June 27, 1961 L. C. BLANDING 2,989,801

ELECTRICAL CONTACT ASSEMBLY AND PROCESS OF MANUFACTURE

Filed Feb. 12, 1958 2 Sheets-Sheet 1

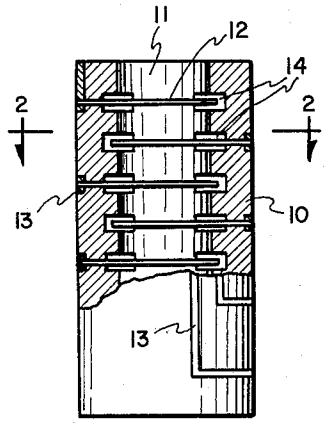

FIG. 1

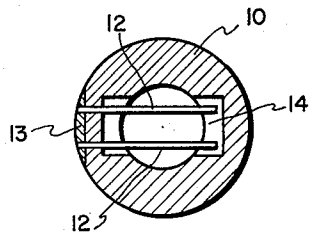

FIG. 2

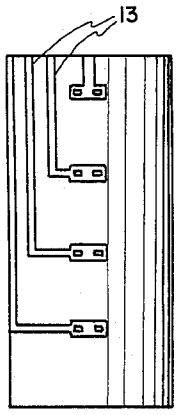

FIG. 3

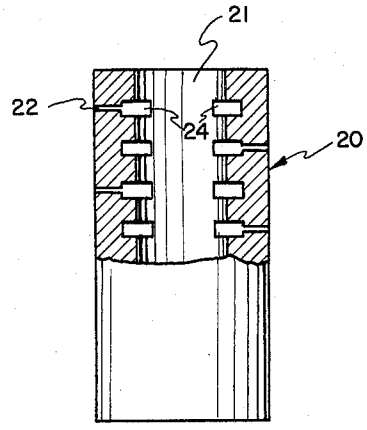

FIG. 4

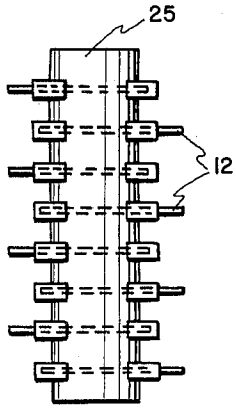

FIG. 5

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ELECTRICAL CONTACT ASSEMBLY AND PROCESS OF MANUFACTURE

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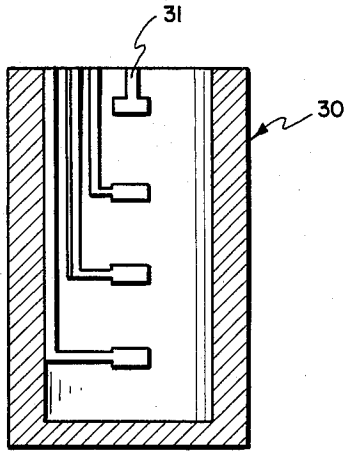

FIG. 6

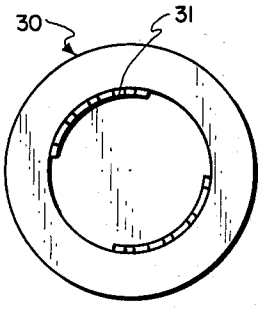

FIG. 7

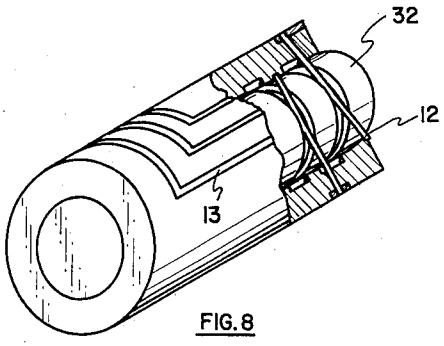

FIG. 8

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ELECTRICAL CONTACT ASSEMBLY AND PROCESS OF MANUFACTURE

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4 Claims. (Cl. 29—155.5)

The present invention relates to a brush assembly portion of a rotatable electric joint and the process of manufacturing the same.

In the past, brush assemblies have been made in miniature form but required a tedious operation of assembly including stacking the brushes by hand using a pair of tweezers and a microscope. This method, although effective, is expensive and there is a limit to how small the brush assembly can be made. The problem exists whereby space requirements dictate that the brush assemblies be made even smaller than have heretofore been made. For example, it is desirable to manufacture a brush assembly whereby the distance from the center line of one brush to the center line of the next brush is .025 of an inch. This means that the brushes must be approximately .005 of an inch in diameter.

It is also desirable to reduce the pressure the brushes apply on the slip ring in order to reduce friction. Electrical "noise" is another important factor in slip ring and brush assemblies. The "noise" is caused, in general, from dust particles on the brush or slip ring and, therefore, a means to keep dust out of the ring and brush assembly is important.

Considering then that ordinary writing paper is approximately .003 of an inch in thickness, it becomes very difficult, if not impossible using the hand assembly method, to manufacture a brush assembly conforming to the dimensions given above.

Therefore, it is an object of this invention to provide a process of manufacturing a miniature brush assembly.

It is another object of this invention to provide a brush assembly that is relatively economical and easy to manufacture.

It is still another object of this invention to provide a miniature brush assembly with a very high accuracy in the positioning of the brushes.

Other objects of this invention will become apparent from the following description with reference to the drawings in which:

FIG. 1 is a cut-away view of the brush assembly of this invention;

FIG. 2 is a sectional view taken along the lines 2—2 in FIG. 1;

FIG. 3 is a plan view of the device shown in FIG. 1;

FIG. 4 is a cross sectional illustration of a first mold utilized in the process of this invention;

FIG. 5 is an illustration of a wax core assembly;

FIG. 6 is a cross sectional illustration of the second mold;

FIG. 7 is a top view of the second mold; and

FIG. 8 is a cross sectional view of a brush and slip ring assembly.

The brush assembly as illustrated in FIGS. 1, 2 and 3 comprises a cylindrical wall **10** made of a casting resin or any non-conductive material, a cylindrical cavity **11** inclosed by wall **10**, brushes **12** and conductive leads **13**. Brushes **12** are preferably made of spring tempered orthodontic gold wire, for example, .005 of an inch in diameter. The brushes **12** are held stationary and positioned such that one end extends through the wall **10** and touches the conductive leads **13** on the outside surface of wall **10**. The other end of brushes **12** extends into the grooves **14** in wall **10** and the exposed portion of brushes **12** is free to move within the restrictions of the grooves **14**.

This allows aligning of the brushes **12** and also permits the brushes **12** to exert a pressure on the slip rings, shown in FIG. 8, so as to produce a good electrical contact. The conductive leads **13** on the outside surface of wall **10** originate at one end of a brush and terminate at one end of the brush assembly to facilitate plugging or wiring of the brush assembly into the rest of an electrical system.

The first mold **20**, as illustrated in FIG. 4, is similar in shape to the cast resin wall **10** of the finished assembly. The mold **20** has a cylindrical cavity **21**, apertures **22** to accommodate the brushes **12**, and grooves **24** identical to the grooves **14** in the finished brush assembly. The first step is to place the brushes **12** in the apertures **22** just as they are positioned in the final brush assembly. The cavity **21** is then filled with a hard wax in its molten state or similar material having a low melting point. It can be seen that the wax will also occupy the space in grooves **24**. The wax is then allowed to harden and the mold **20** is removed leaving the wax core assembly with the brushes **12** embedded therein as illustrated in FIG. 5. It is to be understood that the mold **20** is split so that the separate pieces of the mold may be removed without disturbing the wax core assembly. The apertures **22** of mold **20** are such that they position and hold the brushes **12** in place while the molten wax is being poured and hardened but yet permit the brushes **12** to remain in the wax core assembly **25** when the mold **20** is removed. The core assembly **25** is then placed in the second mold **30**. The second mold **30** has an inside cylindrical cavity larger than the outside diameter of the core assembly and also has convex portions **31** on the inside surface. The portions **31** protrude into the inside cylindrical cavity and are such that when the core assembly **25** with brushes **12** protruding therefrom is placed in the mold **30**, the portions **31** originate at one end of a brush and terminate at one end of mold **30**. The space between the core assembly **25** and the inside surface of the mold **30** is then filled with a casting resin or similar non-conductive material such as solid formulation of 100% solids casting resin. The casting resin is allowed to cure at room temperature. The mold **30**, being two or more sections, is removed from the hardened resin. It can be seen that there are concave indentations on the outside surface of the cast resin.

A plating of a conductive material, such as copper, gold or silver, is applied after the exposed ends of the brushes are cleaned to remove any contamination which may have inadvertently coated the wire by means of spraying, hot dipping, electroplating or any other known method, to the outside surface of the cast resin. The outside diameter of the assembly is then machined back to a diameter such that only the concave indentations remain coated with the conductive material.

It is to be noted that each of the brushes **12** is electrically connected to one of the electrical leads **13**. The brush assembly is then heated to melt and remove the wax and is cleaned with a solvent to make the exposed surfaces of the brushes **12** clean and capable of making an electrical connection with the slip rings. Each of the steps in the above process are performed only once for each brush assembly.

Instead of having convex portions **31** in the mold **30**, the casting resin may have grooves machined in it prior to plating.

A slip ring assembly can be inserted into the passage **11** of the brush assembly and the slip rings will exert an outward pressure on the brushes **12**. The process described above may be used to produce a brush assembly with a high degree of accuracy in the brush positioning such that the brush assembly may be made in miniature form without the loss of accuracy in positioning the brushes.

As shown in FIG. 8, the brush assembly having the slip ring assembly **32** inserted therein forms a closed system which excludes dust and, therefore, produces relatively little electrical "noise." It is preferred to operate this brush assembly with as little as .5 gram pressure exerted by the brushes on the slip rings and in a good dielectric gas atmosphere, such as helium.

Although the present invention has been described with a certain degree of particularity, it is understood that various modifications in the details and arrangements of parts may be had without departing from the spirit and scope of the invention as hereinafter claimed.

I claim:

1. The process of making a brush assembly portion of a rotatable electrical connection having a plurality of brushes extending into a cavity within said brush assembly, including mounting the first end of at least one of said brushes in a first cylindrical mold such that the second end of said brushes extends into said cavity perpendicular to the mold's central axis, filling said first mold with a wax-like material in its molten state, said second end of said brushes being disposed off center so as to intersect the axis of said first mold, solidifying said molten wax, removing said first mold from around the wax core assembly containing said brushes and inserting said wax core assembly in a second cylindrical mold, said second cylindrical mold having an inside diameter of such size that said first end of said brushes is disposed off center so as not to intersect the axis of said first mold, filling the remaining space in said second mold with an insulating material, curing said insulating material at room temperature, removing said second mold from around said insulating material containing said wax portion, plating the outside surface of said insulating material with a conductive material such that the conductive material makes electrical contact with said first ends of said brushes, machining said plating to leave a plurality of leads of conductive material on the outside surface of said insulating material from said brushes to one end of said brush assembly, melting said wax portion and cleaning said brush assembly to expose said plurality of brushes.

2. The process of making a brush assembly portion of a rotatable electrical connection having a plurality of brushes extending into a cylindrical cavity within said brush assembly, including mounting the first end of at least one of said brushes in a first mold such that the second end of said brushes extends into said cavity perpendicular to the mold's central axis, said first mold having a cylindrical passage therein and being capable of accommodating a plurality of brushes such that the brushes extend through the wall of said first mold and into said cylindrical passage, said second end of said brushes being disposed off center so as not to intersect the axis of said first mold, filling the first mold with a wax-like material in its molten state, solidifying said molten wax, removing said first mold from around the wax core assembly containing said brushes and inserting said wax core assembly in a second cylindrical mold, said second mold being large enough to inclose said wax core assembly such that an annular space exists between the outside surface of said wax core assembly and the inside of said second mold and said first ends of said brushes contact the inside diameter of said second mold, filling said annular space with an insulating material, curing said insulating material at room temperature, removing said second mold from around said insulating material containing said wax core assembly, plating the outside surface of said insulating material such that the conductive material makes electrical contact with said first ends of said brushes, machining said plating to leave a plurality of leads of conductive material from said brushes to one end of said brush assembly on the outside surface of said insulating material, melting said wax portion and cleaning said brush assembly to expose said plurality of brushes.

3. The process of making a brush assembly portion of a rotatable electrical connection having a plurality of brushes extending into a cylindrical cavity within said brush assembly, including mounting at least one of said brushes in a first mold, said first mold having a cylindrical passage therein and being capable of accommodating a plurality of brushes such that the brushes extend through the wall of said first mold and into said cylindrical passage such that said second end of said brushes is disposed off center so as not to intersect the axis of said first mold, filling the first mold with a hard wax material in its molten state, solidifying said molten wax, removing said first mold from around said wax core assembly containing brushes and inserting said wax core assembly in a second mold, said second mold being large enough to inclose said wax core assembly such that an annular space exists between the outside of said wax core assembly and inside of said second mold, said second cylindrical mold having an inside diameter of such size that said first end of said brushes is close to the inside diameter of said second mold, filling said annular space with an insulating material, curing said insulating material at room temperature, removing said second mold from around said insulating material containing said wax portion, machining grooves on the outside surface of said insulating material, each of said grooves originating at one end of said brushes and terminating at one end of said insulating material, plating the outside surface of said insulating material including the area of said grooves with a conductive metal material, machining said plating until the only metal remaining is that plated in said grooves, melting said wax core assembly and cleaning said brush assembly to expose said plurality of brushes.

4. The process of making a brush assembly portion of a rotatable electrical connection having a plurality of brushes extending into a cylindrical cavity within said brush assembly, including mounting at least one of said brushes in a first mold, said first mold having a cylindrical passage therein and being capable of accommodating a plurality of brushes such that the brushes extend through the wall of said first mold and into said cylindrical passage such that said second end of said brushes is disposed off center so as not to intersect the axis of said first mold, said passage having reliefs therein enabling limited movement of the exposed portions of said brushes, filling the first mold with a hard wax material in its molten state, solidifying said molten wax, removing said first mold from around the wax core assembly containing brushes and inserting said wax core assembly in a second mold, said second mold being large enough to inclose said wax core assembly such that an annular space exists between the outside surface of said wax core assembly and the inside surface of said second mold, said second mold being constructed as to have one or more extrusions on the inside cylindrical surface of said second mold positioned to contact one end of said brushes, filling said hollow space with an insulating material, curing said insulating material at room temperature, removing said second mold from around said insulating material containing said wax core assembly, plating the outside surface of said insulating material including the area of grooves formed by said second mold with a conductive metal material, machining said plating until the only metal remaining is that plated in said grooves, melting said wax core assembly and cleaning said brush assembly to expose the portions of said plurality of brushes not embedded in the wall of said insulating material.

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