March 9, 1965 K. R. MATZ 3,173,047

ELECTRICAL BRUSH AND CONNECTOR ASSEMBLY

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Fig. 1.

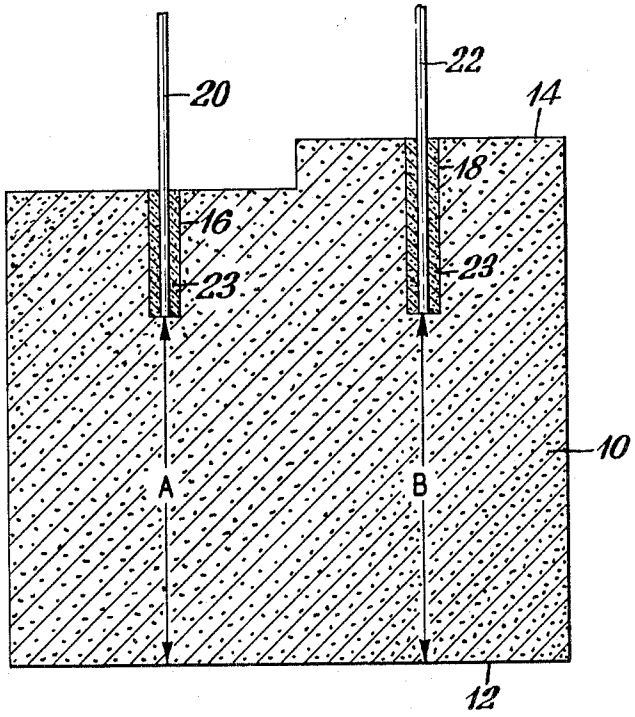
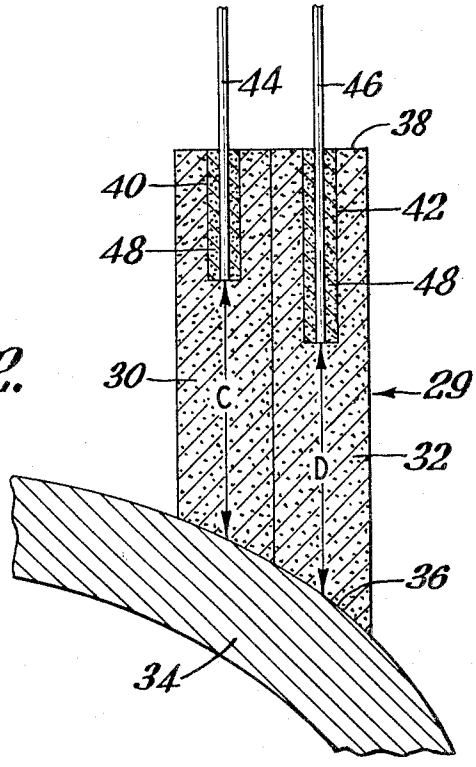


Fig. 2.



INVENTOR.
KENNETH R. MATZ

BY

ATTORNEY

United States Patent Office

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ELECTRICAL BRUSH AND CONNECTOR ASSEMBLY

Kenneth R. Matz, Fairview Park, Ohio, assignor to Union Carbide Corporation, a corporation of New York

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The invention relates to an electrical brush assembly comprising one or more brush bodies and at least two shunts attached thereto, and refers in particular to a construction which substantially equalizes the current flow in different parts of the brush body or bodies.

Many electrical brush assemblies in current use comprise brush units having irregular shapes. As used herein, the term "brush assembly" refers to a construction comprising a brush body, or bodies in juxtaposition and the shunts electrically attached thereto, and the term "brush unit" refers only to the brush body or bodies constituting the brush assembly.

One brush unit in common usage, for example, comprises a brush body having a non-working surface, i.e., the surface usually opposite the face which abuts the commutator, consisting of two parallel, substantially planar surface in different planes with a step therebetween to complete the surface. The brush body is so shaped in order to fit into a brush holder along with a similar brush body and accept pressure from a separate spring finger on each brush body. Another of the brush units having an irregular shape comprises two brush bodies of unequal length disposed side by side which operate in a position angular to the tangent of a commutator in an electrical machine.

Electrical leads or shunts are usually attached to the brush unit by drilling or forming small holes in a non-working surface, inserting an end of a shunt in each hole, and cementing the shunts in place. Although the resutant construction may operate quite well when each brush body is rectangular and adjacent brush bodies are equal in length, the operating characteristics of prior art brush assemblies which comprise irregular brush units are not as good as desired. In particular, wattage losses as heat, temperature differences within a brush unit, and the cycling magnitude between adjacent brush bodies are relatively large. In addition, the working faces of the brush units frequently wear unevenly.

The primary object of the invention, therefore, is to provide an improved electrical brush assembly of the type which employs a brush unit of irregular shape.

Another object of the invention is to provide a novel construction of an electrical brush assembly which employs a brush unit of irregular shape, which construction minimizes the wattage losses as heat, reduces the current cycling magnitude between adjacent brush bodies, and improves the wear pattern of the working face of the assembly.

In the drawing:

FIG. 1 is a sectional view of a brush assembly made in accordance with the invention; and

FIG. 2 is a sectional view of another embodiment of the invention.

Broadly, the above objects are achieved by an electrical brush assembly comprising a brush unit and at least two shunts electrically attached to the unit, each of the shunts being attached at a distance from the working face of the unit which effects substantially equal impedances between each shunt and the working face. Such a construction reduces sparking between the brush unit and the commutator during operation, and reduces overloading of one brush body or part of one brush body ordinarily having a lower impedance than the remaining

parts of the unit. Thus, the temperatures throughout the brush unit tend to remain equal, and the electrical conditions at the working face are improved.

Referring now to the drawing, FIG. 1 shows a sectional view of a brush assembly made in accordance with the invention. As there shown, the brush assembly comprises a brush body **10** having a substantially flat working face **12** and a non-working face **14** consisting of two parallel, planar surfaces in different planes with a step therebetween. Two holes **16** and **18** are drilled in the non-working face **14**, and two electrical shunts **20** and **22** are electrically attached to the brush body **10** by inserting each of them in one of the holes **16** and **18** and then tamping a bonding material **23**, such as a copper powder, solder, or an amalgam, around them. The holes **16** and **18** are each drilled to a depth which permits a mechanically strong connection of low electrical resistance, but which also provides substantially equal distances A and B between the shunt **20** and the working face **12** and between the shunt **22** and working face **12** respectively. As shown in the drawing, the depths of the two holes **16** and **18** from non-working face are necessarily unequal in order to effect the equal distances A and B. For a brush body **10** made of a uniform or symmetric composition, the impedance between each of the shunts **20** and **22** and the working face **12**, in parallel directions, will be substantially equal, and the current flow through each part of the brush body **10** corresponding to the shunts **20** and **22** will also be substantially equal.

Another embodiment of the invention is shown in section in FIG. 2 wherein the brush assembly comprises a brush unit **29** consisting of two juxtaposed brush bodies **30** and **32** of unequal length disposed on a cylindrical communtator **34** in a position angular to the tangent of the commutator **34**. The working face **36** at the bottom of the brush unit **29**, which is arcuate in shape, fits flush against the commutator **34**, and the non-working face **38** at the top surface of the brush unit **29** is flat, although it can be of any shape suitable for use in a desired brush holder. Two holes **40** and **42** are drilled in the non-working face **38** to a depth at which the distances C and D, along parallel lines, between the bottom of each of the holes **40** and **42** and the working face **36** respectively are substantially equal. The holes **40** and **42** are so disposed in the non-working face **38** that each of the brush bodies **30** and **32** has a hole therein. The holes **40** and **42** are unequal in depth in order to effect equal distances C and D.

Two shunts **44** and **46** fit into the holes **40** and **42** to their bottoms respectively, and are both physically and electrically attached to the brush unit **29** by a bonding material **48** tamped around the shunts in each hole. Thus, since the brush bodies **30** and **32** are usually made of the same material or materials, the impedances between the working face **36** and the shunts **44** and **46** respectively will be substantially equal, and the current flow through the two brush bodies **30** and **32** will also be substantially equal.

In view of the foregoing description, other constructions in accordance with the invention will be apparent to those in the art. For example, the equal impedance principle described herein can be applied to all brush assemblies having brush units of irregular shapes and at least two shunts attached thereto. In addition, the invention can be followed no matter what type of electrical shunt connection is employed, such as rivet, spring, cement, clamp, and the like. It will also be apparent that when the contact and shunt connection resistances vary in different parts of a brush unit, the placement of the shunts in or on the brush unit may be adjusted to

compensate for these different resistances, in addition to the resistance of the brush material. In such a case, the distances between each shunt and the working face may not necessarily be equal even though substantially equal overall impedances are achieved.

The outstanding characteristics of the brush assembly of the invention will be appreciated by comparing the wattage (I^2R) effect of it with a standard brush assembly. For example, a standard generator brush assembly having a brush unit nominally 2½ inches by 1½ inches by ¾ inch with a 30° angle bottom and 15° angle top comprising two ⅜ inch thick brush bodies disposed side by side has a resistance of 0.003 ohm/inch of length for each brush body. The standard shunt connections are about 1.362 inches from the working face in the short brush body and about 1.625 inches in the long brush body. Thus, the short brush body has a resistance of 0.0087 ohm and the long brush body 0.0104 ohm. Tests have indicated that up to about 75 percent of the total current will flow through the short body and about 25 percent through the long body. Thus, the I^2R loss in each body for a total current of 175 amps may be in the order of about 149.87 watts in the short body and about 19.91 watts in the long body.

If the standard construction described above is modified in accordance with the invention by placing the shunt in the long brush body at a point 1.362 inches from the working face, the current flowing through each body will be substantially equal, and the I^2R loss in each will be approximately equal rather than totally unequal as before. It has been found that the equalization of the loads in the two brush bodies causes the brush unit to operate at a more uniform temperature and wear more evenly on the working face. Furthermore, the brush assembly of the invention reduces the current cycling magnitude between brush bodies during commutation, and in general improves the stability and life of the assembly. Other advantages include a reduction in the level of sparking during commutation and a reduction in the occurrences of shunt connections becoming unsatisfactory due to high operating temperatures.

What is claimed is:

1. An electrical brush assembly comprising a brush unit consisting of at least one brush body having a bottom surface which constitutes the working face of said unit and a top surface which constitutes the non-working surface of said unit, said non-working surface being irregular in distance from said working face; and at least two shunts electrically attached to said brush unit; the lowest part of one of said shunts being a distance from said non-working surface different from the corresponding distance of another of said shunts, at least one of said shunts being electrically attached to each brush body by being partially embedded and filling a hole in each of said brush bodies, said hole extending from said non-working face toward, but short of, said working face of said brush unit, and the depth of said embedment of said shunts being unequal, and these depths being such that the impedance between the different shunts and said working face of said brush unit are substantially equal.

2. An electrical brush assembly comprising a brush unit consisting of at least two brush bodies having bottom surfaces which constitute the working face of said unit and top surfaces which constitute the non-working surface of said unit, the distance between the bottom surface and top surface of one of said brush bodies being different from the corresponding distance of another of said brush bodies; and at least two shunts electrically attached to said brush unit; the lowest part of one of said shunts being a distance from said non-working surface different from the corresponding distance of another of said shunts, at least one of said shunts being electrically attached to each of said brush bodies by being partially embedded and filling a hole in each of said brush bodies, said hole extending from said non-working face toward, but short of, said working face of said brush unit, and the depth of said embedment of said shunts being unequal, and these depths being such that the impedance between the different shunts and said working face of said brush unit are substantially equal.

3. An electrical brush assembly comprising a single brush body having a working face and opposite said working face a non-working face, said non-working face comprising two substantially planar, parallel surfaces in different planes with a step in between to complete said non-working face, and at least two holes in said non-working face with each of said planar surfaces having at least one of said holes therein, the depth of one of said holes being different from the depth of another of said holes and the depth of each of said holes being such that the distances between the bottom of each of said holes and said working face are substantially equal; and at least two shunts electrically attached to said unit, each of said shunts fitting in one of said holes to its bottom, thus effecting substantially equal impedances between each of said shunts and said working face.

4. An electrical brush assembly comprising a brush unit consisting of at least two brush bodies of unequal length and having bottom surfaces which constitute the working face of said unit and top surfaces which constitute the non-working surface of said unit, said top surfaces having at least two holes therein with each of said top surfaces having at least one hole, the depth of one of said holes being different from the depth of another of said holes and the depth of each of said holes being such that the distances between the bottom of each of said holes and said working face are substantially equal; and at least two shunts electrically attached to said unit, each of said shunts fitting in one of said holes to its bottom, thus effecting substantially equal impedances between each of said shunts and said working face.

No references cited.