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Brush gear for electric motors

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(58) Field of search
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H2E
Selected US
specifications from
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H01R

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FIG. 1

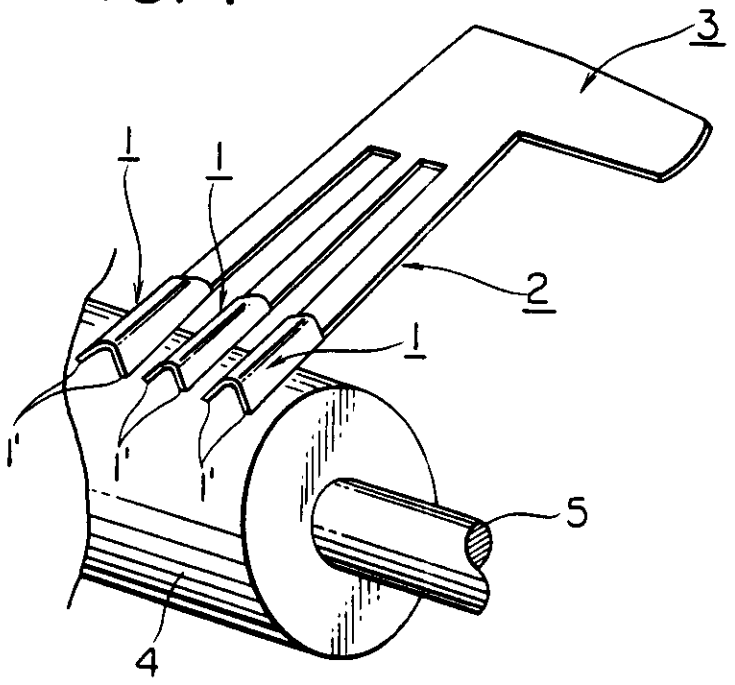

FIG. 2

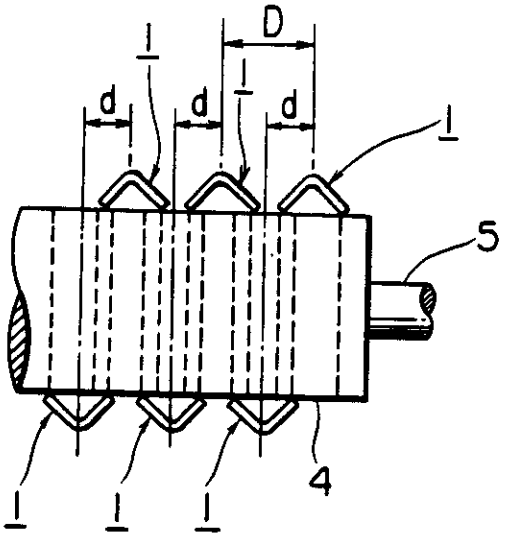

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FIG. 3A

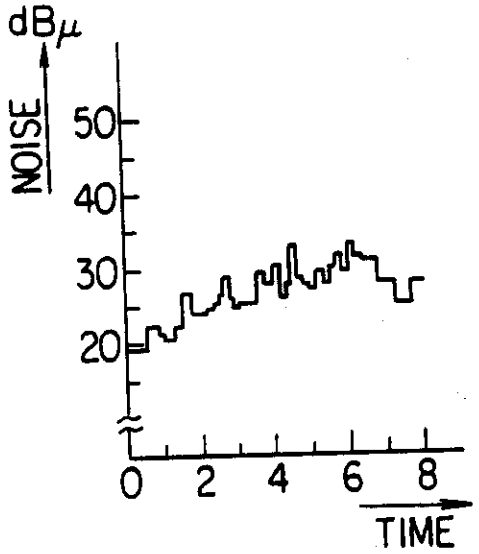

FIG. 3B

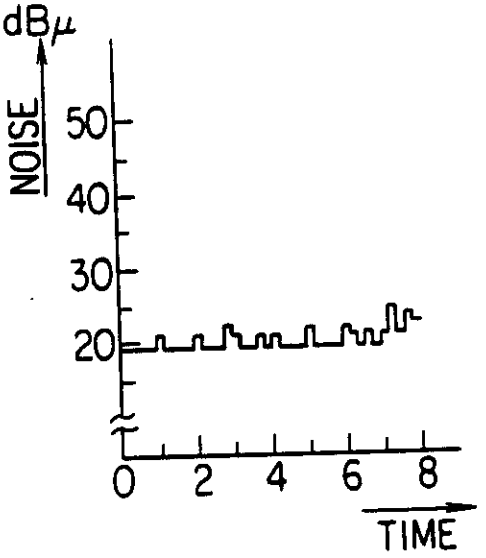

FIG. 4

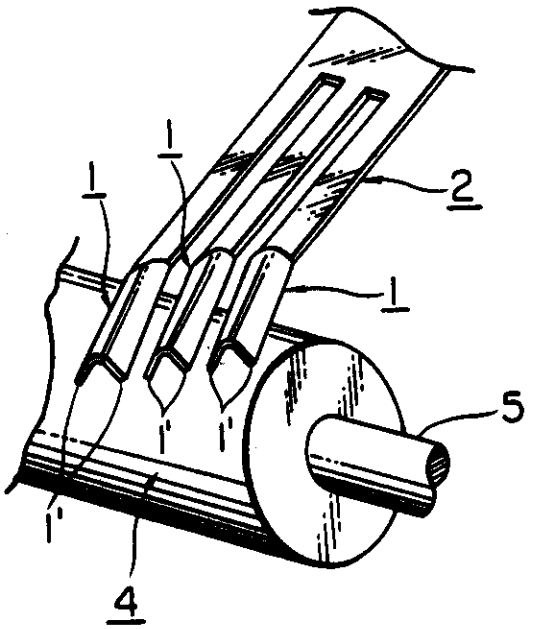

FIG. 5

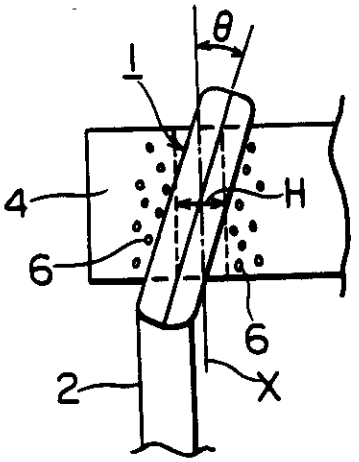

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FIG. 6A

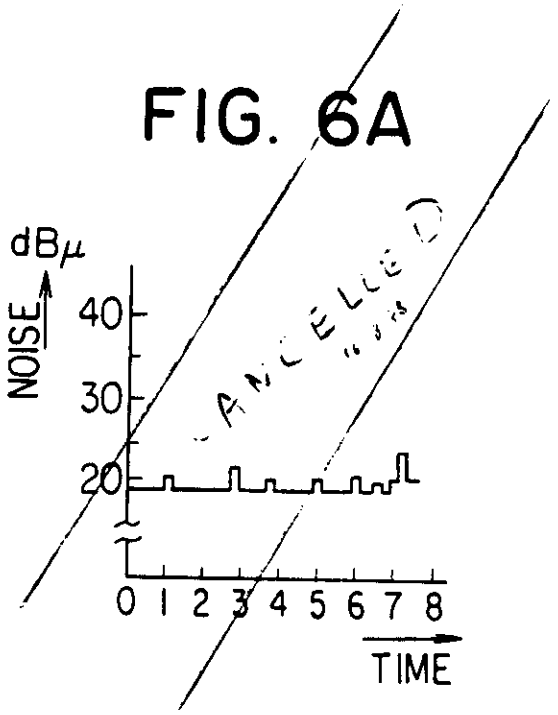

FIG. 6

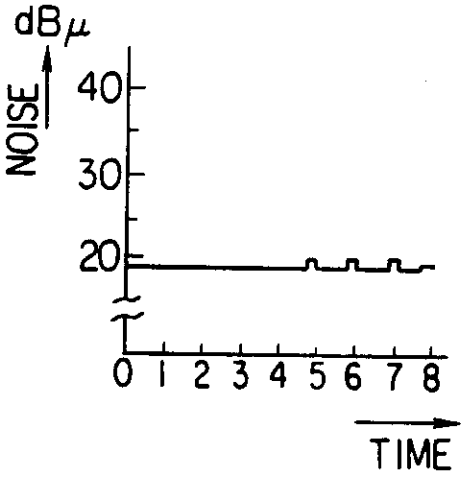

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FIG. 7A

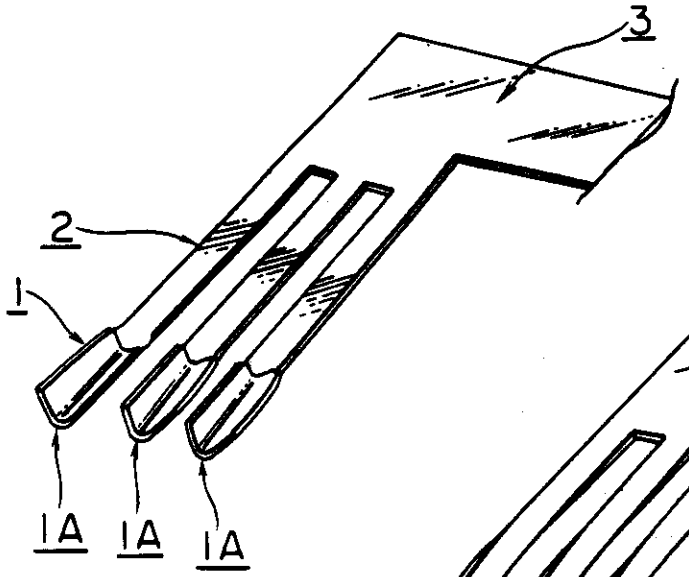


FIG. 7B

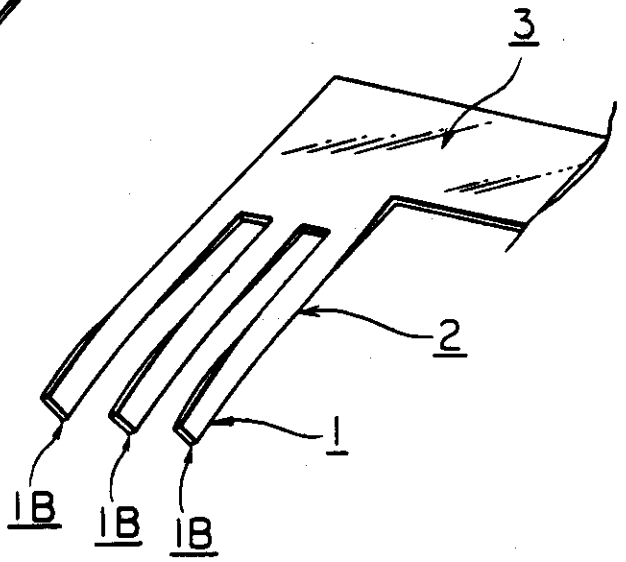


FIG. 8A

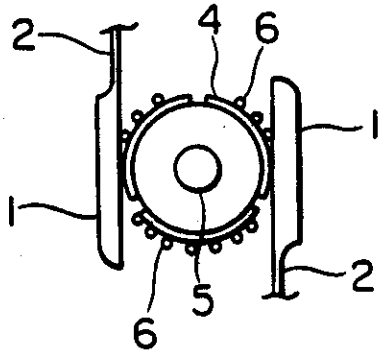
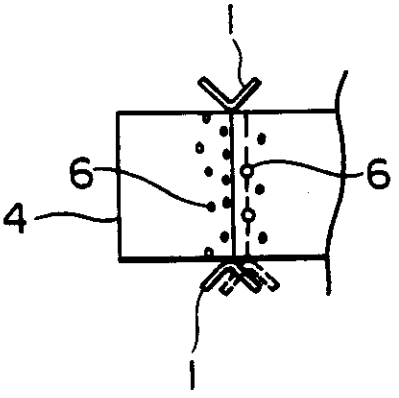


FIG. 8B



BRUSH GEAR FOR ELECTRIC MOTORS

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Description

This invention relates to brush gear for electric motors, to brushes for use in such brush gear, and to electric motors including such brush gear.

In an electric motor in which current is fed to the rotor windings via a commutator and brushes, stable contact between the commutator and the brushes is of great importance. If the contact is not stable, not only will the current being fed to the rotor windings also be unstable, but unwanted electrical noise and sparks may be generated, leading to abrasion of both the commutator and the brushes and consequential reduced service life for the motor in extreme cases.

In the case of thin strip metal brushes of the kind generally used for so-called "miniature" electric motors, there have been a number of proposals over the years in an effort to improve the contact between the brush strip and the commutator. We shall describe a number of these hereinbelow with reference to Figs. 7A to 8B of the accompanying drawings. However, we have not found these previous suggestions adequately good to overcome the problems. Our continuing work in this field has led to the present invention.

In accordance with a first aspect of the present invention, there is provided a brush for electric motor brush gear, provided with a plurality of brush shoes, made of electrically conductive metal strips, and adapted for making sliding contact with a commutator, at least one of said brush shoes being generally inverted V-shape in cross-section; the feet of the inverted V-shaped brush shoe being adapted to make sliding contact with said commutator.

In a second and alternative aspect of the present invention, we provide brush gear for an electric motor, comprising: a pair of brushes made of electrically conductive metal strips, each provided with a plurality of brush shoes, and mounted for sliding contact with the commutator of the motor; at least one of said brush shoes being generally inverted V-shape in cross-section; the feet of the inverted V-shaped brush shoe being adapted to make sliding contact with said commutator.

The invention also extends to an electric motor having a rotary shaft, a commutator mounted thereon, and brush gear as specified above.

The invention is hereinafter more particularly described by way of example only with reference to the accompanying drawings in which:-

Fig. 1 shows a first embodiment of brush in accordance with the present invention in contact with a commutator;

Fig. 2 is a front elevational view illustrating the contact positions for brush gear in accordance with the present invention employing brushes according to Fig 1;

Fig. 3A is a graph illustrating electrical noise with a previously proposed form of brush gear;

Fig. 3B is a similar graph for an embodiment of brush gear according to Figs. 1 and 2;

Fig. 4 is a view generally similar to Fig. 1 for a modified embodiment;

Fig. 5 is a plan view of one brush arm and brush shoe of the embodiment of Fig. 4 illustrating its inclined relation relative to the commutator;

Fig. 6 is a graph illustrating electrical noise with an embodiment of brush gear of the embodiment of Figs. 4 and 5;

Fig. 7A is a perspective view of a previously proposed brush;

Fig. 7B is a similar view of another previously proposed embodiment; and

Figs. 8A and 8B are respectively end elevational views and side elevational views of the brush gear and commutator in previously proposed embodiments of the kind shown in Fig. 7A.

Metallic strip brushes of the kind having a brush base and a plurality of parallel brush arms extending therefrom and having regions adjacent their distal end for sliding contact with a commutator have long been known. It is equally known that sliding contact between the brush and the commutator can be improved by increasing the forces pushing the brush arms against the commutator. However, too great pressure will result in mechanical abrasion. A desired level of brush pressure can be obtained by making use of the inherent elasticity of a bent brush arm. Thus, increased pressure will result from increased bending providing that the bending does not exceed the elastic limit of the brush arm. The examples of previously proposed brush gear illustrated in Figs. 7A to 8B of the accompanying drawings have resulted from an attempt to improve the brush pressure per unit area by reducing the contact area of the brush with the commutator. As will be seen from Fig. 7A, brush base 3 has three parallel brush arms 2 extending therefrom. Brush shoes 1 are provided at the distal end of the brush arms 2 by the addition of a specific brush shoe member 1A, here of V-shaped configuration in section.

Fig. 7B shows an alternative arrangement in which the distal ends of the brush arms are twisted as shown at 1B so as to serve as brush shoes 1 integral with the brush arms.

We have not found the arrangement of Fig. 7A to be entirely satisfactory. Since the V-shaped configuration

of the brush shoes 1A results from bending, the apex corner tends to be rounded. It is a common practice to apply a lubricant such as grease to the surface of a commutator 4 (Figs. 8A and 8B). When the apex of a brush shoe 1A is rounded, it cannot completely scrape away the lubricant to provide good electrical contact between the brush arm and the commutator.

The alternative arrangement of Fig. 7B has also been found by us not to be satisfactory. The contact between the brush arm and the commutator is not sufficiently reliable because of the tendency for the inclination angle of the twisted portions 1B providing the brush shoe 1 to be somewhat erratic.

Figs. 8A and 8B illustrate the problem further. Sliding contact between the brush shoes 1 and the commutator 4 tend to result in abraded powder 6 on the surface of the commutator 4. The rounded apex of the brush shoe 1 cannot in practice, so we have found, satisfactorily scrape away the abraded powder 6. In an effort to improve the removal of the powder 6, we have attempted to align the contact positions of the brush shoes 1 of the two brushes making up the brush gear, but in assembly of the brush gear of miniature electric motors in a mass production line, it is difficult to achieve this; in practice the contact positions of the two brush shoes 1 tend to be misaligned sideways to some extent as indicated in dotted lines in Fig. 8B. Thus, until the present invention, the problems have remained unsolved.

Referring now to Figs. 1 and 2 of the accompanying drawings which show an embodiment of brush gear in accordance with the present invention, it will be noted that like reference numerals are employed, where appropriate, to the reference numerals used in Figs. 7A to 8B.

Thus, brush shoes 1 attached to the distal ends of a plurality of parallel brush arms 2 which extend from a brush base 3 make contact with the surface of a commutator

4 mounted on the rotor shaft 5 of an electric motor. It will be noted that the brush shoes 1 which may each be integral with their respective brush arm 2 are each generally inverted V-shape in cross-section and have feet 1'. The brush base 3 is suitably supported by a motor case cover (not shown) for example, such that the brush arms 2 are slightly bent with the result that the feet 1' of the brush shoes 1 are biased into contact with the commutator 4 as shown. As the feet 1' are provided by sharp edges of the brush shoe 1, removal of commutator lubricant is facilitated with improved contact between the brushes and the commutator and stabilized conduction. The complete brush gear will suitably include a second identical brush on the opposite side of the commutator (see Fig. 2).

The two brushes of the brush gear are suitably disposed relative to the commutator as shown in Fig. 2, where it will be seen that the contact positions for brush shoes 1 of one brush separated from each other by a distance D are offset axially of the rotor 5 and commutator 4 by a predetermined distance d. With this arrangement, the paths on which the pair of brushes slide on the commutator 4 can be completely staggered, as shown by dotted lines in Fig. 2. This results in reduced wear of the commutator by the sliding contact of the brushes, leading to prolonged service life of the motor.

This arrangement stabilizes contact between the brushes and the commutator, remarkably reducing electrical noise generated by the sliding contact between the brushes and the commutator, and reducing fluctuations in electrical noise even when the motor is kept running for long hours.

Figs. 3A and 3B show the results of experiments demonstrating this.

Fig. 3A shows measured electrical noise in a miniature motor having conventional brush gear, and Fig. 3B the measured electrical noise in an otherwise identical miniature motor having brush gear according to

Figs. 1 and 2. In Figs. 3A and 3B, the abscissa represents the elapse of time, and the ordinate the electrical noise value (dBu).

The brush gear of the embodiment of Figs. 4 and 5 has a construction similar to that of Figs. 1 and 2, except that the brush shoes 1 are formed at a skew angle at the distal ends of brush arms 2 so that the feet 1' of the inverted V-shaped brush shoes 1 make contact with the commutator 4 at the same skew angle θ. As the plan view of Fig. 5 shows (only one brush shoe being illustrated for ease of drawing and description), since the brush shoe 1 is angled to extend at a predetermined angle θ relative to planes normal to the axial direction of the rotating shaft, it makes sliding contact askew with the commutator 4 during motor rotation, and scrapes the abraded powder 6 from the commutator surface to produce an area where no powder 6 is present (shown by arrow H in the figure). Though not shown in this figure, there will be a second brush located at the opposite side of the commutator similarly producing an area where no powder exists. Even when the second brush is offset slightly sideways and axially of the commutator, as tends to occur in practice, the area having no powder produced by the other brush will substantially coincide with the area H produced by the feet 1' of the first brush shoe 1 shown in Fig. 5. As a result, the various brush shoes 1 make contact with the commutator 4 almost always within an area having no abraded powder. This reduces fluctuations in contact resistance, leading to stable motor rotation.

As we have observed, Fig. 5 actually only illustrates a single brush shoe 1. In practice, as shown in Fig. 4 all the shoes of a fork-shaped brush may have similar angled brush shoes 1. There is no need to be limited to this arrangement. In general, we have found that the desired effect can be obtained by angling at least one of a plurality of brush shoes 1.

Fig. 6 shows the measured results for electrical noise in a miniature motor having brush gear according to Fig. 4. In each case the abscissa represents the elapse of time and the ordinate the electrical noise value (dBu). As will be seen the modification of Fig. 4 results in a further improvement.

CLAIMS

1. A brush for electric motor brush gear, provided with a plurality of brush shoes, made of electrically conductive metal strips, and adapted for making sliding contact with a commutator, at least one of said brush shoes being generally inverted V-shape in cross-section; the feet of the inverted V-shaped brush shoe being adapted to make sliding contact with said commutator.

2. Brush gear for an electric motor, comprising: a pair of brushes made of electrically conductive metal strips, each provided with a plurality of brush shoes, and mounted for sliding contact with the commutator of the motor; at least one of said brush shoes being generally inverted V-shape in cross-section; the feet of the inverted V-shaped brush shoe being adapted to make sliding contact with said commutator.

3. An electric motor having a rotary shaft, a commutator mounted thereon, and brush gear according to Claim 2.

4. An electric motor according to Claim 3, wherein the sliding contact positions of said brush shoes of said pair of brushes are spaced from each other by a predetermined distance in the axial direction of said commutator.

5. An electric motor according to Claims 3 or 4, wherein the feet of said V-shaped brush shoes are disposed to extend in a direction inclined at a predetermined acute angle to planes normal to the axial direction of the motor shaft.

6. A brush for electric motor brush gear, substantially as hereinbefore described with reference to and as shown in Figs. 1, 2, 3B and 4 to 6B of the accompanying drawings.

7. Brush gear for an electric motor, substantially as hereinbefore described with reference to and as shown in Figs. 1, 2, 3B, and 4 to 6B of the accompanying drawings.

8. An electric motor substantially as hereinbefore described with reference to and as shown in Figs. 1, 2, 3B, and 4 to 6B of the accompanying drawings.

REGISTER ENTRY FOR GB2172446

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Title BRUSH GEAR FOR ELECTRIC MOTORS

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**** END OF REGISTER ENTRY ****