June 30, 1970 A. L. SEBOK ET AL 3,518,475

BRUSH AND BRUSH HOLDER ASSEMBLY

Filed Aug. 15, 1966

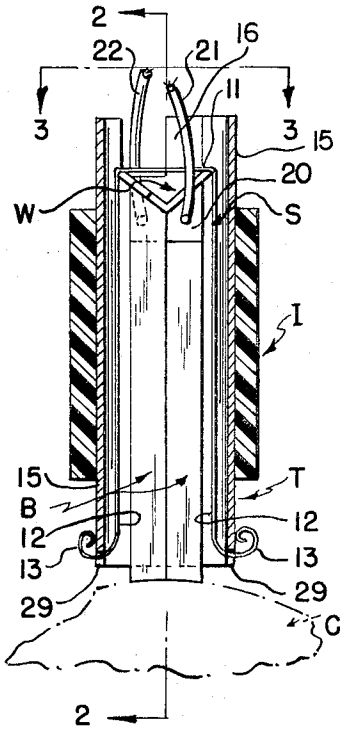


FIG. 1

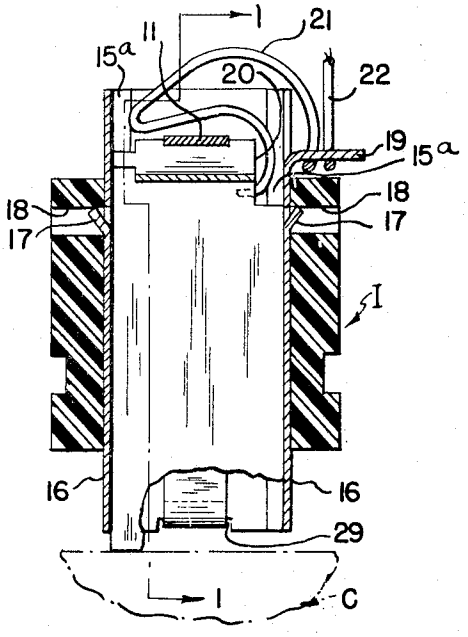


FIG. 2

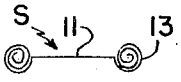


FIG. 5

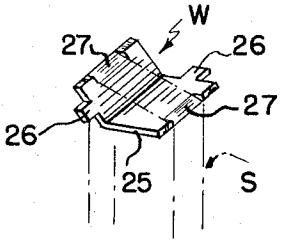


FIG. 4

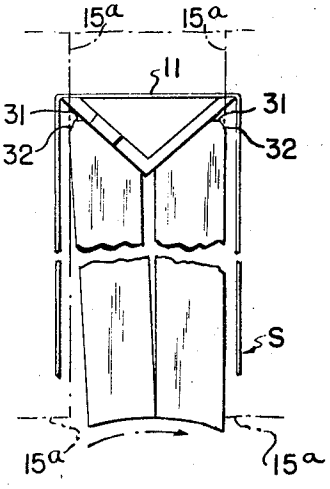


FIG. 6

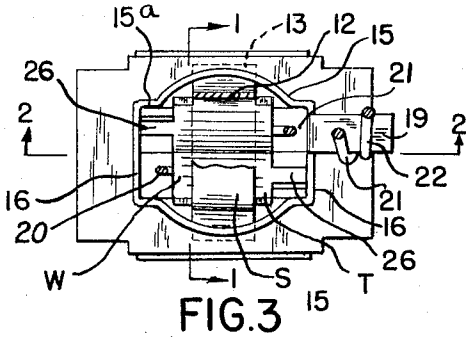


FIG. 3

INVENTORS
ALBERT L. SEBOK,
JOHN H. PORTER,
EVERAL B. MC BROOM JR.

BY Ely and Bolrick

ATTORNEYS

United States Patent Office

3,518,475

Patented June 30, 1970

3,518,475

BRUSH AND BRUSH HOLDER ASSEMBLY

Albert L. Sebok, Tallmadge, and John H. Porter and Everal B. McBroom, Jr., Kent, Ohio, assignors to Ametek, Inc., a corporation of Delaware

Filed Aug. 15, 1966, Ser. No. 572,565
Int. Cl. H01r 39/40
U.S. Cl. 310—245 8 Claims

ABSTRACT OF THE DISCLOSURE

A saddle type constant force feed spring, with end coils seated on outer ends of, and its reaches in longitudinal recesses of, opposed walls of a rectangular guide passage of a brush tube, has a yoke portion transversely seated in a wedge thrusting on V-notch-defining ends of split brush elements. The wedge, side- and end-guided by the passage and end-notched to accommodate connecting respective pig-tails, spaces the reaches from the half-elements so that without interference the inner element ends are slidingly spread against the passage to minimize tilting and simultaneous bounce during operation, there by increasing brush life.

The present invention relates generally to a brush and brush holder assembly for making a sliding type electrical contact with rotating commutators or slip rings in dynamo-electric machines; and more particularly relates to improvements in a so-called longitudinally split brush and brush holder assembly therefor.

For convenience the invention will be discussed in terms of brush holder assemblies for commutator-type electric motors; but it is to be understood that the invention has wider application, as will be apparent to one skilled in the art.

In both prior practice and the patented art, brush holder assemblies for electric motors, having an elongated, usually carbonaceous, brush longitudinally advanced or fed against a commutator or similar moving part, have appeared with the brush longitudinally split rather than solid, in other words, having the brush comprised of two similar elements, each having half of the thickness of the corresponding conventional solid brush which oculd be used in the holder. In such cases, by suitable spring or pressure means, the brush holder assembly fed the two elements more or less in longitudinal contact and generally as a conventional unitary brush would be fed; the plane of the split or of abutting longitudinal faces passing through or at least extending parallel to the axis of the commutator. An advantage of such longitudinally split brush was expected to be a diminution of the mutually aggravating events of heavy arcing and pitting of the commutator, therefore increase of brush life which is adversely affected by heavy pitting. This advantage was anticipated on the theory that any brush bouncing or chattering, caused by transit of successive commutator segments, especially uneven segments or rough segments, would result in less arcing with the current fed through the two brush halves because of a greater probability of conductive contact with the commutator through at least one brush half than would be the case with a solid brush.

It has further been proposed in the prior art both with unitary and split type brushes, to minimize as far as possible the continuous decrease, with brush wear, of brush contact pressure which has been characteristic of the conventional brush feeds such as compressed helical brush feed springs, to use constant force brush feed spring including use of saddle type constant force spring, having a yoke portion engaging endwise a split brush distal from the commutator and parallel side reaches extending along opposite sides of the brush within the brush holder guide tube. In such prior art, it has been further proposed that the distal ends of the split brush halves be each tapered to form therebetween a V-notch or recess receiving a wedge element with the yoke portion of a saddle type spring bearing upon the wedge. By this means it was thought that one cause of brush chatter would be eliminated, namely the swing of one or the other of the brush element outer ends about pivot points at the bottom region of the brush guide tube or of one element relative to the other, a consequence of the necessary clearance and manufacturing tolerances between the combined thickness of the brush elements and the internal dimensions of the brush guide tube wall portions embracing the same.

It is with this type of brush structure that the present invention is patricularly concerned by providing an improved relatively simple and low-cost brush and brush holder assembly of the character described wherein not only are chatter and bounce minimized and certain drag effects by the spring avoided, but also wherein provision is made for ensuring little possibility of any notable conduction of current by the constant force spring thereby eliminating limitations of prior structures, especially respecting the heating effect of current conducted by such spring, detrimental to the spring characteristics and the constancy of its applied feeding force.

It is then the general object of the present invention to provide an improved longitudinally split brush and holder assembly therefor. Another object is provision of a relatively simple brush holder and brush assembly affording increased brush life. It is another object to provide in an assembly of split brush and holder therefor of improved means for feeding current to the brush elements. It is a still further object to provide in a device or assembly of the character described of an improved means for applying the force of the constant force type spring to the split brush portions. Another object is to provide means for retaining a worn brush stub and spring of the type described in the holder.

Other objects and advantages will appear from the following description and the drawings wherein:

FIG. 1 is a generally longitudinal, though somewhat irregular, section through a brush holder assembly taken substantially as indicated by the lines 1—1 in FIG. 2 or FIG. 3;

FIG. 2 is another longitudinal section of the assembly taken approximately as indicated by the lines 2—2 in FIG. 1 and FIG. 3;

FIG. 3 is an enlarged view of the assembly, certain portions being broken away, taken at the end of the assembly distal from the commutator;

FIG. 4 is an enlarged perspective view of a brush end spreader or wedge element;

FIG. 5 is a detail of the brush feed spring; and

FIG. 6 is an enlarged schematic representation indicating approximately, in exaggerated form, the geometry and mode of action of certain features or structures of the assembly.

In the embodiment of the invention shown in the drawings, a brush holder assembly for making conductive contact with the rotating element such as a commutator,

suggested by a dashed outline portion C, comprises as principal elements a conductive metal holder or guide tube T, received and secured in an insulating tube I engaged by suitable known means (not shown) securing the entire assembly to but insulated from the environment such as a motor end bracket; brush means B comprised of two identical half portions representing, as it were, a longitudinally split brush, slideably guided for longitudinal feed movement in and connected to the tube T; a saddle type "constant force" brush feeding spring S (see also FIG. 5) with is transverse yoke portion **11** bearing on the outer end region of the brush means B through the mediation of a spreader or wedge element W (see also FIG. 4) and having extended side portions **12**, each reaching downwardly respectively from a wedge edge, in a longitudinal recess of the brush tube and in spaced relation between the adjacent brush and brush tube wall, to terminate in the residual coiled portion **13** engaging the bottom end of the brush tube. As the brush wears and is fed inwardly the side portions feed themselves into the bottom coiled portions **13** by the characteristic action of this type of spring.

The brush may be formed of any of the conventionally used material, such as carbon; and the spring may be a NEG'ATOR saddle type, for example. Also for the brush lead connection to the holder (not shown) various known and obvious expedients may be used.

The general form, particularly the cross section of the brush tube T, is seen, especially from FIG. 3, to be of a conventional form currently used for unitary or solid brushes of rectangular cross section longitudinally fed against the commutator by an end-bearing helical compression spring; being formed either as an extrusion of the section indicated or formed from sheet metal, usually brass, with a longitudinal dove-tail type interlock seam along one of the arcuate side portions. The tube section is basically a rectangle with opposite sides dimensioned to correspond to the total brush cross section with appropriate clearances and with longer sides respectively bowed outwardly into portions of concentric circular arcs, the diameter across which in a conventional brush tube being slightly larger than the intended helical brush feed spring diameter.

Here such a tube, readily available from commercial sources, affords not only paired parallel straight longitudinal surfaces requisite for brush guiding, but also the arcuate portions serving as the previously mentioned longitudinal recesses for accommodation of the side reaches **12** of the brush spring.

Spaced downward from the upper brush tube end in the opposite flat parallel side walls **16**, barbs **17** are outwardly staked or sheared, with upper ends free as shown in FIG. 2, whereby the tube T may be inserted from an open upper or outer end of the insulation tube I until such barbs come into coincidence and retaining engagement with corresponding insulation tube inside wall recesses or apertures **18** affording shoulders engaged with the top walls of such recesses especially effective to immobilize the guide tube T in the insulation tube I against any tendency to move radially away from the commutator.

A tab **19** is sheared and bent outwardly at right angles from the outer end of one tube wall **16** for a soldered or spot welded attachment of the free ends of the respective flexible conductor brush pigtails **21, 22**, each received and secured by conventional means in an aperture in a vertical face resulting from cutting out of the upper end corner of the brush at **20** to form a recess which with a coincident cut-out thereabove in the spreader wedge W and the region between the top of wedge W, spring yoke **11** and the surrounding top end region of tube T affords an accommodating space for the slack length of brush pigtails in a newly installed holder assembly. The pigtail length preferably is selected so as to stop brush feed at a point before the brush has worn into the pigtail connecting region or cut-out **20**, thereby to retain the brush stub and spring safely in the holder.

At the bottom of the tube T, centrally located on the end edges of bowed wall portions **15** are shallow notches **29** of width corresponding to the spring stock width, through which respectively pass the outermost turns of the residual portion of the coiled ends **13**, lying outside the tube, leading into the straightened reaches **12** which both permit a closer setting of the holder to the commutator (on the order of 1/64 inch spacing) and also engage edgewise the lower ends of each reach near the coil **13** to locate the spring.

The form of the spreader or wedge element W and of the unstressed normal or uninstalled form of a NEG'ATOR saddle type spring S are seen respectively in FIG. 4 and FIG. 5.

The brush spreader or wedge device W has wedging faces forming a dihedral angle of 90° and bearing on respective 45° tapered or angular end faces at the upper ends of the brush elements; and has a central spring yoke seat formed across the top. The wedge length corresponds with slight free sliding clearance to the internal length of the tube cross-section, but its top width is slightly greater than the tube recangular width; and the wedge at each side has end notches permitting wedge end portions **26** to project into and be guided by right angle longitudinal surfaces of the tube while wedge top longitudinal edge portions project slightly into the arcuate recesses **15** of the guide tube T to support the spring yoke in such manner that the side spring reaches are in the tube longitudinal recesses spaced from the brush element sides and tube sides. Over the location of each brush element cut-out **20**, the wedge end notching is correspondingly enlarged for brush pigtail accommodation. The element W thus is rotationally sypmmetrical with two-fold symmetry about an axis perpendicular to the dihedral edge and lying in a bisecting plane of the angle.

The wedge W is thus oriented by the tabs **26** slideably guided and supported endwise by tube walls **16**, and to some degree sideways by the outer corners of the tube rectangle.

The wedge or spreader element W may be considered as fabricated from a right angle metal section (e.g., hard brass) providing sides or plates **25** equal in dimension from the wedge dihedral edge or apex to the free longitudinal edges, and length corresponding (with the tube clearance) to the brush width or longer internal cross-section length dimension of the tube, the span between the opposed free edges of the plate being somewhat greater than the inside rectangular width. At each end a portion is cut off entirely across a respective plate **25** at a location which will fall over a brush recess **20** and partially up the end of the other plate to afford the described brush pigtail accommodating notches, and also forming tabs or lugs **26** as the aforementioned guided wedge end portions, each further narrowed or defined by corner notching each plate inward from the free edge, whereby the free edge portion is reduced in length sufficiently to project into the longitudinal recesses formed by the bowed wall portions **15**.

A flat **27** of length corresponding to the spring stock width is milled along each plate edge, centrally of the wedge length, such flats coplanar and forming in the edges opposed aligned notches as the spring yoke seat upon or within which is received and located the straight transverse yoke portion **11** of the spring S. These flats preferably are milled down into coincidence with the outermost or remote parallel edges of the longitudinal end faces, such longitudinal edges having a spacing corresponding to the internal length of yoke **11**.

The wedge W keeps the lateral portions of the spring, especially just beneath the yoke, from collapsing or pinching inward on the brush pair as well as serving in conjunction with tube bottom notches **29** to "trap" or locate the spring edgewise.

In FIGS. 1 and 3 no attempt is made to show the brush wedging or spreading effect of the element W on the brushes, this effect being presented rather schematically and in exaggerated manner by FIG. 6. This FIG. 6 shows also a structural refinement at the very upper end of each brush element, comprising the termination of the brush actually in a narrow flat end face **31** and a slight external taper or flat face **32** at 30° to the external face, having respective widths on the order of 0.035 inch for a ⅛ by 7/16 by 1⅞ inch brush half element, giving a "broken corner" which will not wedge between the adjacent spreader side plate **25** and spring reach **12**, giving free action in brush feed.

Assuming clockwise commutator rotation in FIG. 6, the lower ends of the brush elements are dragged by the commutator to the right; at the guide tube bottom edge region, the right half bearing against the short residual straight portions **15***a* of the tube rectangle and the left half bearing against the right half, so that practically the total of all corresponding tube and brush tolerances and clearances appears as the bottom spacing between the left side of the left half element and the bottom edge of residual straight portions **15***a* of the left tube wall. The upper ends of the halves, however, are spread by the wedge W into engagement with such tube wall portions **15***a*, and thus effectively prevented by the wedge face and wall contacts from swinging or pivoting about the bearing lines of contact near the bottoms of their respective right faces. The upper longitudinal edges of the wedge in keeping the spring reaches spaced out in the recesses formed by side bows **15** thus ensure that the brush upper ends bear against the tube and not against the yieldable spring reaches.

As an example of brush life prolongation, may be noted the fact that in a test of a brush holder and split brush assembly as above described in a continuously operating motor, after five thousand hours the motor was still operating with good commutation, with the commutator in good condition, and with a brush length yet remaining which would indicate some thousands of hours of further brush life to be expected; in comparison with a maximum expected brush life of about 1000 hours in the same motor for a comparably sized brush holder with solid brush and helical feed spring.

Though for convenience of description the ends of the assembly remote from and proximate to the commutator may be referred to as upper ends or top and lower end or bottom, or similar terms of orientation may be used for the assembly or parts thereof corresponding to the drawing orientation, there is, of course, no implication that use of the assembly is restricted to such orientation. Moreover, it is to be noted that though the location of elements is generally shown as for an assembly with new brush in operative position with the spreader W spaced downward from the top end of the holder, the brush pigtails for clarity are not shown laid down in the defined space adapted to receive the same, even with an end cap applied thereover, if desired. Also where the longitudinal brush guide passage, provided by the rectangularly disposed inside wall portions of tube T, is referred to as having a cross-section corresponding to or conforming to the external cross-sectional shape of the split brush, this is to be understood as contemplating normal manufacturing tolerances for the necessary free sliding clearances.

What is claimed is:

1. A brush and brush holder assembly for dynamoelectric machines or the like wherein a longitudinally centrally split brush is used and held with the plane of the split extending substantially transverse to the direction of movement relative to a surface with which the brush is to afford conductive moving contact, comprising:

a brush guide tube providing a longitudinal brush guide passage,

a pair of like brush half elements slideable longitudinally in the guide tube for simultaneous feed toward said surface in longitudinally facing relation as a split brush,

the upper ends of said brush halves having opposing longitudinal faces thereof terminating in inclined faces forming a V-notch at the split brush top,

the cross-section of said guide passage conforming generally to the external cross-sectional shape of and split brush, a brush spreading wedge in said V-notch

having upper longitudinal edge portions located above and projecting outboard of the upper ends of the respective brush halves,

whereby the said upper ends are spread away from each other into contact with opposite sides of the tube passage when the split brush bears on a said surface,

a saddle type constant force brush feed spring having

a yoke portion seated on the top of and extending transversely across said upper longitudinal edge portions of the wedge at right angles to the longitudinal split of the split brush, and

respective side reaches extending from the ends of the yoke downwardly within the guide tube and terminating in end coils, whereinto the side reaches tend to self-wind and exert brush feeding tension through the reaches on the yoke,

said end coils secured at the bottom region of the tube,

said tube having longitudinal recesses in opposite wall portions of said passage receiving with clearance the respective, outboard projecting, edge portions of said wedge and for accommodating said spring side reaches in spaced relation from the guide tube and the respective brush halves.

2. The assembly of claim **1**, wherein each brush half has a top end corner cut-out wherein a respective pigtail end is secured, the cut-outs in the split brush occurring under opposite ends of said wedge, said wedge having correspondingly located end cut-outs above the brush cut-outs, and said wedge spaced inwardly from the proximal end of the guide tube when the unworn split brush is in operating position, whereby a pigtail accommodating space is defined in said passage between the said end of the tube, the tube walls and the wedge.

3. The assembly of claim **2** wherein the cut-outs of said wedge leave wedge end portions guideable by opposed wall portions of the tube.

4. The assembly of claim **2** wherein said guide tube is a conductive tube, said guide tube having an anchor formation adjacent said defined space for attachment of the other ends of the pigtails; and including an insulation tube surrounding the greater part of said guide tube whereby the assembly may be clamped in insulated relation in the environment of use.

5. The assembly of claim **1** having a respective pigtail connected to the upper end of each brush half and to an anchor point at the upper end region of said assembly with the pigtail of such length that it stops brush feed advance by said spring at a preselected extent of brush wear, thereby to retain the brush halves, wedge and spring in said guide tube.

6. The assembly of claim **1**, wherein said wedge has a central transverse spring yoke seat formed across its top and the guide tube has on opposite sides of its bottom end region seat formations for the respective coil-terminated end portions of the spring.

7. The assembly of claim **6** wherein said wedge has end portions guided by opposed wall portions of said tube.

8. The assembly of claim **1**, wherein said wedge has end cut-outs located on opposite sides of the wedge apex, said brush halves having correspondingly located respective end corner cut-outs beneath the wedge cut-outs wherein a respective pigtail end is secured, and said wedge

spaced inwardly from the adjacent end of the guide tube when the unworn split brush is in operating position; the adjacent end of the tube having a pigtail anchoring tab formation; the cut-outs of said wedge leave wedge end portions guideable by opposed wall portions of the tube.

References Cited

UNITED STATES PATENTS

3,133,218	5/1964	Harris	310—247
2,864,019	12/1958	Gordon	310—247
3,025,421	3/1962	Sievert	310—245
2,695,968	11/1954	Welch	310—247
2,194,620	3/1940	Sekyra	310—247

FOREIGN PATENTS

732,470	6/1955	Great Britain.
620,114	9/1961	France.
17,954	12/1955	Germany.
658,776	4/1938	Germany.
835,167	7/1949	Germany.
891,288	8/1953	Germany.

MILTON O. HIRSHFIELD, Primary Examiner

M. O. BUDD, Assistant Examiner

U.S. Cl. X.R.

310—249