

MOUNTING A SPARK QUENCHING ELEMENT TO A COMMUTATOR

This invention relates to rotors for miniature electric motors, and particularly to such rotors having spark-quenching element for suppressing electrical sparks generated between the commutator and brushes of the motor. It is especially concerned with the installation of the spark-quenching element and its electrical connection to the commutator.

In a miniature motor in which power is fed to rotor windings through a commutator making sliding contact with brushes to which d-c current is fed, electrical sparks generated between the brushes and the commutator can produce unwanted electrical noise and increase wear of the commutator and brushes, thus reducing the service life of the motor. To meet this problem, it is known to fit an annular spark-quenching element (a ring-shaped resistor, varister, for example) among the commutator segments.

A spark-quenching element is usually electrically connected to the commutator ^{manually} by soldering or bonding using an electrically conductive adhesive. Because of the extremely delicate nature of the commutator, the spark-quenching element and other components of a miniature motor, installation of such components requires a high degree of skill, leading to poor working efficiency and high labour costs. The use of a varister in particular involves quality problems because, when locally heated, it tends to crack.

The present invention addresses the above problems, and seeks to provide a rotor assembly in which a spark-

quenching element can be easily and safely installed. To this end, a rotor for miniature electric motors has a commutator with commutator segments for carrying electrical current from the brushes of a said motor to windings on the rotor, each segment comprising a commutating portion for making sliding contact with said brushes, a terminal portion for connection to a said rotor winding, the terminal portion having a neck, and being bent at the neck through 180° around a lead connected to said rotor windings to make electrical connection therewith, and a retaining portion formed by bending a portion of the terminal portion in a direction normal to the commutating portion, the rotor including an annular spark-quenching element abutting the retaining portions and electrically connected thereto. The disposition of the spark-quenching element is such that electrical sparks generated between the commutator segments and the brushes can be suppressed.

The spark-quenching element is preferably electrically connected to the retaining portions by direct contact therebetween. In any event, it is preferred that each retaining portion is electrically connected to any one surface of the spark-quenching element, such electrical connection holding the spark-quenching element in position. Typically, abutting surfaces of the spark-quenching element and the retaining portions bear previously applied layers of solder fused together.

In another preferred feature of the invention, the terminal portion has a neck, the terminal portion being bent at the neck around a head connected to said terminal windings to make electrical connection therewith. For

example, the terminal portion may be bent through 180° at the neck, and electrically connected to the respective rotor winding lead by resistance welding.

The spark-quenching element may take any suitable annular form. Examples of such elements are annular varistors and ring resistors.

Rotors according to the invention may have a molded commutator in which the commutator segments are integrally formed with an insulating member made of a synthetic resin.

The invention will now be described by way of example and with reference to the accompanying drawings wherein:

Figure 1A is an end view of a rotor according to the invention;

Figure 1B is a partially enlarged cross-sectional view taken along line A-A of Figure 1A;

Figure 2A is a perspective view of a commutator segment of the rotor of Figure 1; and

Figure 2B is a developed view of the commutator segment of Figure 2A.

Referring to the drawings, a commutator segment 4 has a construction substantially similar to that disclosed in Japanese Utility Model Application No. 114086 of 1981 to which reference is directed. A lead wire 9 of a rotor winding is fused to a terminal portion 6 by resistance welding in such a manner that the lead wire 9 is held by the bent part of the terminal portion 6, as shown in

Figure 2A. As shown more clearly in Figure 2B, the lead wire 9 is more effectively fused to the terminal portion 6 by providing a neck portion 11 on the terminal portion 6.

In the commutator segment used in this embodiment of the invention, an element-retaining portion 7 is provided as an integral part of the terminal portion 6, as shown in Figure 2B. Figure 2A shows where the commutator segment 4 is bent at locations shown by dotted lines in Figure 2B; the neck portion shown in Figure 2B being bent 180°.

The rotor shown in Figures 1A^{and 1B} has a motor shaft 2, and a rotor iron core 1 fixedly fitted to the motor shaft 2, to which an insulating cylinder 3 is also fixedly attached. The insulating cylinder 3 has integrally formed an insulating flange 12 that protrudes in such a fashion as to form a surface substantially normal to the motor shaft 2. The commutator segment 4 is fitted to the insulating cylinder 3 by disposing the commutator segment 4 in such a manner that its commutating portion 5 comes into contact with the insulating cylinder 3, and the terminal portion 6 comes in contact with the insulating flange 12, and fitting an insulating washer 8 to the commutating portion 5 of the commutator segment 4. On the commutator segment 4 provided in a direction normal to the motor shaft 2 is an element-retaining portion 7, on which a ring-shaped spark-quenching varister 10 is mounted in such a manner as to be in contact with the element-retaining portion 7. The element-retaining portion 7 is electrically connected to the varister 10 by an appropriate joining means, such as soldering.

Where the commutator segment 4 is disposed on the insulating cylinder 3 in the course of assembly the neck portion 11 (Figure 2A) of the terminal portion 6 is half bent (into a U shape, for example) so as to accommodate the lead wire 9 of the rotor winding (not shown) wound on the rotor iron core 1. Consequently, the lead wire 9 is electrically connected to the terminal portion 6 by inserting the lead wire 9 into the bent part of the neck portion 11 and fusing the lead wire to the terminal portion 6 by resistance welding in a state where the commutator segment 4 is held in position on the insulating cylinder 3.

The fusing operation by resistance welding means that the terminal portion 6 is bent to secure the lead wire 9, and voltage is applied with an electrode rod (not shown) forced onto the terminal portion 6. The heat generated by the current flowing in the terminal portion 6 as a result of voltage application fuses together the lead wire 9 and the terminal portion 6.

In general, the above fusing operation by resistance welding has an advantage that it lends itself to automation. However, it has the disadvantage of poor electrical conductivity. The poor electrical conductivity associated with the fusing operation by resistance welding is largely due to poor contact between the lead wire 9 and the terminal portion 6. To eliminate the cause of this shortcoming, it has been proposed to increase both the current value flowing in the terminal portion 6 and the pressure with which the electrode rod is forced onto the

terminal portion 6. This could result not only in deformation in the insulating cylinder 3 and the insulating flange 12, but also in breakage of the lead wire 9.

This invention seeks to meet the aforementioned problems associated with the fusing operation by reducing the width or thickness of the part of the terminal portion 6 onto which the lead wire 9 is forced so as to form an area having a large electrical resistance; ie, the neck portion 11. By forming the neck portion 11, not only can the terminal portion 6 be easily bent, but also the desired heat can be obtained with a lower current value, limiting the heated portion to a small area. This helps prevent poor contact between the terminal portion 6 and the lead wire 9, as well as deformation by heat of the insulating cylinder 3.

In the embodiment illustrated, the varister 10 can be easily mounted on the element-retaining portion 7 since the element-retaining portion 7 is integral with the terminal portion 6 in a direction normal to the motor shaft 2. By subjecting the terminal portion 6 and the element-retaining portion 7 in advance to pretreatment, such as solder coating, the soldering of the varister 10 to the element-retaining portion 7 and the fusing of the lead wire 9 to the terminal portion 6 can be further facilitated. In addition, the soldering of the varister 10 to the element-retaining portion 7 can also be performed simultaneously. Although the embodiment shown uses a varister as the spark-quenching element, the same

holds true when a ring resistor is used as the spark-quenching element.

The invention can also be applied to a so-called molded commutator in which commutator segments are integrally formed with an insulating member made of a synthetic resin.

As described above, the invention makes it possible to provide a rotor for miniature motors having an annular spark-quenching element for suppressing electrical sparks generated between the commutator and the brushes in which the spark-quenching element can be easily installed and electrically connected by providing on the terminal portion of the commutator an element-retaining portion to which the spark-quenching element is fitted and fused.

CLAIMS:

1. A rotor for miniature electric motors having a commutator with commutator segments for carrying electrical current from the brushes of a said motor to windings on the rotor, each segment comprising a commutating portion for making sliding contact with said brushes, a terminal portion for connection to a said rotor winding, the terminal portion having a neck, and being bent at the neck through 180° around a lead connected to said rotor windings to make electrical connection therewith, and a retaining portion formed by bending a portion of the terminal portion in a direction normal to the commutating portion, the rotor including an annular spark-quenching element abutting the retaining portions and electrically connected thereto.
2. A rotor according to Claim 1 wherein the spark-quenching element is electrically connected to the retaining portions by direct contact therebetween.
3. A rotor according to Claim 1 or Claim 2 wherein each retaining portion is electrically connected to any one surface of the spark-quenching element, such electrical connection holding the spark-quenching element in position.
4. A rotor according to Claim 3 wherein abutting surfaces of the spark-quenching element and the retaining portions bear previously applied layers of solder fused together.



5. A rotor according to any preceding Claim wherein each terminal portion is electrically connected to the respective rotor winding lead by resistance welding.
 6. A rotor according to any preceding Claim wherein the spark-quenching element is an annular varister.
 7. A rotor according to any of Claims 1 to 5 wherein the spark-quenching element is a ring resistor.
 8. A rotor according to any preceding Claim wherein the commutator is a molded commutator constructed by forming the commutator segments integrally with an insulating member made of a synthetic resin.
 9. A rotor for miniature electric motors substantially as described herein with reference to the accompanying drawings.
 10. A miniature electric motor having a rotor according to any preceding Claim.
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