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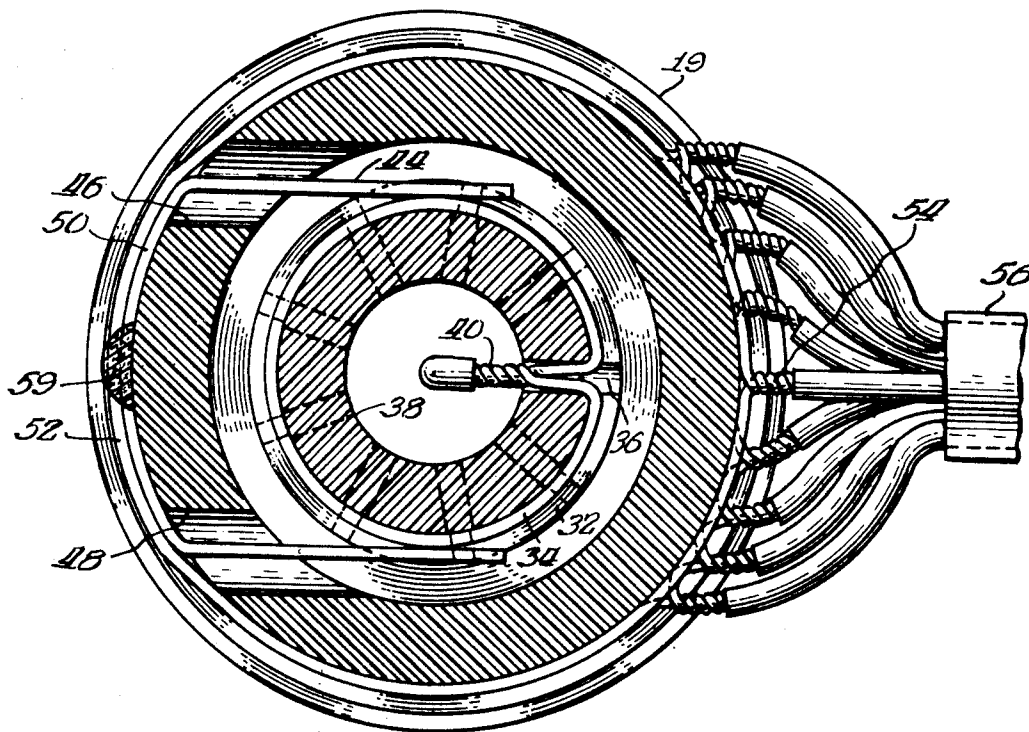
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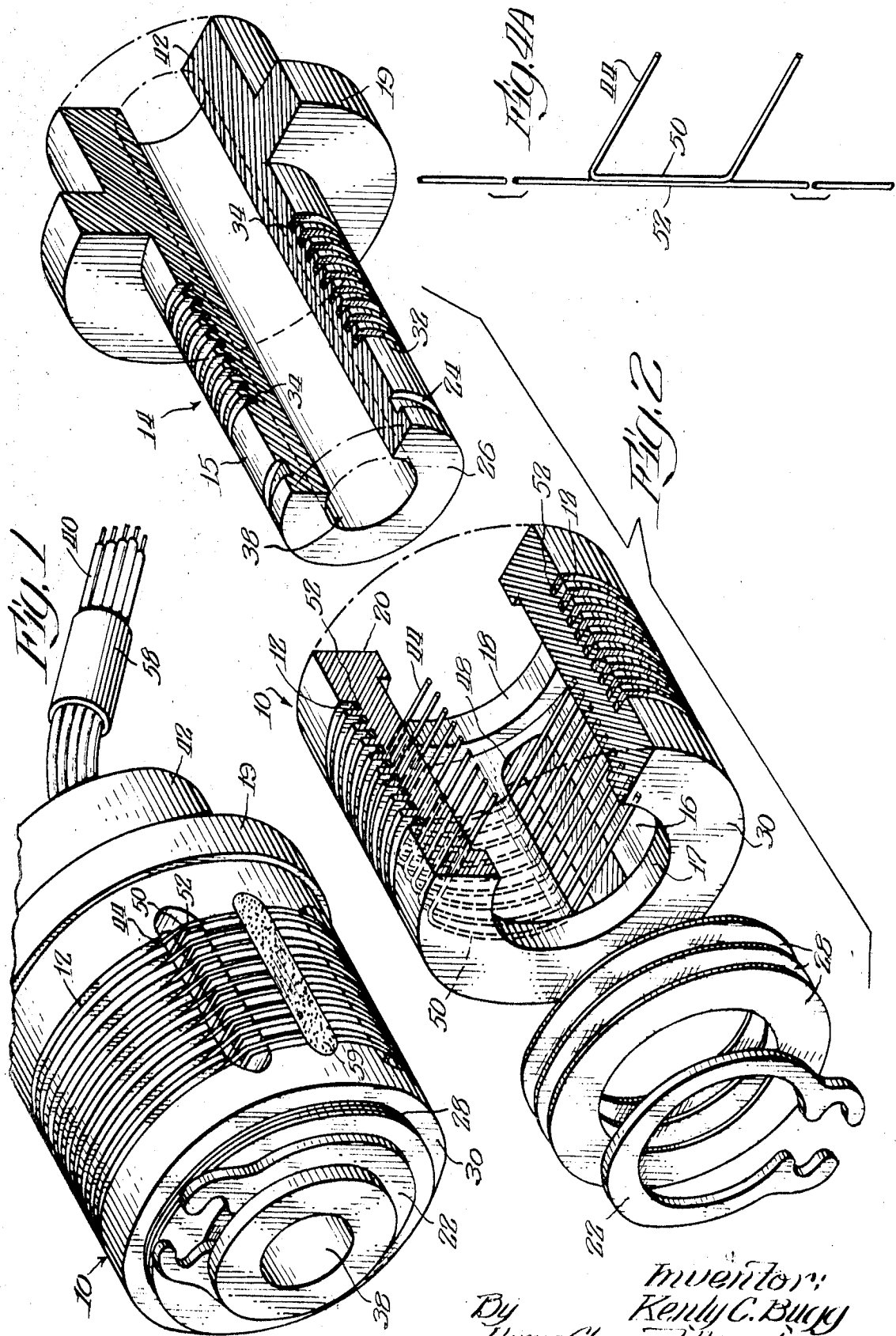
[54] **ROTARY ELECTRICAL CONTACT ASSEMBLY
WITH IMPROVED CONTACT COLLECTOR
RETAINING MEANS**
8 Claims, 9 Drawing Figs.

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310/232; 200/166
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[50] Field of Search 200/8, 166
(B1); 310/232, 234, 236

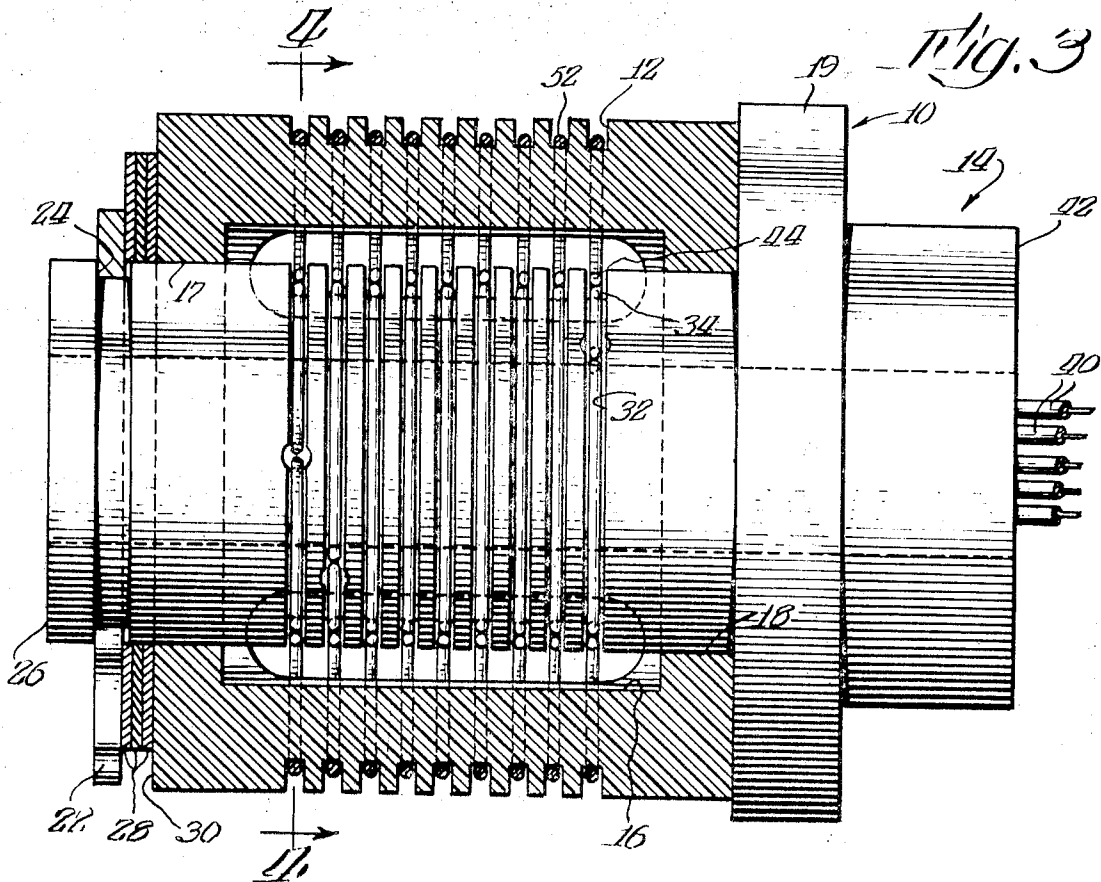
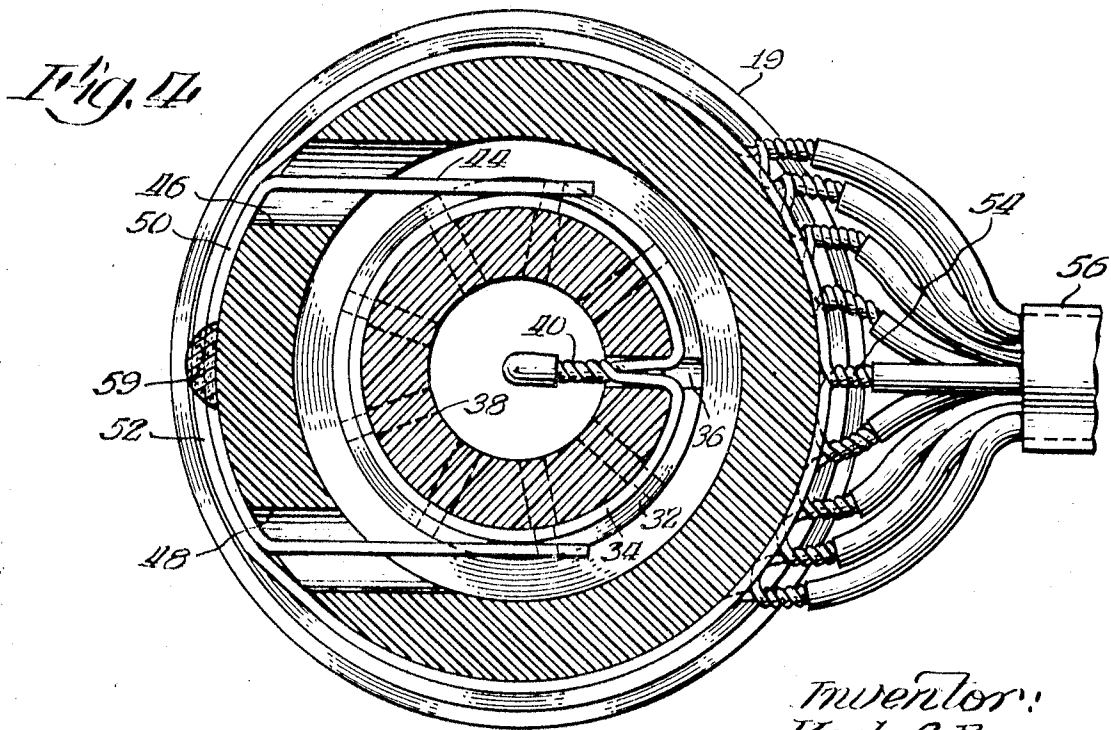
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ABSTRACT: A rotary electrical contact assembly which includes a cylindrical core member and a housing of electrically insulating material disposed in concentric, rotatable relation to each other, an elongated electrical conductor terminating in a lead wire, which conductor is supported by at least a segment of said core member, and a brush member supported by and extending through an opening in the housing, the conductor and brush member being disposed in coplanar, annular recesses in their respective supporting members, with the brush member being held in place therein by an overlying second conductor which also terminates in a lead wire.

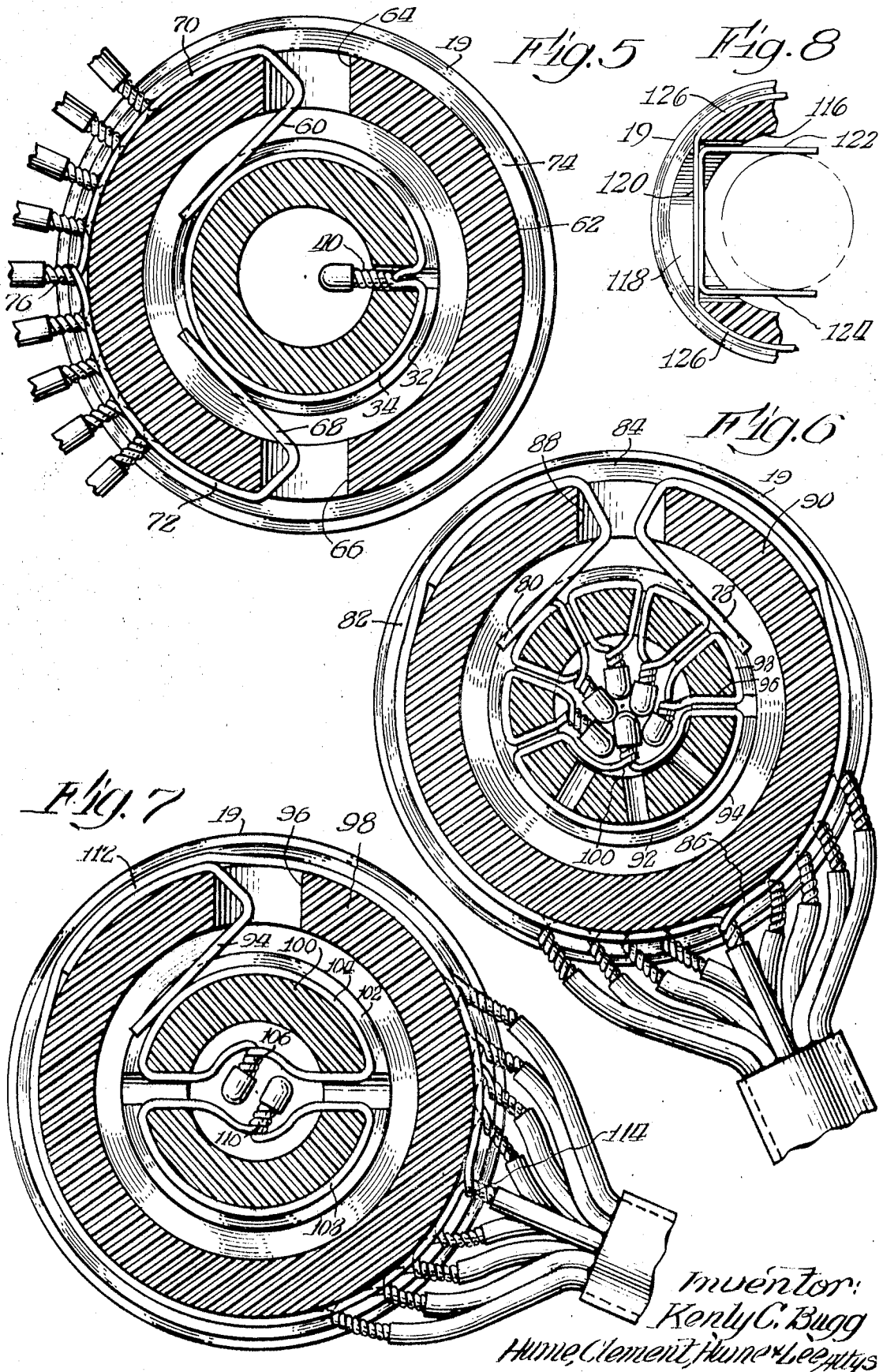




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ROTARY ELECTRICAL CONTACT ASSEMBLY WITH IMPROVED CONTACT COLLECTOR RETAINING MEANS

BRIEF SUMMARY OF THE INVENTION

This invention relates to rotary electrical contact assemblies, such as slip rings and selector switches, and more particularly, to a rotary contact construction known as a capsule assembly, particularly useful in environments in which there is a demand for a highly accurate and reliable electrical connection between rotating and stationary elements.

Among the objects of this invention are to provide:

- a. A rotary contact assembly having a simplified construction which readily permits miniaturization and encapsulation;
- b. A rotary contact assembly having a construction such that the component parts thereof can be formulated of a suitable material having a low coefficient of friction so that the device may be made without bearings, needs no lubricant, and has very good dielectric properties and thermal stability.
- c. A rotary contact assembly in which the component parts, though made of insulating material, can be machined so as to maintain the geometry thereof within very close tolerances;
- d. A rotary contact assembly which can be fabricated without requiring hand operations of a delicate nature, and in which the components forming the rotary electrical contacts can be given a predetermined amount of final loading by providing them with a suitable configuration prior to their assembly;
- e. A rotary contact assembly with electrical leads formed integrally therewith, having substantial flexibility and strength, and, therefore, long life and high resistance to breakage or disruption;
- f. A rotary contact assembly which can be fabricated with accurately molded or machined annular recesses which become a repository and positioning elements for contacts and brushes so that accumulated dimensional tolerances in multiple contact installations can be held to a minimum; and
- g. A rotary contact assembly having a construction such that the brush elements thereof perform the function of bearing members, which characteristic helps to eliminate the need for conventional bearings and lubricants.

DESCRIPTION OF PREFERRED EMBODIMENT

Further objects and advantages of this invention will become evident as the description proceeds and from an examination of the accompanying drawings which illustrate several embodiments of the invention, and in which similar numerals refer to similar parts throughout the several views.

Electromechanical control systems have achieved a high degree of development and their use in computers, space vehicles, and similar installations has created a demand for highly accurate and reliable electrical slip ring and switching assemblies. At the same time, there is a growing demand for such assemblies that are "miniaturized" and "encapsulated" in the sense that all of the parts are of a minimum size, and the delicate parts are all well protected. Such a device is shown in FIGS. 1 to 4.

IN THE DRAWINGS:

FIG. 1 is a perspective view of a slip ring capsule assembly incorporating one form of the invention.

FIG. 2 is an exploded view showing the component parts of the slip ring capsule assembly shown in FIG. 1.

FIG. 3 is a view, partly in vertical, longitudinal section, of the slip ring capsule assembly shown in FIG. 1.

FIG. 4 is a view in vertical cross section of the slip ring capsule assembly shown in FIG. 1 taken along the lines 4-4 of FIG. 3.

FIG. 4a is a plan view of a brush assembly component for the form of slip ring capsule assembly shown in FIG. 4.

FIG. 5 is a view in cross section similar to FIG. 4 of a modified form of the slip ring capsule assembly.

FIG. 6 is a view in vertical cross section of still another modified form of slip ring capsule assembly incorporating the invention.

FIG. 7 is a view in vertical cross section of another embodiment of the invention in the form of a selector switch assembly incorporating the invention.

FIG. 8 is a somewhat diagrammatic fragmentary view in vertical cross section of a portion of a modified form of slip ring capsule assembly generally similar to that shown in FIG. 4.

Referring to FIGS. 1 to 4, a rotary electrical contact assembly incorporating the invention is shown therein, the specific form being that of a slip ring capsule assembly. A substantially cylindrical housing member 10 is provided with a plurality of spaced, annular grooves 12 on the exterior surface thereof. A core member 14 is also provided having an area of reduced diameter 15 that is rotatably received within a central, longitudinal bore 16 in the housing member 10. The shoulders 17 and 18 are provided at each end of the bore 16 to form bearing areas for the core member 14. The core member 14 is provided with a collar portion 19 of increased diameter against which one end 20 of the housing member 10 is adapted to abut. The housing member 10 is retained in this position on the core member by a suitable retaining ring 22 adapted to be received in an annular groove 24 formed adjacent the outer end 26 of the area of reduced diameter 15 of the core member 14. Suitable spacing members 28 may be provided between the retaining ring 22 and the outer end 30 of the housing member 10. With such a construction, the housing member 10 and the core member 14 are disposed in concentric, rotatable relation.

These two members 10 and 14 may be formed of a suitable plastic material, such as Teflon, for example. A material like Teflon has proven to be particularly advantageous for a number of reasons, among which is the fact that the necessity for providing bearings is eliminated because of the low coefficient of friction of the material. This, in turn, eliminates the need for any lubricant which, in a miniaturized precision electrical instrument of this type, can cause very undesirable complications such as fouling of the electrical contact elements. In addition, Teflon has very good dielectric properties, and has excellent thermal stability. Advantage is taken of this latter characteristic by having everything dimensioned from one end of an abutment on one of the rotating members, such as from the collar 18. Any alteration in dimensions of the component parts due to thermal change is self-compensating under this type of construction. A further advantage of a material such as Teflon is that it permits a machined construction of the various components which, in turn, permits maintenance of the geometry of the elements. This is particularly desirable in a device such as a slip ring capsule assembly, where it is necessary to keep one major element and its component parts in critical alignment with another major assembly and its component parts. For example, in the type of slip ring capsule assembly shown in FIGS. 1 to 4, there normally is a .015 to .012 of an inch gap between pitches, so that the alignment tolerances are necessarily quite small.

Although Teflon has been indicated as being a preferred material from which to formulate the devices incorporating the invention, it is given only by way of example, and it is obvious that any material having similar properties can be utilized.

Referring again to FIGS. 1 to 4, the core member 14 has a plurality of annular recesses 32 formed on the outer surface of the area of reduced diameter 15. Each recess 32 is adapted to receive a loop of wire 34, which loop forms an individual slip ring. Each ring may have its ends threaded through a suitable opening 36 in each annular recess, which opening communicates with the hollow interior of the core 14 formed by the longitudinal bore 38. The two ends of each wire 34 extending into communication with the interior bore 38 of the housing 10 are twisted together therein to form a single lead 40 which is preferably brought out of the end 42 of the core member 14 in a suitable manner.

The housing 10 and the core 14 are so aligned that each annular recess 12 in the housing 10 is disposed in a plane which includes one of the annular recesses 32 in the core member 14. Likewise, each of the annular recesses 12 has disposed therein a brush member 44 which may be substantially U-shaped. The two arms thereof are adapted to project inwardly into association with the core member 14 through the two openings 46 and 48 provided in the housing 10. The bight portion 50 of the brush member 44 is adapted to be received in the recess 12 and to be held therein with the arms in the position just described by an overlying loop 52 of conducting wire, which has its two ends twisted together to form a lead 54 providing an electrical connection to the brush member 44.

As shown in FIG. 4a, the brush member 44 and the wire 52 may be initially formed so that the brush member 44 is fixed to and depends from the central portion of the wire 52, with the two arms of the brush member being disposed substantially at right angles thereto. When the brush member 44 is installed, as shown in FIG. 4, the curvature imparted to the bight portion 50 and the retaining wire 52, when it is placed in the annular recess 12, will bring the outer extremities of the two arms of the brush member together to some extent, and they will thus be brought into abutment with the wires 34 in the corresponding annular recesses 32 in the core member 14, and a predetermined amount of pressure will be applied to the wires or slip rings 34 by the two arms of the brush member 44.

In the complete installation, as shown in FIG. 4, each of the annular recesses 12 has such a wire disposed therein, together with a brush 44, and the lead wires 54 are preferably brought into alignment within the collar member 56. A similar flexible collar member 58 is provided for the lead wires which exit from the end 42 of the core member 14 as shown in FIG. 1.

As shown in FIGS. 1 and 4, the bight portion 50 of the brush members 44 and the overlying loops 52 may be cemented in place with a strip 59 of suitable adhesive material such as epoxy resin, for example.

The wires utilized in this assembly are, of course, formed of a metal suitable for this type of use, such as alloys of gold, platinum, silver, and other precious metals. The term "wire" in this disclosure is utilized to include the conventional wire of circular cross section, as well as other configurations—such as triangular, square, rectangular, or the like.

OPERATION

The operation of the device just described is obvious from the description which has already been given, in that the wire 34 in each annular recess in the core member 14 forms a slip ring to which an electrical connection can be made through the lead 40, and the wire and brush assembly in each of the annular recesses 12 in the housing 10 forms a brush which is in sliding electrical contact with its associated slip ring, and each such brush has an electrical connection established through a lead 54. Thus, an electrical connection can be maintained between the leads to associated slip ring and brush assemblies during relative rotation of the housing 10 and core member 14. Needless to say, the rotation referred to can be established by relative movement between the two members 10 and 14, so that either member can function as the rotor, although in the embodiment shown, the core 14 is designed to be the rotor.

DESCRIPTION OF ALTERNATIVE EMBODIMENTS

It is apparent that the wires 34 need not be full 360° loops in recesses 32, but may also be only a segment of a circle, with either one common lead or a lead for each segment. This latter characteristic is well illustrated in applicant's reissue U.S. Pat. No. Re 26,480 issued Oct. 22, 1968, which is a reissue of applicant's U.S. Pat. No. 3,286,069, issued Nov. 15, 1966, both entitled "Rotary Electrical Contact Assembly." As indicated in that application, the segmental contacts or slip rings can take various configurations, depending upon what function is desired.

The alternative embodiment illustrated in FIG. 5 is one in which a somewhat modified form of brush member 60 is utilized, along with a housing member 62, that differs from the housing member 10 principally in the provision of the openings 64 and 66 for the brush members 60 and 68. The latter are formed at the ends of the two wires 70 and 72, respectively, which are received in the annular recess 74 with the ends forming the brushed 60 and 68 extending through the openings 64 and 66, respectively, and the opposite ends thereof being twisted to form the lead 76. The core member 14 is substantially identical with that previously described in connection with FIGS. 1 to 4.

Still another embodiment of the invention is disclosed in FIG. 6. In this form, the brush members 78 and 80 are held in place in the annular recess 82 by the wire loop 84, having its ends twisted to form the lead 86. The brush members 78 and 80 both project through the opening 88 provided in the housing 90 in a manner generally similar to the disposition of brushes 60 and 68 in FIG. 5. Here, however, the brushes are formed as a separate element somewhat similar to the brush member 44 which is shown in FIG. 4. The configuration of the brush members 78 and 80 prior to their being assembled as shown in FIG. 6 will determine how much of a load is applied by the brush members to the contact members disposed in the annular recess 92 on the core member 94.

Although the embodiments illustrated and described have all been in the form of a slip ring capsule assembly, as previously noted, substantial variation is possible in the specific design of the rotary electrical contact assembly which incorporates the invention. The number of brush and ring elements can, of course, be varied from one to any desired number, and the elements which have been shown in the form of a slip ring can be formed as a substantially 360° element, or something much less. The core member 94 shown in FIG. 6 incorporates contact members of this latter form. A plurality of openings 96 are provided through which the ends of the contact members 98 can be threaded into the interior 100 of the core member 94 and twisted together so as to form suitable connecting leads to the segmental contact members 98. In this instance, more than one such shorter segment is disposed in a single annular recess 92 on the core member 94 although it could also be only a single segment in each recess. The contact member on core 14 can likewise be formed as a single member having interrupted segments, by threading the conducting wire in and out of spaced openings in a single annular recess although this form is not shown here. All of these variations are shown and described in applicant's reissue U.S. Pat. No. Re 26,480 issued Oct. 22, 1968.

FIG. 7 illustrates still another embodiment of the invention in the form of a selector switch. Here a single brush member 94 is provided extending through the opening 96 in the housing 98. The core member 100 is provided with a pair of openings disposed on diametrically opposite sides of the core. A segmental contact member is formed in each of the annular recesses 102 substantially in the manner previously described. The wire 104 is formed into one segment with its ends being twisted to form the lead 106. The wire 108 is likewise formed into a second segment having a similar lead 110. The wire loop 112 serves to retain the brush member 94 in place and has its two ends formed into the lead 114.

FIG. 8 illustrates a modification of construction of the assembly shown in FIG. 4. In this form, the housing member 116 is provided with an elongated slot member 118 having a length sufficient to accommodate the bight portion 120 of the brush member which has the two arms 122 and 124. The brush member is comparable to that previously described and shown in FIG. 4a. However, instead of providing the two openings 46 and 48 through which the arms 44 are adapted to protrude inwardly, a single opening 118 is provided across which the supporting wire 126 which carries the brush is stretched.

This latter arrangement has the advantage of permitting the brush member to be formed to very close tolerances prior to assembly and maintaining those tolerances without alteration when the assembly is carried out.

All of the advantages mentioned for the slip ring assemblies incorporating the invention are equally applicable to selector switch assemblies. Obviously, all of the various specific arrangements which are possible with this type of construction have not been illustrated, but each of them would have the same advantages previously identified as being inherent in this type of construction.

I claim:

1. A rotary electrical contact and brush assembly comprising a cylindrical core member and a housing therefor disposed in concentric, rotatable relation, an annular recess in said core member, an electrical conductor supported by at least a segment of said core member within said recess to form an arcuate conducting element, an opening in said core member through which each end of said conductor is threaded into the interior of said core member, an annular recess in said housing, an opening in said housing in said recess, at least one brush member in said housing recess disposed so as to project through said opening in said housing into sliding electrical contact with said arcuate conducting element on said core member, and a second electrical conductor disposed in said recess in said housing to retain said brush member therein.

2. A rotary electrical contact and brush assembly of the character defined in claim 1, further characterized in that the ends of both said conductors are formed as a twisted pair to provide an electrical lead to said arcuate conducting element and said brush member, respectively.

3. A rotary electrical contact and brush assembly of the character defined in claim 1, further characterized in that said core member and said housing are provided with a plurality of radially aligned, spaced annular recesses in the outer surfaces thereof, each such recess having an electrical conductor wound in at least a segment thereof, and each said conductor is formed as a twisted pair to form a lead to the arcuate conducting element and the brush member associated therewith, respectively.

4. A rotary electrical contact and brush assembly comprising a cylindrical core member and a housing therefor disposed in concentric, rotatable relation, an annular recess in said core member, an electrical conductor wound on at least a segment of said core member within said recess to form an arcuate conducting element, an opening in said core member through which each end of said conductor is threaded into the interior of said core member, an annular recess in said housing, a pair of openings in said housing in said recess, a pair of brush members secured in said housing recess disposed so that one end of each said pair each projects through one of said pair of openings in said housing into sliding electrical contact with

said arcuate conducting element, the ends of said electrical conductor and the opposite ends of each brush member being formed as a twisted pair to provide an electrical lead to said arcuate conducting element and said brush members, respectively.

5. A rotary electrical contact and brush assembly comprising a cylindrical core member and a housing therefor disposed in concentric, rotatable relation, an annular recess in said core member, an electrical conductor wound on at least a segment of said core member within said recess to form an arcuate conducting element, an opening in said core member through which each end of said conductor is threaded into the interior of said core member, an annular recess in said housing member, an opening in said housing in said recess, and a pair of brush members in said housing recess disposed so that one end of each said pair projects through said opening in said housing into sliding electrical contact with said arcuate conducting element on said core member, and a second electrical conductor disposed in said recess in said housing to retain said brush members therein.

6. A rotary electrical contact and brush assembly of the character defined in claim 1, further characterized in that said housing member has an area of increased inner diameter forming an annular space between said core and said housing member into which said brush member projects through said opening in said housing into sliding electrical contact with said electrical conductor.

7. A rotary electrical contact and brush assembly comprising a cylindrical core member and a housing therefor disposed in concentric, rotatable relation, an annular recess in said core member, a plurality of electrical conductors supported by spaced segments of said core member within said recess to form segmented arcuate conducting elements, an opening in said core member through which each end of each conductor is threaded into the interior of said core member, an annular recess in said housing, an opening in said housing in said recess, at least one brush member in said housing recess disposed so as to project through said opening in said housing into sliding electrical contact with said arcuate conducting element on said core member, and a second electrical conductor disposed in said recess in said housing in electrical contact and retaining relation with said brush member.

8. A rotary electrical contact and brush assembly of the character defined in claim 7 further characterized in that the ends of each conductor are formed as a twisted pair to provide an electrical lead to said arcuate conducting element and said brush member, respectively.

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