

[54] ELECTRICAL SLIP COUPLING

[75] Inventor: Frank Gordon, Jr., Cincinnati, Ohio

[73] Assignee: Welco Industries, Inc., Cincinnati, Ohio

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[58] Field of Search 339/4, 5, 8, 182, 183

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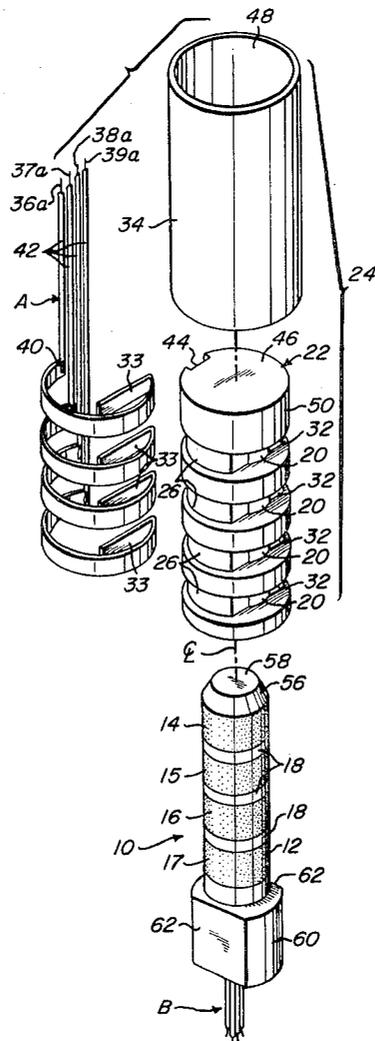
Primary Examiner—Richard E. Moore
 Attorney, Agent, or Firm—J. Warren Kinney, Jr.

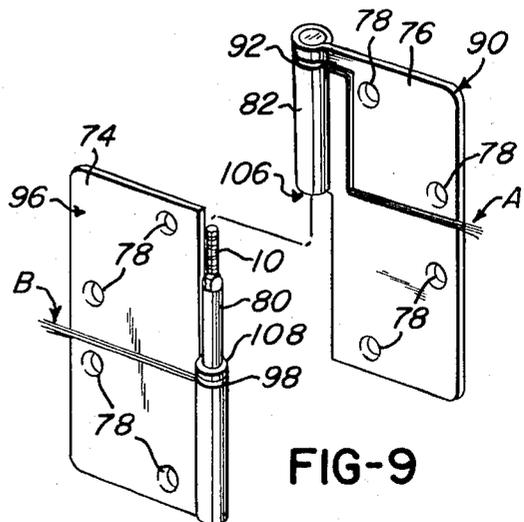
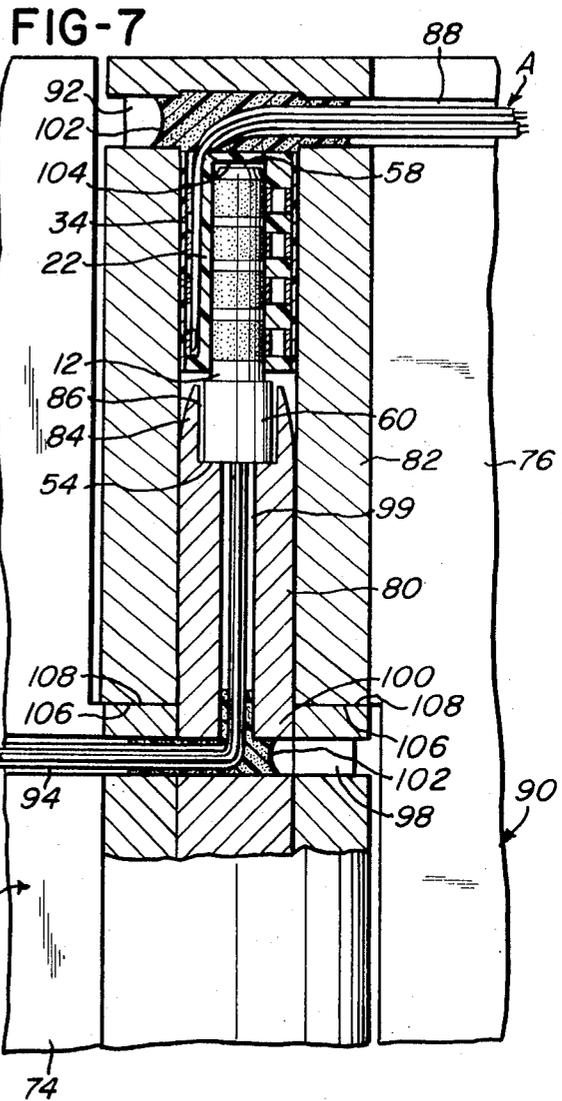
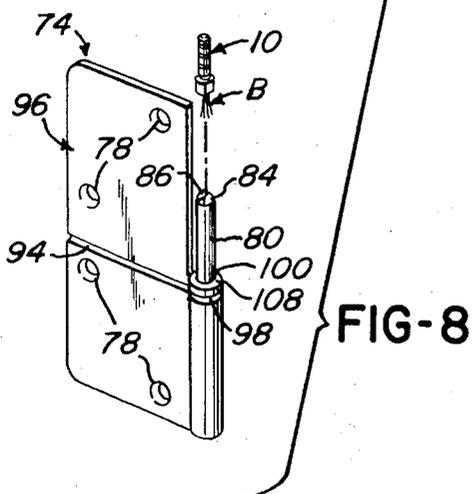
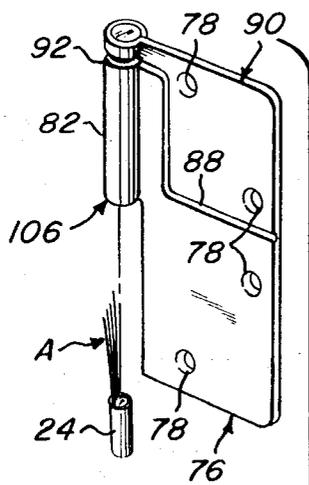
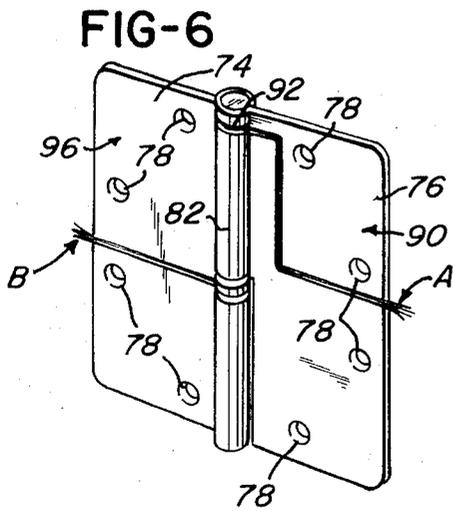
[57] ABSTRACT

The electrical slip coupling comprises elongate plug and socket elements wherein the plug element constitutes a slip ring assembly containing a plurality of laterally spaced conductor rings separated by non-conductive regions and wherein the socket element constitutes a brush holder assembly having a housing for receiving the brush holder assembly, the housing containing a plurality of conductor brushes, each brush in yieldable contacting relationship with one of the conductor rings to produce selective electrical continuity therebetween. The plug is adapted to be freely and repeatedly inserted into and/or withdrawn from the socket without adversely effecting the electrical continuity when coupled.

The subject coupling is ideally adapted, without change or alteration, for association with the hinge pin and hinge pin-socket portion of a hinge for establishing one or more electrical circuits between the hinge halves.

18 Claims, 9 Drawing Figures





ELECTRICAL SLIP COUPLING

BACKGROUND OF THE INVENTION

While electrical slip couplings are not novel, per se, none of the prior art devices provide couplings that are adapted to be repeatedly coupled and uncoupled without the requirement of special tools or skilled labor, or without requiring at least a partial disassembly of one or more of the elements which collectively constitute the assembly.

A primary object of the present invention is to achieve a rotary coupling which will provide electrical continuity between circuits contained in elements disposed in rotational or pivotal relationship while ensuring the easy and frequent coupling and/or uncoupling of the slip ring assembly and brush holder assembly without impairing the electrical continuity therebetween when said assemblies are in coupled relationship.

It is further an object of the invention to provide an electrical slip coupling that may be used in combination with a pair of pivotally mounted elements, for example, a hinge assembly, without requiring alteration in the design of the elements and without requiring special tools or skilled labor to assemble and disassemble the combination.

DESCRIPTION OF THE PRIOR ART

U.S. Pat. No. 3,185,951 discloses a slip ring assembly which comprises a rotor element 11, opposite ends of which are journaled for rotation within and relative to a multi-element outer housing 12. The rotor element is provided with a plurality of integrally formed flanges 17 which define the side limits of each of a plurality of metallic slip rings 14. An individual brush 30 is provided for each slip ring wherein each brush comprises a pair of parallel legs 31, 32, which are adapted to engage opposite sides of a slip ring 14. The brushes are secured to and carried by an insert 29 which, as clearly illustrated in FIGS. 2 and 3, is secured to and carried by the upper half 25 of the two piece housing 12, the other portion of said housing being indicated by the numeral 26. The structural details of the assembly are such as to preclude withdrawal of the rotor unit 1 without completely disassembling the unit.

U.S. Pat. No. 3,564,168 discloses a slip ring assembly which includes a core member, the outer surface of which is suitably grooved for containing a loop of wire 34 which constitutes an individual slip ring (see FIG. 4), and an outer housing is provided with a plurality of laterally spaced brush members 44 (note FIGS. 2, 4, and 4A) which are adapted to engage the outer surface of a corresponding slip ring. The "locking" relationship between brush members 44 and the grooves (32) in which the slip rings are located preclude endwise withdrawal of the core member 14.

U.S. Pat. No. 3,297,973 discloses a miniaturized slip ring assembly comprising an inner member 12, the outer surface of which is provided with a plurality of pairs of grooves each containing a slip-ring 34. As best illustrated in FIGS. 3 and 4, wires 16 are adapted to be received in said grooves to contact the slip rings 34, wherein the upper ends of the wires 16 are loosely secured to and carried by a conducting sleeve 28 carried by outer housing or insulating cylinder 32. Although the specification of this patent reference is to the fact that the assembly can be "disassociated" for cleaning, it would appear that the manner in which wires 16 are

disposed within the slip ring grooves would seriously impair the free assembly and disassembly of the device.

U.S. Pat. No. 3,243,866 discloses a method of constructing an elongate plug-type miniature slip-ring assembly.

None of the aforesaid patents disclose or suggest an electrical rotary coupling of the type which comprises elongate plug and socket elements which are adapted to be freely and repeatedly coupled and uncoupled without impairing electrical continuity between said elements when coupled.

A search of the prior art for electrically conductive hinge assemblies revealed the existence of U.S. Pat. No. 3,355,695 which discloses a hinge having means for providing one or more slip-ring-type circuits in conjunction with the barrel portion of a hinge, such as found in automotive vehicles. An electrical path is provided by the structure illustrated in FIGS. 3, 4, and 5 by means of hinge leaf 31 and 32 which are securely, though movably interconnected by means of a grommet 35.

U.S. Pat. No. 1,744,040 discloses a hinge structure having means for establishing an electrical circuit between a pair of hinge plates 10 and 11, by means of a hinge pin 42 having conductive portions 18 and 19 which are adapted to engage and electrically interconnect sockets 14 and 15 of the hinge pin-receptive portions of plates 10 and 11.

No prior art was located which disclosed a hinge construction which included a slip ring assembly in the form of an elongate plug element secured to, carried by and projecting axially from a hinge pin for the free insertion into and/or withdrawal from a brush holder assembly in the form of an elongate socket member housed within the hinge-pin-receptive socket of a hinge assembly, for enabling a plurality of electrical circuits to be established between the hinge leaves when in assembled, cooperating relationship.

SUMMARY OF THE INVENTION

The present invention relates generally to the class of electrical couplings referred to as rotary couplings, floating brush assemblies or electrical slip couplings, that is, couplings providing electrical continuity between two rotationally or pivotally disposed elements.

The device of the present invention comprises an elongate plug constituting slip ring assembly containing a plurality of laterally spaced conductor rings separated by non-conductive regions and an elongate unitary socket constituting a brush holder assembly for rotationally receiving the plug, the socket containing a plurality of conductor brushes, wherein insertion of the plug into the receptive socket provides electrical continuity between conductor rings and conductor brushes. Electrical connectors are carried in each assembly and coupled to the conductor elements to provide easy access of the coupling components to an external electrical circuit.

The slip ring assembly includes a smooth continuous outer surface having alternative conducting and non-conducting regions, the assembly being insertable in the brush holder assembly without longitudinal or rotational restriction. The slip ring assembly may likewise be freely withdrawn from the brush holder. The electrical slip coupling may, therefore, be used in combination with a pair of rotationally disposed elements, such as a hinge assembly, without requiring special tools or

skilled labor to assemble and disassemble the hinge components.

While a detailed description of exemplary embodiments is contained in the drawings and following description, it is to be understood that modifications may be made in structural details here shown and described within the scope of the appended claims without departing or exceeding from the spirit and scope of the invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view illustrating the relationship of the various components which collectively comprise an electrical slip coupling which embodies the teachings of the invention.

FIG. 2 is a view of the assembled electrical slip coupling, partly in section, for clarity of detail and understanding.

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2.

FIG. 4 is a view similar to FIG. 3, illustrating a modification thereof.

FIG. 5 is an end view of the elongate plug or electrical slip ring assembly of FIG. 1.

FIG. 6 is a perspective view of a hinge assembly which is provided with the slip coupling of FIG. 1.

FIG. 7 is an enlarged fragmentary view of the hinge assembly of FIG. 6 shown partially in section for clarity of detail and understanding.

FIG. 8 is an exploded view illustrating the relationship of the various components of the hinge assembly in combination with the components of the electrical slip coupling.

FIG. 9 is an exploded view of the hinge assembly of FIG. 6, with the hinge halves or plates in a disconnected relationship.

DETAILED DESCRIPTION

The structural details of the electrical slip coupling of the present invention are illustrated in FIGS. 1-5 of the drawings, whereas FIGS. 6-9 illustrate utilization of the coupling in combination with a typical hinge assembly.

FIG. 1 is an exploded view of the various components of the electrical slip coupling. The plug or slip ring assembly denoted generally by the numeral 10 comprises an elongate cylindrical member 12 of a non-conductive material having a plurality of conductor rings 14-17 separated by non-conductive regions 18. The slip ring assembly is designed to be inserted in the central bore 20 (see FIG. 2) of the housing 22 of the brush holder assembly or socket denoted generally as 24. Housing 22 contains a plurality of peripheral channels 26 providing suitable seats for conductor brushes 27-30. Each peripheral channel contains a spaced planar surface area 32 formed by a chord sector. The spaced planar surface areas 32 are in open communication with bore 20 to provide exposure of or free access to conductor rings 14-17 when the slip ring assembly 10 is inserted within the housing 22. Each of the brushes 27-30 include a contact projection 33 which is designed to be seated in the planar surface region 32 of a corresponding peripheral channel 26. When brushes 27-30 are seated in channels 26 and the slip ring assembly 10 is inserted in bore 20 each of the conductor brushes will be in contact with its respective conductor ring. In the embodiment illustrated, the projecting surface 33 of brush 27 will bear against conductor ring 14;

likewise, brush 28 with respect to ring 15, brush 29 with respect to ring 16, and brush 30 with respect to ring 17. Thus, electrical continuity is provided between slip ring assembly 10 and brush holder assembly 24.

Brushes 27-30 are fabricated from any suitable spring like material such as strip, beryllium copper, for example, thus establishing a yielding contacting relationship with the conductor rings 14-17 and allowing free rotation of the various components when assembled. A sleeve 34 embraces housing 22 to encase the housing and maintain the brushes in proper relationship with their respective channels 26.

Electrical connectors 36a-39a (which are collectively designated by the letter A) are suitably secured at 40 one each to a corresponding brush 27-30. Each connector is insulated by a typical wrapper 42 to ensure electrical isolation of the various brush elements. Connectors A are carried within the brush holder assembly in a suitable channel 44 extending the length of housing 22. Thus, when sleeve 34 embraces housing 22, all of the components of the brush holder assembly are encased, forming a single, unitary coupling component. Connectors A extend beyond end 46 of the brush holder assembly to provide easy access to external electric circuitry. The brush holder assembly is easily assembled and disassembled by simply removing the outer sleeve 34 to expose housing 22. If desired, an adhesive substance may be applied to interior 48 of the sleeve thus securing the sleeve to peripheral surface 50 of the housing, sealing the brush holder assembly in a compact, unitary package.

Electrical connectors 36b-39b (which are collectively designated by the letter B) are secured one each to a corresponding slip ring 14-17 at 52, shown particularly in FIG. 2. As with connectors A, the connectors B are each suitably insulated by a typical wrapper 42. Connectors B are carried within the elongate member 12 and extend beyond end 54 to provide easy access to external electrical circuitry.

When slip ring assembly or plug 10 is inserted in brush holder assembly or socket 24 electrical continuity is established between connectors A and B. For example, wire 36a establishes electrical continuity with wire 36b through the yielding contacting relationship between slip ring 14 and conductor brush 27, likewise wires 37a and 37b through brush 28 and conductor ring 15, 38a and 38b through brush 29 and conductor ring 16, and 39a and 39b through brush 30 and conductor ring 17. It is often desirable to identify the complementary connectors or wires by uniquely coloring each wrapper 42 of the various complementary connector pairs.

The slip ring assembly 10 may be made in any suitable manner. One suitable method comprises the placement of the conductor rings 14-17 and attached connectors B in proper relationship within a mold and molding or vacuum casting a plastic non-conductive material thereabout to provide elongate member 12 and generate the assembled slip ring assembly 10. It is possible to provide a smooth continuous outer peripheral surface on the elongate member 12 by removing the excess plastic from the assembly, generating a surface wherein the outer diameter of the rings 14-17 is substantially equal to the diameter of the non-conductive regions 18. Providing the slip ring assembly with a smooth, continuous peripheral surface permits unrestricted longitudinal as well as rotational move-

ment between central bore 20 of housing 22 and elongate member 12. To enhance this feature, taper end portion 56 is provided at leading end 58 of the elongate member to lift contact projections 33 as the elongate member enters bore 20. Thus, the slip ring assembly provides an outer, substantially cylindrical surface defined by non-conductive areas between adjacent conductor rings with the outer diameter of the non-conductive areas conforming substantially to the outer diameter of the conductor rings to provide an overall uniform and continuous outer surface.

When slip ring assembly 10 and brush holder assembly 24 are constructed in this manner, they form a suitable plug and socket assembly wherein the entire slip ring assembly may be inserted and/or withdrawn from the brush holder assembly without use of special tools or skilled labor, or without disassembly of any of the various components of the electrical slip coupling, that is without the disassembly of either the brush holder assembly or the slip ring assembly.

It is often desirable to include an enlarged base portion 60 on the tail end 54 of elongate member 12. This permits attachment of the slip ring assembly to a rotating external member containing electrical circuitry. While base portion 60 may be of any suitable configuration, permitting easy attachment of the slip ring assembly to an external element, the flat portions 62 contained in the illustrated embodiment permit lateral movement of the slip ring assembly with respect to the center line C_L of the electrical slip coupling assembly while insuring rotational engagement with the external element. In this manner, the tolerance to be maintained between the various components of two bodies held in rotational relationship need not be as critical as the tolerance to be maintained in manufacturing the electrical slip coupling to provide adequate electrical continuity between the various components of the system.

An alternative embodiment of the slip ring assembly is illustrated in FIG. 4. FIG. 4 conforms generally to the view illustrated in FIG. 3, however, the continuous slip ring 17 illustrated therein has been replaced by a split slip ring 64 separated by a pair of ends 66 and 68 to form a C-shaped element. The non-conducting material comprising the elongate element 12 extends beyond the slip ring 64 to form a non-conductive area 70 between the spaced ends 66 and 68. The non-conducting area 70 has an outer surface conforming substantially with the overall outer peripheral surface of the elongate member 12 to provide a smooth and continuous surface on the slip ring assembly 10 for easy insertion into bore 20. By introducing the split ring 64, continuous electrical continuity is replaced with selective electrical continuity and discontinuity. For example, as the ring 64 rotates in the direction of arrow 72, the electrical slip coupling will conduct when contact portion 33 is in communication with the slip ring 64, and will not conduct when contact projection 33 is bearing against the non-conductive region 70. It should be understood that any split ring configuration could be utilized, producing any desired pattern of electrical continuity and discontinuity without departing from the invention as herein described. It should be further understood that split rings and continuous rings can be used alternatively or in any suitable order to provide the desired electrical continuity and discontinuity between rotationally mounted elements containing electrical circuitry.

FIGS. 6-9 illustrate a typical hinge assembly in combination with the electrical slip coupling of the present invention. The hinge assembly includes two hinge halves or leaves 74 and 76 each adapted to be secured via mounting holes 78 to an element designed to be disposed in rotational relationship with another element. While the hinge assembly here shown includes one leaf 74 having a hinge pin 80 adapted to be received by sleeve or socket 82 of the other hinge leaf 76, see particularly FIG. 8, it should be understood that the combination could include any suitable hinge assembly or pair of rotationally disposed elements.

Brush holder assembly 24 is attached to one of the rotational elements and substantially in coaxial relationship therewith, and slip ring assembly 10 is attached likewise to the other element to provide electrical continuity between elements upon their proper assembly. In the illustrated embodiment, the brush holder assembly 24 may be inserted in socket 82, with slip ring assembly 10 being attached to the end portion 84 of pin 80. As shown in FIG. 7, when the two leaves 74 and 76 are assembled, the slip ring assembly 10 is properly inserted within the brush holder assembly 24 to provide electrical continuity between the hinge leaves.

The base portion 60 of the slip ring assembly contains flat surfaces 62 to provide limited lateral movement between the hinge pin 80 and slip ring assembly 10, thus ensuring proper alignment of the slip coupling components when the hinge is assembled. A complementary slot 86 is supplied in the end 84 of hinge pin 80 for this purpose. Thus the slip ring assembly 10 is free to move laterally with respect to the center axis of hinge pin 80 while engaged rotationally therewith.

Groove 88 milled or otherwise provided in surface 90 of hinge plate 76 is adapted to receive wires A of brush holder assembly 24, said groove being in open communication with open recess 92 at the upper or closed end of socket 82. Connectors or wires A extend through the end of the brush holder assembly 24 and are carried by the recess 92 and grooves 88 to external electric circuitry in the element to which the hinge plate 76 is secured. Likewise, groove 94 is provided in surface 96 of hinge plate 74 to receive wires B of slip ring assembly 10, said groove being in open communication with open recess 98 in the lower or secured end 100 of pin 80. A central bore 99 is provided in pin 80, having open ends in communication with slot 84 and recess 98 for carrying connectors B extending through end 54 of the slip ring assembly, see FIG. 7. An adhesive substance 102 is then inserted in each recess 92 and 98 to hold the electrical slip coupling components in place with respect to their respective hinge leaves. When the hinged leaves are assembled as shown in FIGS. 6 and 7, it is desirable to provide clearance between the leading end 58 of the slip ring assembly and the interior end wall 104 of bore 20. This is to ensure that the weight of the hinged elements is borne by the hinge assembly and not by the electrical slip coupling. For this reason, each of the hinge halves 74 and 76 contains bearing surfaces contacting one another when hinge halves are properly assembled. The bearing surface 106 of hinge leaf 76 slidably bears against the surface 108 of leaf 74 when the leaves are assembled as shown in FIG. 7. Due to the unrestricted endwise longitudinal relationship as well as the unrestricted rotational relationship of the electrical slip coupling, it is possible to assemble and

disassemble the hinge halves with ease and efficiency, without requiring special tools or skilled labor.

When the electrical slip coupling has been properly combined with the hinge components, electrical circuitry may be attached to connectors A and B. When the continuous slip conductor rings 14-17 are utilized, continuous electrical continuity is provided, while use of the split ring 64, shown in FIG. 4, permits predetermined selective continuity and discontinuity between hinge halves during rotation. By using a suitable adhesive 102 it is possible to remove and replace the components of the electrical slip coupling without special tools or skilled labor. Thus, the present invention provides a simple and efficient electrical slip coupling for ensuring electrical continuity between two rotationally disposed elements which may be easily assembled and disassembled without impairing the electrical conductive properties of the various components of the combination.

What is claimed is:

1. An electrical slip coupling including complementary socket and plug elements;

said plug element comprising an elongate member having a plurality of spaced, parallel conductor rings in circumscribing relationship therewith;

said socket element comprising an elongate brush holder having a plug-receptive bore therein;

a plurality of spaced, circumferential brush-receiving channels in the outer surface of said holder wherein a portion of each channel is in open communication with said bore;

a plurality of resilient conductor brushes, one in each of said channels, wherein each brush includes a plug-contact portion which normally and yieldably extends into and beyond the inner surface of the said bore;

an elongate, axially extending, conductor-receptive channel in the periphery of said brush holder intersecting and in open communication with each of said circumferential channels;

means engaging portions of the outer surface of the brush holder and portions of the brushes and conductors received in said circumferential and axial channels securing said brushes and conductors to and against accidental or unintentional displacement from said holder;

the peripheral surface of said plug element and the inner surface of the bore of said socket element providing endwise, longitudinal and free rotary relative motion between said plug and socket elements;

the plug-contacting portion of each of said brushes being disposed in yielding contacting relationship with a conductor ring for providing electrical continuity therewith when the plug element is housed within the socket element.

2. A coupling as called for in claim 1, wherein that portion of each of said brush receiving channels are defined by a pair of spaced, co-planar surfaces one each on opposite sides of the channel opening into the said bore, and wherein the pairs of coplanar surfaces of each of said channels are disposed in axial alignment.

3. A coupling as called for in claim 2, wherein the plug contact portion of each brush engages the spaced, coplanar surface areas of a corresponding brush-receiving channel and spans the bore between said surfaces.

4. A coupling as called for in claim 1, wherein each brush is in series circuit with an electrically isolated conductor disposed in the said conductor-receptive channel.

5. An electrical coupling as called for in claim 1, wherein the plug element includes an outer substantially cylindrical surface defined by alternate non-conductive areas between adjacent conductor rings and wherein the outer diameter of the non-conductive areas conforms substantially to the outer diameter of said conductor rings, providing an overall, uniform, continuous outer surface.

6. A coupling as recited in claim 1, wherein each conductor ring is in series circuit with an electrically isolated conductor, and wherein each conductor is embedded within the interior of the plug element.

7. A coupling as called for in claim 1, wherein the means engaging the outer surface of the brush holder comprises a sleeve which substantially encases the brush holder and maintains said brushes and conductors in their respective brush-retaining and conductor-receptive channels.

8. A coupling as called for in claim 1, in combination with a pair of bodies pivotally interconnected for movement about a common axis of rotation, wherein there is provided means for securing said plug element relative to one of said bodies and in axial alignment with its said axis of rotation, and means for securing said socket element relative to the other of said bodies and in axial alignment with its said axis of rotation.

9. A combination as called for in claim 8, wherein one of said bodies includes a cylindrical hinge pin and the other of said bodies includes a hollow hinge-pin-receptive sleeve for providing pivotal connection between said bodies when the hinge pin is housed within the said hinge pin receptive socket.

10. A combination as called for in claim 9, wherein said plug element is secured to and is in substantial axial alignment with the said hinge pin and wherein said socket element is contained within and in substantial axial alignment with said hinge pin receptive socket.

11. A combination as called for in claim 8, wherein each of said bodies comprises a hinge leaf.

12. A combination as called for in claim 11, wherein each hinge leaf includes a bearing surface which limits the relative axial movement between the hinge pin of one leaf and the hinge pin receptive socket of the other leaf.

13. A combination as called for in claim 12, wherein the conductor rings of the plug element comprise continuous peripheral surfaces which provide continuous electrical continuity with the conductor brushes of the socket element for all pivotal positions of the hinge leaves.

14. A combination as called for in claim 12, wherein one or more of the conductor rings of the plug element comprise discontinuous peripheral surfaces which provide selective electrical continuity and discontinuity with the conductor brushes of the socket element for different pivotal positions of the hinge leaves.

15. A multi-electrical-circuit conductive hinge of the type which includes a pair of hinge leaves, one of which leaves includes a hinge pin having an outer terminal end, the other of said leaves including a hinge-pin receptive socket, a slip ring assembly secured to, carried by and projecting axially from the terminal end of the hinge pin, a conductor brush assembly housed within

the said hinge-pin receptive socket, said slip ring assembly including conductor rings which are disposed in contacting relationship with the brushes of the conductor brush assembly for providing electrical continuity therebetween when the hinge pin is fully housed within the hinge-pin receptive socket.

16. A hinge as called for in claim 15, wherein a surface of each of the hinge leaves is provided with conductor-receptive channels, wherein conductors from each of the conductor rings of the slip ring assembly are disposed within the conductor-receptive channels of the hinge leaf which includes the hinge-pin, and

wherein conductors from each of the brushes of the conductor brush assembly are disposed within the conductor-receptive channels of the hinge leaf which includes the hinge-pin receptive socket.

17. A hinge as called for in claim 15, wherein the overall length of the hinge pin and slip ring assembly projecting therefrom are adapted to be received within the hinge-pin receptive socket.

18. A hinge as called for in claim 17, wherein the slip ring assembly is secured to the terminal end of the hinge pin for relative lateral movement therewith.

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