harden said substance.

4. The method of making commutators which consists in clamping commutator-bars against a body of insulating material containing a partially cured phenolic resin, and then heating the commutator to cure the resin.

5. A commutator comprising commutator-bars with inwardly and outwardly directed bearing-surfaces at their ends; clamping and supporting means for the bars; and insulating material interposed between said means and said bearing-surfaces, the insulating material engaging the inwardly-directed surfaces being comparatively yielding so as to permit the position of the bars to be determined with reference to the outwardly-directed surfaces.

6. A commutator comprising commutator-bars with inwardly and outwardly inclined bearing-surfaces at their ends; a shaft; clamping-collars on the shaft; comparatively thin and rigid bushings, of insulating material, interposed between the collars and the outwardly-inclined bearing-surfaces; and conical bushings, of comparatively yielding insulating material, interposed between the inwardly-inclined bearing-surfaces and the shaft.

7. The method of making a commutator comprising a rigid core, commutator-bars, and end-members, which method consists in clamping the bars between the end-members and around the core, with a body of yielding insulating-material interposed between the bars and the core, and then subjecting said material to a hardening treatment.

8. The method of making a commutator comprising a rigid core, commutator-bars, and end-members, which method consists in clamping the bars between the end-members and around the core, with a body of insulating material, comprising incompletely cured phenolic resin, interposed between the bars and the core, and then completing the curing of said resin by the agency of heat.

EDWARD A. HALBLEIB.
THOMAS L. LEE.