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SUBMINIATURE BRUSH ASSEMBLY

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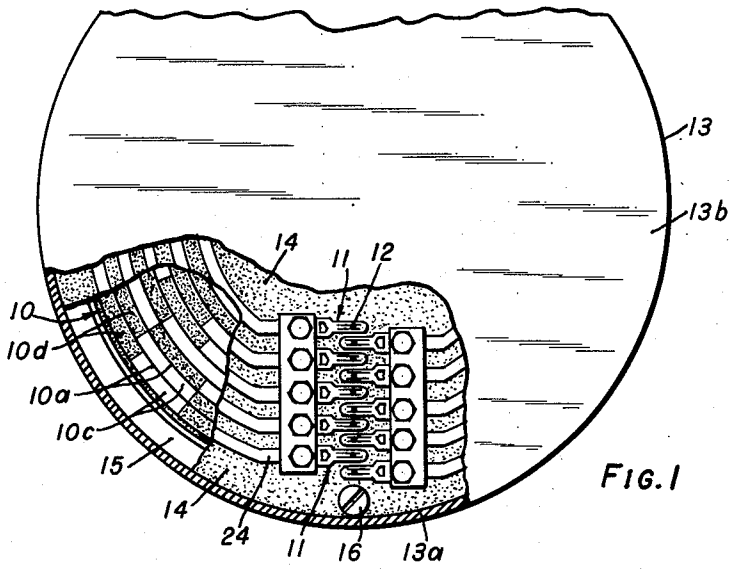


FIG. 1

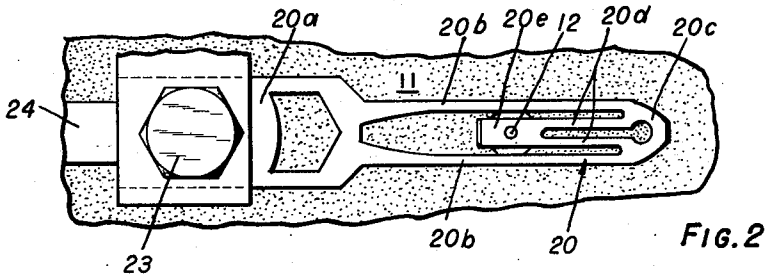


FIG. 2

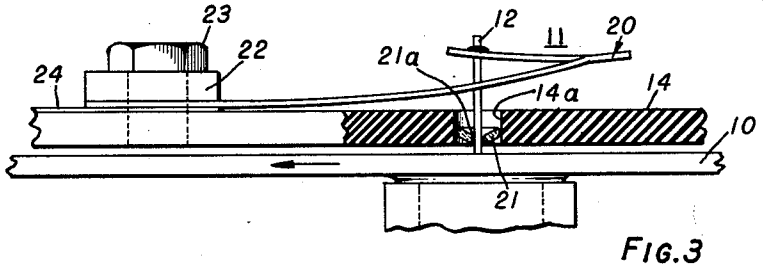


FIG. 3

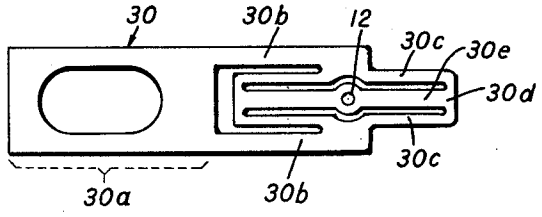


FIG. 4

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SUBMINIATURE BRUSH ASSEMBLY

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This invention relates to brush assemblies for electrical apparatus and is particularly useful in subminiature apparatus employing sliding contacts such as, for example, digital coding and decoding equipment involving a commutator having very narrow segmental tracks with respect to which the associated brushes must be very accurately positioned and must present a uniform contact area and force throughout their life.

In general, the techniques employed in brush design for ordinary electrical apparatus are not applicable to extremely small apparatus, particularly apparatus employing commutators having very narrow, closely positioned tracks, each of which must have one or more individual brushes accurately positioned with respect thereto.

The most common type of brush presently employed wtih microcommutators is simply a length of spring wire having a curved end, a convex face of which bears against the commutator. Such brushes are difficult to position accurately, have poor contact resistance and wear properties, and have a short useful life, because wear changes the shape of and the position of the contact area with respect to the commutator.

An object of the invention is to provide a brush assembly design that can be made in very compact form and does not have the aforementioned disadvantages of present designs.

More specifically, the object of the invention is to provide a brush assembly adapted for subminiature equipment that:

(1) Accurately positions the brush despite changes in the brush length resulting from wear;

(2) Provides a brush contact face that does not change its shape or size with wear;

(3) Provides a predetermined uniform contact force between the brush and commutator;

(4) Functions equally well with movement in either direction between the brush and the commutator;

(5) Permits brush and spring elements of different materials, each best adapted for its particular function.

The foregoing objects are obtained in accordance with the invention by employing an elongated brush element held perpendicular with respect to the commutator by a guide aperture close to the commutator and a leaf spring element attached to the brush element at a point thereon substantially spaced from the commutator. The brush element is of uniform cross-section longitudinally, so that the shape, size and position of its face does not change with wear. Shortening of the brush element with wear permits the position of that end of the spring attached to the brush to change, but any resultant lateral shifting of the spring end produces only a much lesser shifting of the contact end of the brush because, considering the brush element as a lever fulcrumed in the guide aperture, the contact end of the brush is much closer to the fulcrum than is the spring end. In practice, the distance from the guide aperture to the spring end may be twenty or thirty times the distance from the aperture to the contact end. Furthermore, the spring is designed to have little lateral movement in response to movement toward and away from the commutator. The brush position is substantially unchanged in response to reversal of the frictional drag of the commutator thereon by reversal of the direction of movement of the commutator, because of the close positioning of the guide aperture to the commutator and the relative remote point of attachment of the spring to the brush.

A full understanding of the invention may be had from the following detailed description, referring to the drawing.

In the drawing:

FIG. 1 is a plan view, with portions broken away, of a digital coding device incorporating brush assemblies in accordance with the invention.

FIG. 2 is an enlarged plan view of one of the brush assemblies.

FIG. 3 is a front elevation view of the assembly shown in FIG. 2.

FIG. 4 is a plan view of an alternative spring construction.

FIG. 1 discloses a digital coding device of well known type employing a disk commutator **10** rotatable past a plurality of brush assemblies **11**, each having a brush **12** which bears upon the commutator. The commutator has a plurality of closely spaced annular tracks **10***a*, each of which contains insulating segments **10***d* and conductive segments **10***c*. There is a brush assembly **11** for each of the commutator tracks **10***a*, the brush **12** of each brush assembly riding on a different track.

In the particular construction of FIG. 1, the apparatus is encased in a cylindrical casing **13** having a cylindrical side wall **13***a* and a top wall or cover **13***b*. The commutator **10** is positioned in the lower portion of the casing and the brush assemblies **11** are mounted on an insulating disk **14** that is positioned above and close to the commutator and supported on a shoulder **15** projecting inwardly from the casing side wall **13***a* and secured to the shoulder, as by screws **16**. The brushes **12** are all located in a common radial plane with respect to the commutator, and because of the close spacing of the commutator tracks and the brushes, the latter are arranged in two banks, the brush assemblies of one bank being positioned on one side of the radial plane and the brushes of the other bank being supported on the other side of the radial plane, the brushes of the two banks being dovetailed with respect to each other. In the particular design shown, the radial width of the entire track portion of the commutator is only about ½", and since there are ten tracks and ten brushes their design presents a serious problem. The problem is further aggravated by the fact that the brushes must be accurately and permanently positioned both radially and circumferentially in a single radial plane. The present invention solves this problem with the particular brush assembly construction shown in FIGS. 2 and 3, reference to which is made.

Each brush assembly **11** comprises, in addition to a brush **12**, a spring means **20**, and a guide member consisting of the adjacent portion of the stationary disk **14** having a hole **14***a* therein containing a bearing jewel **21**, the inner periphery of which defines an aperture **21***a* through which the brush **12** extends into contact with the commutator **10**.

As clearly shown in FIG. 3, the brush **12** is an elongated cylinder or rod of smaller diameter than the width of a commutator track **10***a*, and since it does not have to perform any spring function itself, it can be made of material chosen solely on the basis of its electrical properties and compatibility with the commutator material for sliding contact therewith. The chief support for the brush is afforded by the jewel **21** which is positioned closely adjacent the commutator end of the brush. This restricts lateral movement of the contact end of the brush very narrowly, while permitting free movement of the brush longitudinally in response to any irregularities in the commutator surface. The brush is attached to the spring

20 near its upper end by soldering or welding. The nature of the spring is such that it produces only limited lateral movement of the upper end of the brush in response to shortening of the brush from wear against the commutator, while maintaining a relatively constant force against the commutator. Any slight lateral movement that may be permitted by the spring has little effect on the lateral position of the lower end of the brush relative to the commutator, because the distance from the jewel to the point of attachment of the spring to the brush is much greater than the distance from the jewel to the commutator. The aperture 21*a* in the jewel is preferably flared at both ends, so that such slight rocking movement of the upper end of this brush 12 as may be caused or permitted by the spring will not cause the brush to bind in the aperture. The jewel 21 is press-fitted into the hole 14*a* in the stationary disk 14.

As shown, the brush 12 and the guide aperture 21*a* are circular in cross section, this shape being the easiest to manufacture, and being suitable in most applications. However, brushes of rectangular cross section provide more desirable contact areas against a commutator and may be used where their cost is justified. A rectangular brush may be guided by a circular aperture of size circumscribing the brush, or preferably by a corresponding rectangular aperture.

The spring 20 is a leaf spring of thin sheet metal and of such design as to minimize lateral movement of the upper end of the brush in response to longitudinal movement thereof. As shown in FIGS. 1 and 2, this spring comprises a relatively wide base portion 20*a* which merges into a pair of narrow portions 20*b* straddling and extending beyond the brush 12 and merging into a single end portion 20*c* from which a pair of narrow portions 20*d* extend back between the portions 20*b* and merge into a single tip portion 20*e* having a hole through which the brush 12 extends, the brush being fixed to the tip portion by soldering, welding or any other suitable manner.

The base portion 20*a* of the spring is clamped between the stationary disk 14 and a block 22 which is secured or pressed against the disk 14 by screws 23, there being one screw for each spring and the springs being apertured in their base portions to receive the screws.

Electrical connection to each brush is made through its spring, and the different springs are insulated from each other by utilizing an insulating material for the disk 14 and the block 22. Electrical connections to the springs 20 may be made in various ways, depending upon the particular requirements. In the present instance, printed circuit methods are employed to provide strip conductors 24 on the upper surface of the stationary disk 14, each of which extends below the base portion of its associated spring. The remote ends of the conductors 24 may be connected to a suitable terminal block (not shown).

The spring construction shown in FIGS. 2 and 3 is particularly desirable when a large number of brushes are positioned in a line closely adjacent each other, as in FIG. 1. Because of the fact that the spring portions 20*b* are positioned much closer together than the overall width of the base portion 20*a*, adjacent springs can be positioned closely together by locating their bases on opposite sides of the plane of the brushes, as shown in FIG. 1.

Where greater spacing between the brushes is permitted, an alternative spring construction, such as that shown in FIG. 4, can be employed, which provides somewhat greater stability against lateral movement than the spring construction of FIGS. 2 and 3.

Referring to FIG. 4, the alternative spring 30 comprises a wide base portion 30*a* merging into a pair of widely spaced narrow portions 30*b*, the outer ends of which extend substantially to the plane of the brush 12 and thence inwardly toward each other where they merge with the center sections of longitudinally extending narrow portions 30*c* which are joined to each other at their ends by

transverse portions 30*d*. The portions 30*d* merge at their midpoints into opposite ends of a final portion 30*e* to the middle of which is secured the brush 12.

With the spring design of FIG. 4, when the brush 12 is elevated to its normal position, the major bending of the spring occurs in the portions 30*c* and 30*e*, the center of the portion 30*e* going upwardly at the middle and the portions 30*c* going upwardly at their ends. Such movement produces substantially equal longitudinal movements of the portions 30*d* toward each other so that the brush 12 is not shifted laterally.

It will be apparent from the foregoing description that the brush assembly described has the following advantages:

(*a*) A brush that is accurately positioned with respect to the commutator despite changes in its length resulting from wear;

(*b*) A brush presenting an unchanging face to the commutator despite wear;

(*c*) A compact spring structure capable of providing a predetermined, relatively uniform contact force;

(*d*) A brush that functions equally well with movement of the commutator in either direction;

(*e*) A practical subminiature design for minute assemblies, providing separate brush and spring elements so that each can be made of material more suitable for its function.

Although for the purpose of explaining the invention a particular embodiment thereof has been shown and described, obvious modifications will occur to a person skilled in the art, and I do not desire to be limited to the exact details shown and described.

I claim:

1. A brush assembly for making electrical contact with a commutator surface comprising:
   a guide member positioned closely adjacent said commutator surface and having a brush-guiding aperture perpendicular to the commutator surface;
   an elongated brush of uniform cross-section extending through said aperture with a close sliding fit, and having one end in abutting relation with the commutator surface the longitudinal extent of said close sliding fit between said brush and said aperture being too short to prevent rocking movement of said brush in said aperture;
   elongated spring means anchored at one end to said guide member and at the other end to said brush at a point thereon spaced from said aperture on the side thereof remote from said commutator;
   said spring means having substantial resistance to lateral displacement of its said other end for maintaining said brush in alignment with said aperture and preventing said rocking movement of said brush in said aperture, and having yieldable resistance to displacement of its said other end axially away from said aperture to resiliently urge said brush against said commutator.

2. Apparatus according to claim 1 in which:
   said guide member comprises a bearing jewel, the inner periphery of which defines said aperture;
   and a supporting member engaging the outer periphery of said jewel.

3. Apparatus according to claim 1 in which said aperture is of length approximating its lateral dimension and flared at both ends to permit limited misalignment of said brush without binding.

4. Apparatus according to claim 1 in which said point of attachment of said spring to said brush is spaced from said brush-guiding aperture a distance substantially greater than the distance from said aperture to said commutator surface.

5. Apparatus according to claim 1 in which said spring means comprises a leaf spring having a base portion anchored to said guide member, a pair of spaced

elongate portions extending from said base portion past said brush on opposite sides thereof and merging into a common end portion, and a third elongate portion extending back from said end portion between said spaced portions to said brush and anchored thereto.

6. Apparatus according to claim 1 in which said spring means comprises a leaf spring having a base portion anchored to said guide member, a pair of spaced portions extending from said base portion substantially to the plane of said brush and merging at their ends with the midportions of a pair of elongate members positioned closer together than said first-mentioned two members and substantially parallel thereto, a second pair of members merging into common end portions at their opposite ends, and a third elongate section extending between and joined

to said end portions and connected at its midportion to said brush.

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