Jan. 16, 1962 C. O. DROLLINGER ET AL 3,017,595

PLUG-IN SLIP RING AND BRUSH ASSEMBLY

Filed Dec. 16, 1955 2 Sheets-Sheet 1

Fig. 1.

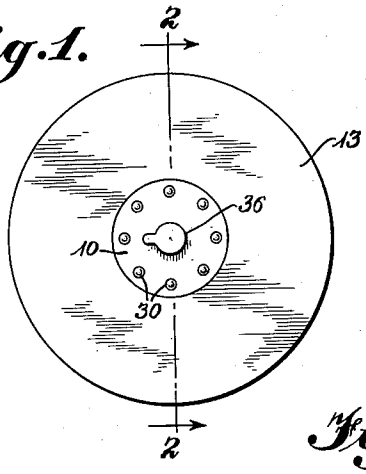


Fig. 3.

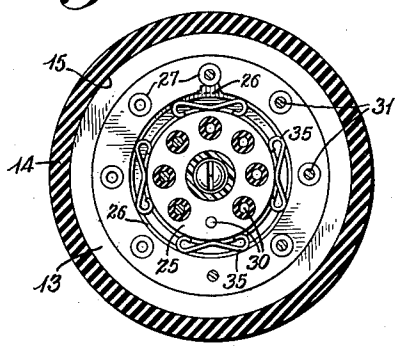


Fig. 2.

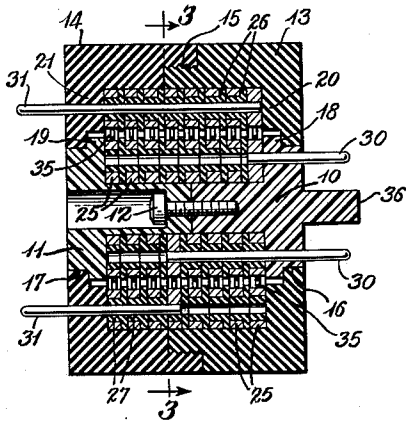
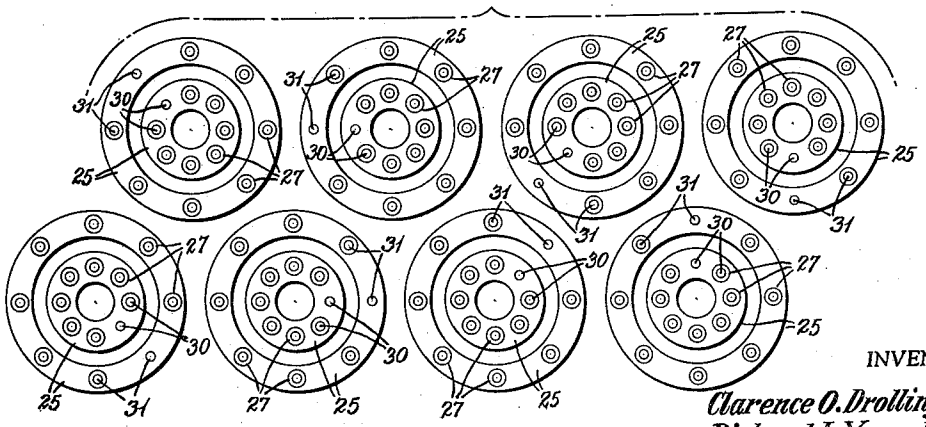


Fig. 4.



INVENTORS

Clarence O. Drollinger and

Richard L. Yarnall

BY Stevens, Davis, Miller and Mosher

ATTORNEYS

Jan. 16, 1962 C. O. DROLLINGER ET AL 3,017,595

PLUG-IN SLIP RING AND BRUSH ASSEMBLY

Filed Dec. 16, 1955 2 Sheets-Sheet 2

Fig. 5.

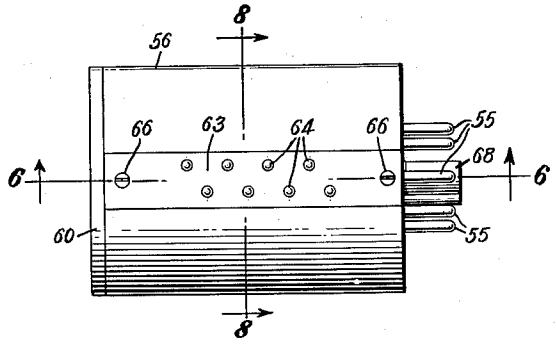


Fig. 6.

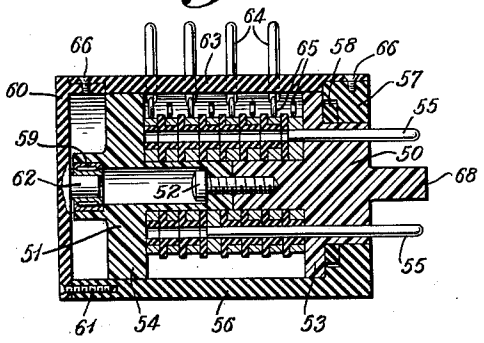


Fig. 7.

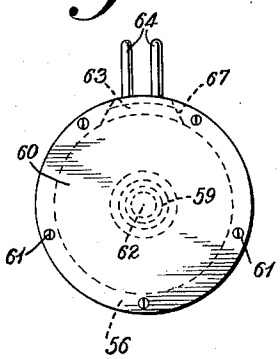
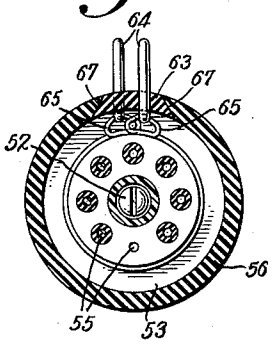


Fig. 8.



INVENTORS
Clarence O. Drollinger and
Richard L. Yarnall

BY Stevens, Davis, Miller and Mosher
ATTORNEYS

United States Patent Office 3,017,595 Patented Jan. 16, 1962

3,017,595

PLUG-IN SLIP RING AND BRUSH ASSEMBLY

Clarence O. Drollinger and Richard L. Yarnall, Dallas, Tex., assignors to Texas Instruments Incorporated, Dallas, Tex., a corporation of Delaware

Filed Dec. 16, 1955, Ser. No. 553,557
16 Claims. (Cl. 339—8)

This invention relates to electrical connectors and more specifically to a slip ring and brush assembly which will provide constant electrical contact between several circuits contained in two separate members having rotational relative motion.

It is quite often desirable to connect a plurality of electrical conductors between two pieces of associated equipment which must be able to rotate relative to each other, such as for example, connections between a stationary piece of equipment and an associated piece of equipment suspended from the connecting conductor cable which is to be wound and unwound from a reel or drum. Another example of such connections is electrical power and signal connections between a stationary base and the rotating portions of a radar antenna. Of course, it is imperative that the connected conductors be kept separate in the electrical sense. Otherwise, there exists the danger of undesirable interaction or short-circuits between the electrical signals on the various conductors.

Heretofore, most such connections between two associated pieces of equipment have been achieved through a slip ring assembly bolted to one of the two pieces and a brush assembly belted to the other. In most installations conductors are permanently affixed to the individual slip rings or brushes by means such as soldering and their other ends connected to the equipment cables through the various screw terminals of ordinary terminal strips affixed to the equipments. These arrangements quite often are bulky and cumbersome and do not facilitate easy connection to or disconnection from the conductor cables.

It is, accordingly, an object of this invention to provide a compact connector which will insure constant electrical connection of a plurality of conductors between two pieces of associated electrical equipment when the two pieces of equipment are rotated relative to each other and which will not be subject to the disadvantages above enumerated.

A further object of this invention is to provide a safe, efficient means for connecting several wires between two pieces of equipment to be rotated relative to each other which will prevent the intermingling of electrical signals and relieve the danger of short-circuits.

A further object of this invention is to provide an electrical connector which can be made economically and which will allow the desired relative rotational motion.

A still further object of this invention is to provide a reliable electrical connector for connecting a plurality of conductors which utilizes slip rings and brushes in a novel manner and which at the same time prevents each pair of connected conductors from contacting any of the other conductors.

A still further object of this invention is to provide an electrical connector of the class described which will furnish a rotatable connection for a plurality of conductors, which possesses plug receiving panels so that connection or disconnection of any or all conductors can be made quickly and easily.

These objects together with further objects and details will become more fully apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

FIGURE 1 is an end view in elevation of the connector of the invention;

FIGURE 2 is a sectional view taken on line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken on line 3—3 of FIGURE 2;

FIGURE 4 is a schematic view of the several slip rings and their corresponding insulator discs showing the staggered arrangement of insulation which permits electrical connection to particular slip rings;

FIGURE 5 is a top plan view of a second embodiment of this invention;

FIGURE 6 is a sectional view taken on line 6—6 of FIGURE 5;

FIGURE 7 is an end view taken from the left side of FIGURE 6; and

FIGURE 8 is a sectional view taken on line 8—8 of FIGURE 5.

Referring now to the drawings, one form of the invention is shown in FIGURES 1 to 4.

There is provided an inner core composed of members **10** and **11** which are detachably held together by suitable means, such as screw **12**. The core members **10** and **11** are made from an appropriate insulating material, such as plastic. An outer casing is provided likewise composed of two members **13** and **14** fashioned from an appropriate insulating material, such as plastic, and these members are complementarily threaded as indicated by the numeral **15** to be conveniently detachably joined together. The outer casing is arranged for rotational motion relative to the inner core and for this purpose, the contacting surfaces between the casing member **13** and core member **10**, indicated by the numeral **16**, and between the casing member **14** and the core member **11**, indicated by the numeral **17**, facilitate this rotary motion. The core members **10** and **11** each define an outer flange **18** and **19** respectively. Between these flanges and on the core members **10** and **11** is mounted a stacked plate arrangement consisting of a plurality of metal slip rings alternating with a plurality of insulator rings. Likewise, the casing members **13** and **14** define outer flanges **20** and **21**, respectively. Between these flange members, is located a second staggered plate arrangement similar to the first. With each slip ring of each staggered plate arrangement, there is associated an insulator ring. Since all of the slip rings are identical in construction, as well as all of the insulator rings, it will suffice for a clear understanding of the present invention to merely describe the construction of a single slip ring and its associated insulator ring.

Slip ring **25**, which is flat and disk-like in construction, is provided with a plurality of equally peripherally spaced holes. There are eight such holes as shown in the drawings, but it will be appreciated that this number has been arbitrarily selected purely for purposes of illustration. All of the holes except one are of the same diameter and the exceptional hole is of smaller diameter. An insulator ring **26** is associated with the slip ring **25**. The insulator ring **26** defines eight equally peripherally spaced holes of a diameter equal to the diameter of the exceptional small hole defined by the slip ring **25**. Also defined by the insulator ring **26** are a plurality of bosses **27** arranged around each hole in the insulator ring **26** with the exception of one hole. The two components are placed together with the small hole on the slip ring **25** and the hole without a boss **27** in the insulator ring **26** in registry. The bosses **27** fit through or are received through all of the larger holes defined in the slip ring **25**. It will be evident from the foregoing that if rods are passed through all of the holes in slip ring-insulator ring combination, the only rod which will contact the slip ring will be the one which is passed through the small hole of the slip ring, all other rods will be held spaced and insulated from the slip ring by the bosses **27**.

Thus arranged, the plurality of slip rings and associated

insulator rings are stacked together onto the core members 10 and 11 between the flanges 18 and 19. In stacking, the small hole in each slip ring is rotated to various positions in each successive slip ring of the stack. For purposes of demonstrating this feature of the invention, reference is made to FIGURE 4 which shows schematically the eight sets of slip rings and their associated insulator rings. As will be evident, the small hole in each slip ring is rotated one hole position in each successive slip ring of the stack.

Received through the stack of plates are a plurality of conductor rods 30. Since there are eight holes in each slip ring, there will be eight such conductor rods 30. By virtue of the stacking arrangement above described, each conductor rod 30 when received through the aligned holes of the several slip rings and their associated insulator rings will only contact one of the slip rings and more specifically that one which has its small hole in the position through which the rod 30 is received. All other slip rings will be insulated from the conductor rod 30 by means of the bosses 27 on the insulator rings.

The conductor rods 30 are affixed to their respective slip rings by means such as soldering, silver-soldering, staking or swaging. The conductor rods 30 may be of various lengths such that when all project from the core member 10 an equal distance, each rod extends only far enough into the slip ring and insulator stack to contact and be affixed to its associated slip ring as shown in FIGURE 2. Alternately, all the connector rods 30 may be of the same length and extend completely through the slip ring and insulator stack to the inner walls of core members 11. In such an arrangement, each slip ring is affixed to its associated conductor rod at a point along the rod different from all of the other rods.

The stacked plate arrangement mounted in the outer casing is identical in all respects to the stacked plate arrangement moutned on the core as will be evident from a close inspection of FIGURES 2 and 4. Again, each slip ring is characterized by eight equally peripherally spaced holes one of which is of smaller diameter. The insulator ring for each slip ring in the stacked arrangement in the casing again is provided with eight equally peripherally spaced holes of a diameter equal to the diameter of the smaller hole of the slip ring with seven of the holes being surrounded by bosses. Conductor rods 31 are received in the aligned holes of the stacked plate arrangement located in the casing and affixed to the slip ring as explained above. Again, each conductor rod 31 will only contact a single slip ring since all others will be held spaced from the conductor rod 31 by means of the bosses (see FIGURE 4).

The insulator rings associated with the slip rings stacked on the core are of slightly greater outside diameter whereas the insulator rings associated with the slip rings stacked in the casing are of lesser inner diameter. This results in the insulator rings projecting beyond both sets of slip rings. This feature is clearly brought out in FIGURE 2. Thus, there is defined between each radially aligned pair of slip rings a channel. In this channel is located a plurality of free floating spring brushes 35 which serve to make radial contact between radially aligned slip rings.

A key 36 is molded as part of the core member 10 and serves as a means to properly orient a matching connector or plug of the connecting cable. Additionally, the key 36 serves the function of relieving the rods 30 of torsional load resulting from rotation of the slip rings. It will be apparent that the key 36 may be omitted and some other means can be utilized to achieve the orienting feature. Thus, for example, one of the rods 30 may be omitted thereby producing a situation where all of the rods are equally peripherally spaced except one pair. If desired, a second key can be provided for the casing members 13 and 14 to serve the same function of relieving torsional load. Further, if desired, the conductor rods 30 and 31 in place of projecting from opposite ends of device may project from the same end.

A second form of the invention allowing a "plug-in" connection from a connecting cable to the side of the slip ring assembly is illustrated in FIGURES 5 to 8 inclusive. In this form of the invention, only a single staggered plate arrangement is utilized with the coacting conductor components being arranged in parallel rows and emerging from the side rather than the end of the staggered plate arrangement. As before, the device consists of a core member composed of parts 50 and 51 held together by means of a threaded element 52. Each core member 50 and 51 defines a flange, 53 and 54 respectively. A stacked plate arrangement consisting alternately of slip rings and insulator rings identical in construction with those discussed with reference to FIGURES 1 to 4 is arranged on the core members 50 and 51 between the flanges 53 and 54. A series of conductor rods 55 are received through the holes in the stacked plate arrangement and affixed to the slip rings. As will be recalled from the description of the first form of the invention, each conductor rod 55 is only in contact with one of the slip rings and is insulated from the remaining slip rings by means of the bosses on the insulator discs. Again, as before, the insulator discs are of slightly greater diameter than the metal slip rings and thus define a channel radially outwardly of each slip ring.

Surrounding the core members 50 and 51 is an outer cylindrical casing 56 having an inwardly projecting flange 57 at one end. A suitable bearing 58, such as a "Teflon" bearing is positioned between the core member 50 and the inwardly projecting flange 57 of the casing 56. Thus, at this end of the device, the outer and inner parts are mounted for relative rotation by virtue of the "Teflon" bearing. Cast into the end of core member 51 is a ball bearing assembly 59. An end plate 60 is provided to close the left end of the assembly and is attached to the outer casing 56 by means of threaded elements 61. The end plate 60 defines a central projection 62 which is received within the ball bearing assembly 59 in a snug fit. Thus, the left end of the assembly is supported by the central projection 62 and the outer and inner parts of the assembly are free for relative rotation.

The outer casing 56 is axially slotted and fitted into this slot is a plate 63. Imbedded in the plate 63 are a pair of staggered rows of pins 64. The inner end of each pin 64 has attached to it a spring brush 65 which rides in contact with a slip ring of the stacked plate arrangement when the plate 63 is fixed to the casing 56. By the means above described, each pin 64 is in sliding contact with a slip ring through the agency of a slip brush 65. The plate 63 is attached to the outer casing 56 by threaded elements 66. It will be noted at this point that the outer casing 56 is tapered on either side of the slot as indicated in FIGURE 8 by the numeral 67. This allows for greater clearance between the casing 56 and slip brushes 65. The core member 50 is provided with a key 68 which serves the same functions as key 36 in the first embodiment.

Although the present invention has been shown and described with reference to particular embodiments, nevertheless various changes and modifications obvious to one skilled in the art are within the spirit, scope and contemplation of the present invention.

What is claimed is:

1. An electrical slip ring and brush assembly comprising a stack of alternately disposed conductor slip rings of a moderate thickness and flat circular insulator members, a first set of conductor rods longitudinally disposed in aligned holes defined by said conductor slip rings and said insulator members, said insulator member having bosses of substantially the same thickness as said slip rings and being positioned in all but one of the holes defined by each conductor slip ring so that each said rod is in direct electrical connection with a different slip

ring, a second conductor associated with each said slip ring, and means having a brush element in sliding frictional engagement with each slip ring electrically connecting each said slip ring with its associated second conductor and means mounting said stack and the associated second conductors for relative motion.

2. An electrical slip ring and brush assembly comprising a stack of alternately disposed conductor slip rings of a moderate thickness and flat circular insulator members, a first set of conductor rods axially disposed in peripherally spaced and axially aligned holes defined by said conductor slip rings and said insulator members, said insulator members having bosses of substantially the same thickness as said slip rings and being positioned in all but one of the holes defined by each conductor slip ring so that each said rod is in direct electrical connection with a different slip ring, a second conductor associated with each said slip ring, a conductor brush in sliding frictional engagement with each slip ring electrically connecting each said slip ring with its associated second conductor and means mounting said stack and the associated second conductors for relative motion.

3. An electrical slip ring and brush assembly comprising a stack of alternately disposed conductor slip rings of moderate thickness and flat circular insulator members, a first set of conductor rods longitudinally disposed in aligned holes defined by said conductor slip rings and said insulator members, said insulator members having bosses of substantially the same thickness as said slip rings and being positioned in all but one of the holes defined by each conductor slip ring so that each said rod is in direct electrical connection with a different slip ring, a plug receiving element mounted for rotation relative to said stack, a conductor pin disposed in said element associated with each said slip ring and means having a brush element in sliding frictional engagement with each slip ring and coupled to one of said pins for electrically connecting each pin with its associated slip ring.

4. An assembly as defined in claim 3 wherein said brushes slidably contact the outer peripheral edges of said slip rings.

5. An electrical slip ring and brush assembly comprising a stack of alternately disposed conductor slip rings of moderate thickness and flat circular insulator members, a first set of conductor rods axially disposed in peripherally spaced and axially aligned holes defined by said conductor slip rings and said insulator members, said insulator members having bosses of the same thickness as said slip rings and being positioned in all but one of the holes defined by each conductor slip ring so that each said rod is in direct electrical connection with a different slip ring, a plug receiving element mounted for rotation relative to said stack, a conductor pin disposed in said element associated with each said slip ring and a brush element in sliding frictional engagement with each slip ring and coupled to one of said pins for electrically connecting each pin with its associated slip ring.

6. An assembly as defined in claim 5 wherein said brushes slidably contact the outer peripheral edges of said slip rings.

7. An electrical slip ring and brush assembly comprising a housing a stack of alternately disposed flat circular conductor and insulator members, conductor rods longitudinally disposed in holes defined by said flat circular members, insulating means defined by said insulator members to afford each conductor rod electrical connection with a different conductor member, a second stack of alternately disposed flat circular conductor and insulator members concentrically disposed outside of said first stack, conductor rods longitudinally disposed in holes defined by said members of said second stack, insulating means defined by said second insulator members to afford each conductor rod of said second stack electrical connection with a different conductor member of said second stack, and means electrically connecting each conductor member of said first stack with the corresponding conductor member of said second stack, the ends of the conductor rods of said first named stack extending from one end of said housing to form a plug, and the ends of the conductor rods of said other stack extending from another location on said housing to form a second plug.

8. An assembly as defined in claim 7 wherein said stacks are mounted for relative rotation.

9. An electrical slip ring and brush assembly comprising a housing, a stack of alternately disposed conductor slip rings and flat circular insulator members, conductor rods longitudinally disposed in holes defined by said conductor slip rings and said insulator members, insulator bosses defined by said insulator members positioned in all but one of the holes defined by each conductor slip ring to afford each conductor rod direct physical but unattached electrical connection with a different slip ring, a second stack of alternately disposed conductor slip rings and flat circular insulator members concentrically disposed outside of said first stack, conductor rods longitudinally disposed in holes defined by said conductor slip rings of said second stack, insulator bosses defined by said second insulator members positioned in all but one of the holes defined by each conductor slip ring to afford each conductor rod of said second stack electrical connection with a different slip ring of said second stack, and free floating conductor brushes electrically connecting each slip ring of said first stack with the corresponding slip ring of said second stack.

10. An assembly as defined in claim 9 wherein said brushes slidably contact the outer peripheral edges of said slip rings of said first-mentioned stack and the inner peripheral edges of said slip rings of said second-mentioned stack.

11. An assembly as defined in claim 10 wherein means are provided mounting said stacks for relative rotation, said conductor rods of said first stack extending through said housing to form an external plug, said conductor bars of said second stack extending through said housing at another location to form a second electrical plug.

12. A plug-in slip ring and brush assembly for completing an electrical circuit between one group of electrical conductors and a second group of electrical conductors being relatively rotatable with the said one group comprising: an inner core, an outer casing, a series of individual annular slip rings in said casing and in electrical contact with certain of said electrical conductors of one named group, a second series of individual slip rings on said core and in concentric relation to said first named series and in electrical contact with certain electrical conductors of said other named group, both said slip rings being relatively flat but having a finite thickness and defining a concentric space therebetween, spring means in said space providing radial electrical contact between said concentric rings while one ring is rotating relative to the other ring, and means to maintain said spring means axially in place.

13. A plug-in slip ring and brush assembly for completing an electrical circuit between one group of electrical conductors and a second group of electrical conductors being relatively rotatable with the said one group comprising: an inner core, an outer casing, a series of individual annular slip rings in said casing and in electrical contact with certain of said electrical conductors of one named group, a second series of individual slip rings on said core and in concentric relation to said first named series and in electrical contact with certain electrical conductors of said other named group, both said slip rings being relatively flat but having a finite thickness and defining a concentric space therebetween, free floating spring means in said space providing radial electrical contact between said concentric rings while one ring is rotating relative to the other ring, and means to maintain said spring means axially in place.

14. A plug-in slip ring and brush assembly for com-

pleting an electrical circuit between one group of electrical conductors and another group of electrical conductors comprising: an inner core, an outer casing, a series of individual annular slip rings in said casing and in electrical contact with certain of said electrical conductors of one named group, a second series of individual slip rings on said core and in concentric relation to said first named series and in electrical contact with certain electrical conductors of said other named group, both of said slip rings being relatively flat but having a finite thickness and defining a concentric space therebetween, free floating leaf spring means in said space providing radial electrical contact between said concentric rings while one ring is rotating relative to the other ring, that portion of said leaf spring which contacts each ring being convex in shape, and means to maintain said spring means axially in place.

15. A plug-in slip ring and brush assembly for completing an electrical circuit between one group of electrical conductors and a second group of electrical conductors being relatively rotatable with said one group comprising: an inner core containing said one group of conductors, an outer casing containing the other group of conductors, a series of individual disk-like slip rings mounted in said inner core and having a cylindrical electrical conducting surface, a series of individual disk-like insulator rings mounted in said core in staggered relation to said slip rings and having a circumferential surface extending radially out from said cylindrical surface and thereby providing a captive annular groove relative to each slip ring, a second series of individual slip rings mounted on said outer casing in concentric relation to said first-named series, and a free floating spring brush installed in said groove in gliding electrical contact with a slip ring of said first-named series and a slip ring of said second series, and means to attach an electrical conductor of one group with only one said slip ring of said first-named series and to connect an electrical conductor of said other group into electrical conducting relation with only one said slip ring of said second series.

16. A plug-in slip ring and brush assembly for completing an electrical circuit between one group of electrical conductors and a second group of electrical conductors being relatively rotatable with the said one group comprising: an inner core containing said one group of conductors, an outer casing containing the other group of conductors, a series of individual disk-like slip rings mounted in said inner core and having a cylindrical electrical conducting surface, a series of individual disk-like insulator rings mounted in said core in staggered relation to said slip rings and having a circumferential surface extending radially out from said cylindrical surface and thereby providing a captive annular groove relative to each slip ring, a second series of individual slip rings mounted on said outer casing in concentric relationship with said first-named series of slip rings, and a free-floating convex spring brush installed in said groove in gliding electrical contact with a slip ring of said first-named series and a slip ring of said second series, and means to attach an electrical conductor of one group with only one said slip ring of said first-named series and to connect an electrical conductor of said other group into electrical conducting relation with only one said slip ring of said second series, said first named means comprising: each slip ring of said first-named series defining a series of circumferentially spaced holes defined by and in said slip rings, and each insulator ring defining a corresponding number of aligned holes, said conductors of one group comprising bars disposed longitudinally through the aligned holes in said rings, and means between said insulator ring and said slip ring to provide electrical contact between only one of said conductor bars and any slip ring.

References Cited in the file of this patent

UNITED STATES PATENTS

1,711,858	Samminiatelli	May 7, 1929
1,908,764	Kruger	May 16, 1933
2,291,071	Bruno	July 28, 1942
2,319,443	Corte	May 18, 1943
2,376,370	Lombardi	May 22, 1945
2,467,758	Lindenblad	Apr. 19, 1949
2,494,244	Jonard et al.	Jan. 10, 1950
2,751,565	Johnston	June 19, 1956
2,854,647	Nugent	Sept. 30, 1958

FOREIGN PATENTS

317,313	Germany	Dec. 17, 1919