United States Patent

[11] 3,599,164

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[21] Appl No **816,968**
[22] Filed **Apr. 17, 1969**
[45] Patented **Aug. 10, 1971**
[32] Priority **Apr. 19, 1968**
[33] **Germany**
[31] **P 17 65 211.8**

[54] **ARTICULATED CONDUCTOR CONNECTION**
5 Claims, 3 Drawing Figs.

[52] U.S. Cl. **339/4,** 308/230
[51] Int. Cl. **H01r 39/28**
[50] Field of Search. 339/4, 5, 6, 7, 8; 308/235, 219, 221

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ABSTRACT: An articulated conductor connection has a rotation axis and has two conductor plates disposed perpendicular to this axis. The conductor plates have mutually opposing surfaces each with a conical groove coaxial with the axis. The grooves define an annular channel of wedge-shaped cross section. Rollers are placed in the channel and function to transmit current between the plates; and springs are positioned intermediate the plates for radially pressing the rollers into the channel.

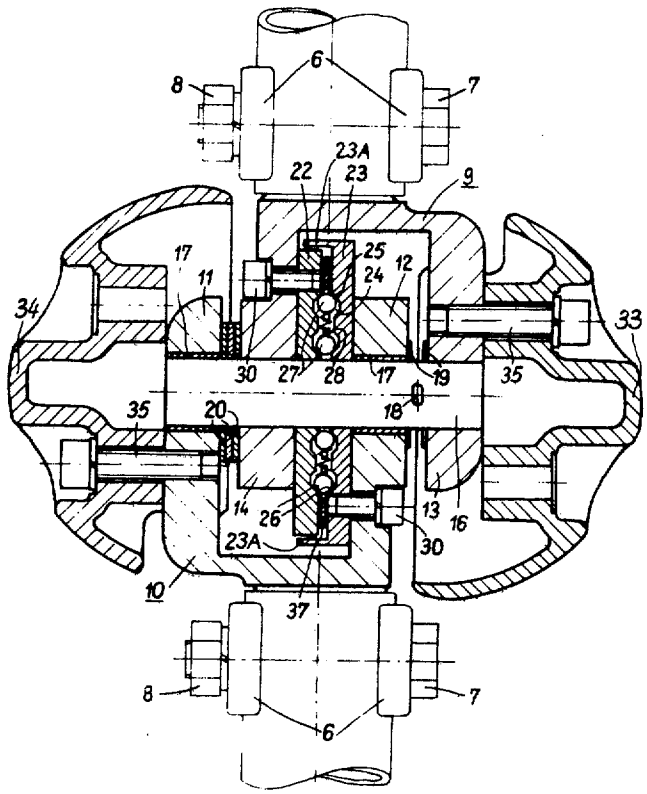

Fig. 1

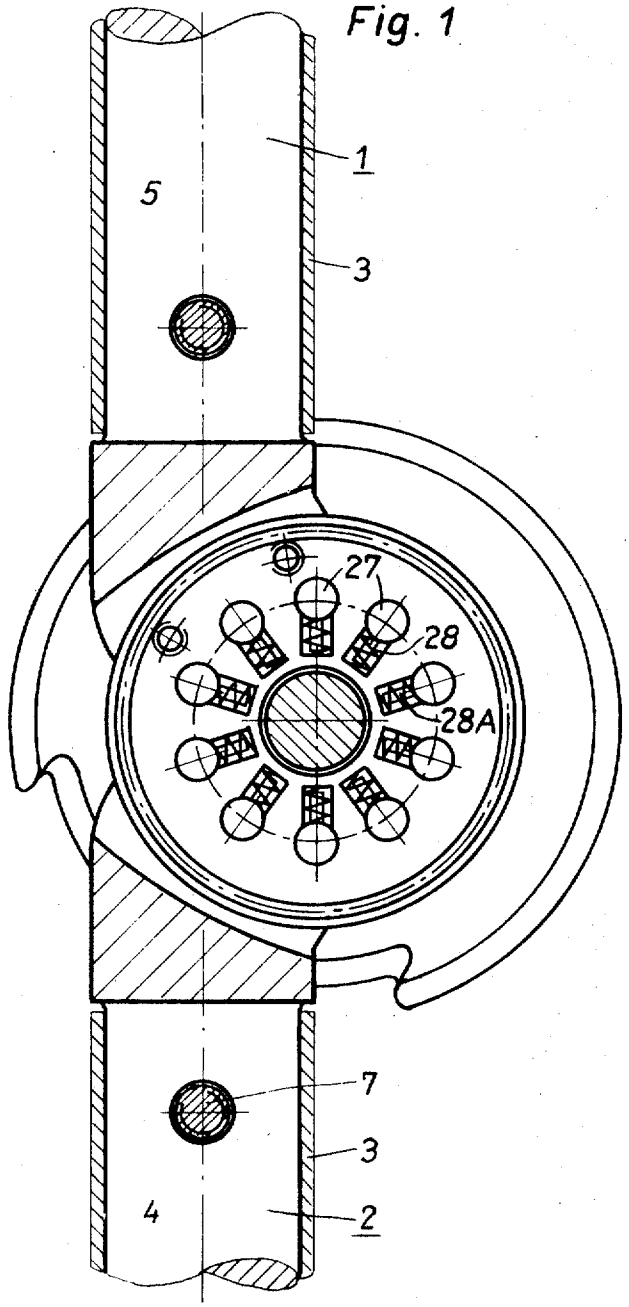

Fig. 2

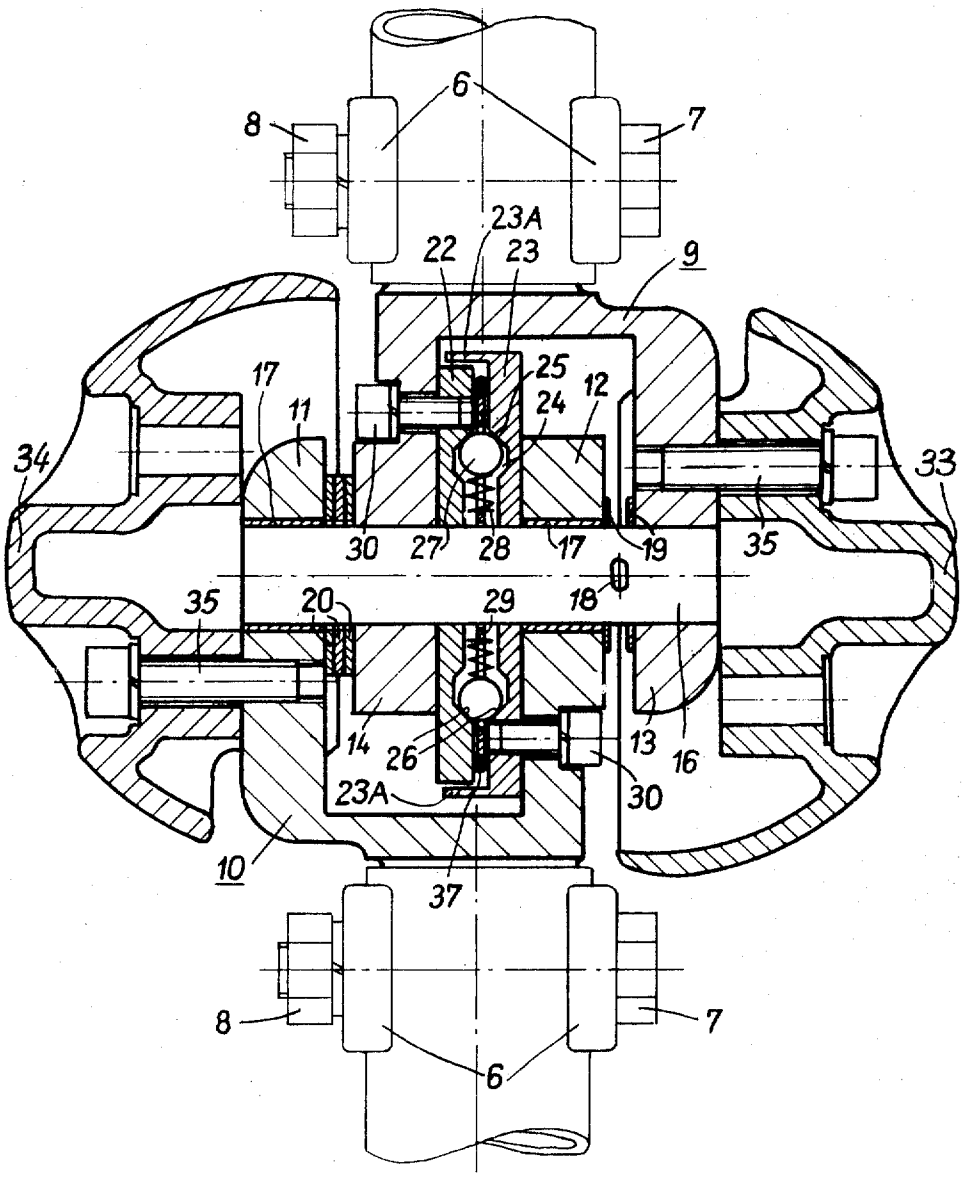
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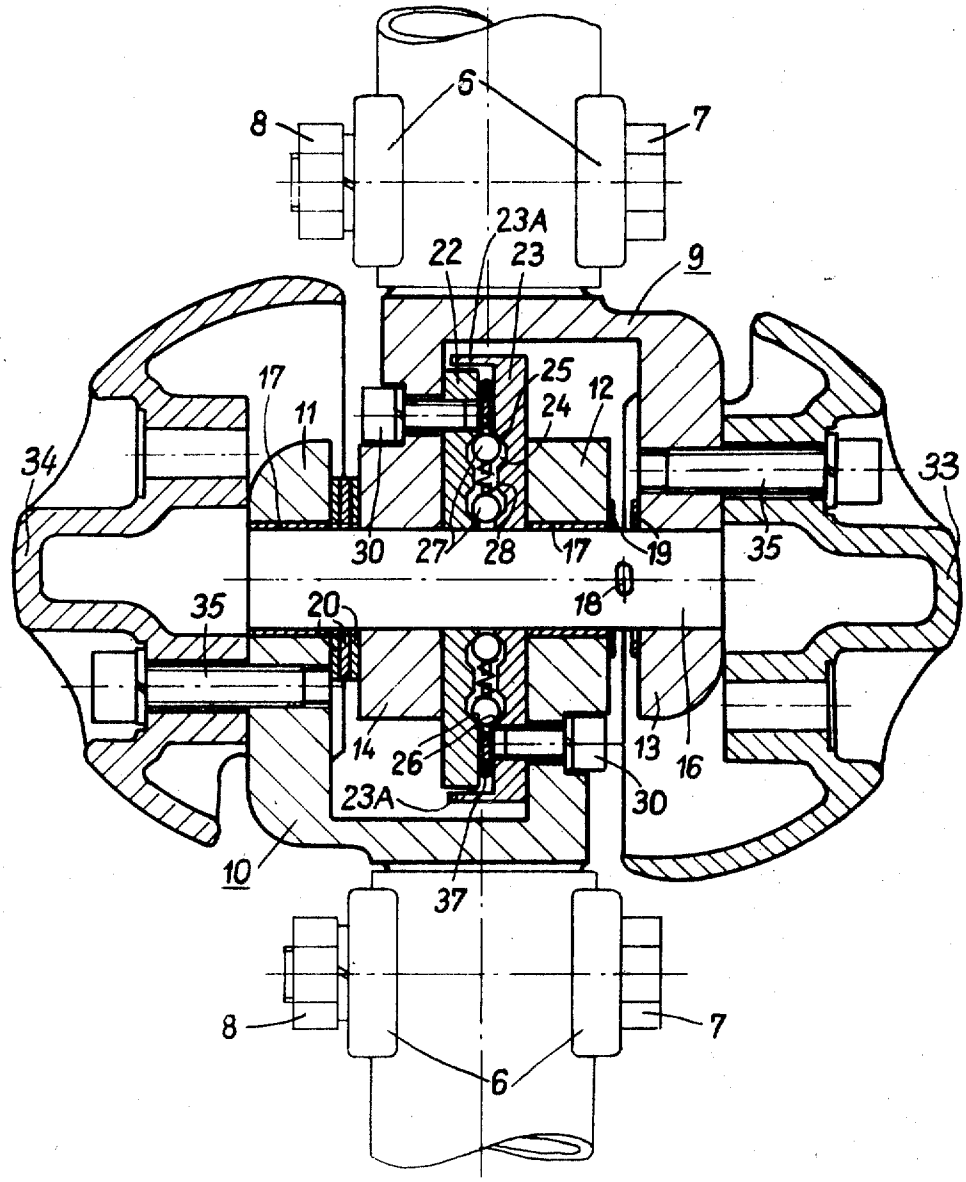
Fig. 3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ARTICULATED CONDUCTOR CONNECTION

My invention relates to articulated conductor connections. Such connections are particularly necessary for pantograph-type disconnects wherein the current flows across rotatably connected members of the lazy tongs type. The connection can also be used for other switches as well as for providing a current connection across any other articulate joint.

The German Published Pat. application No. 1,111,694 discloses a rotary contact device in which the current connection is established independently of the mechanical bearing by means of contact rollers. The contact rollers are conical bodies whose tips are directed toward one another. They are pressed with a spring against two mutually opposing annular bulges in a plane perpendicular to the axis of rotation. The known device is essentially also a flexible connection in which considerable discharge is directed along the rotation axis so that it cannot be used in all places. In addition, the contact rollers are relatively expensive. This applies also in the case where two contact rollers are constructed with U-shaped cross sections, and are joined by a common rod or axle and moved by a common spring along the rod.

Another rotary contact device is disclosed in German Printed Pat. application No. 1,083,889 wherein the current connection is established between a bolt and a stationary portion by spherical rollers. The bolt braces with a radial protrusion upon a row of the rollers while at the same time supporting a second row of spherical rollers. Both rows of rollers are subjected to pressure by a ring assisted with a helical spring which surrounds the bolt. This arrangement also requires considerable space. In addition, the contact resistance is different since the rollers of the upper row abut with uncertainty against the stationary part. Simultaneously, this device is to have a bearing which requires that special care be taken during production and assembly.

It is an object of my invention to provide an articulated conductor connection which overcomes the aforementioned disadvantages of the existing connections.

In particular, it is an object of my invention to provide an articulated conductor connection wherein spherical rollers are pressed by individual springs against the respective surfaces of the connected conductors.

According to the invention, two conductor plates are arranged perpendicular to the joints axis and have mutually opposing surfaces which are provided with mutually opposing recesses symmetrically arranged so as to form in cross section a wedge-shaped ring gap. Several spherical rollers are guided with a spring which presses the rollers in radial direction into the wedge-shaped ring gap. Preferably, each roller is provided with its own spring.

The articulated conductor connection of the invention provides high reliability at minimum cost with regard to material, production and mounting. Foremost is the fact that the parts are small. Thus, the invention meets all requirements.

For directing the rollers and the corresponding springs, special recesses can be provided in one of the plates. However, it is preferable to place a disc between the two plates which has openings for the rollers and, if necessary, for the springs. Such a disc can be produced without difficulty as a stamping. This makes it possible to construct the plates merely as turned or stamped parts which makes the processing costs less than those associated with machining recesses into one of the plates.

According to a feature of the invention, the rollers are subjected to a spring preload directed either outwardly away from the rotary axis, or inwardly toward the latter. The number of rollers is determined by the required current. Accordingly, to accommodate high current requirements, a double-conical ring opening can be formed with the plates wherein two rollers are loaded by a common spring in radial direction against the mutually opposing conical surfaces facing one another in this direction. Such roller pairs are then disposed about the rotary axis in accordance with the required current carrying capacity.

The conical surfaces which bound the ring opening preferably form an angle of 45° with the rotary axis. The contact force between the roller and the corresponding conical surfaces is then just as great as the spring force. The force ratio can be changed by reducing the angle. A limit value is obtained by clamping the rollers tightly in the opening.

While the known contact devices involve considerable expense and effort in order to obtain a tight seal, the articulated conductor connection of the invention is simple to encase because of its small dimensions. This is of particular importance for switches which are to be installed in the open air and, also for inside use, this affords a significant advantage, since the penetration of dust and, thus, a roughening of the contact surfaces therefrom is prevented. In the simplest arrangement, the opening between the plates which receives the rollers can be closed with a sealing ring. The sealing ring is subjected to only slight forces. In cases where coarse dirt, or icing can be expected one of the plates can be provided with a rim which extends over the periphery of the other plate.

The invention will be further elucidated with reference to the accompanying drawings which illustrates to scale, a portion of a shear-pantograph switch provided with an articulated conductor connection according to the invention.

FIG. 1 is a side view, partially in section, of the articulated conductor connection.

FIG. 2 is another side view, also partially in section, of the embodiment of the invention illustrated in FIG. 1.

FIG. 3 is an illustration, partially in section, of an alternate embodiment of the articulated conductor connection illustrated in FIG. 1 showing how pairs of contact bearings are disposed between the conductor plates of the connection.

In FIG. 1 reference numerals 1 and 2 denote arms comprised of aluminum tubing 3 which fit over massive bolts 4 and 5 at the articulate joint locations. A collar 6 held tight by screw 7 and nut 8 ensures a tight seat for the tubes 3 upon the bolts 4 and 5.

The bolts 4 and 5 are part of two similar U-shaped aluminum castings 9 and 10 whose legs 11, 12, 13 and 14 are provided with bores for accommodating shaft 16. The bores in the legs 11 and 12 are equipped with sleeves of bearing metal at 17. The shaft 16 is seated firmly in legs 13 and 14.

A securing pin 18 is put through the shaft 16 between the legs 12 and 13 whereat shaft 16 carries two discs 19. Between the legs 11 and 14, three spacers 20 are arranged on the shaft 13 which determine the space which is utilized between legs 14 and 12 for the transfer of current. The conductor connection accommodated in this space includes two plates 22 and 23 made of copper. The plates illustrated in this embodiment are of the same configuration and are provided with symmetrical recesses 24 with inclined outside walls 25 which are silver-plated. The plates with recesses 24 form an annular channel 26 having a 90° opening angle and a wedge-shaped cross section. The annular channel contains spherical rollers 27 which are disposed against walls 25.

The illustrated embodiment has ten rollers 27 made of copper. Each roller has a corresponding pressure spring 28 which presses the roller outwardly. The rollers 27 and the springs 28 are guided by a brass disc 29 provided with appropriate slots.

Assembly of the conductor connection is considerably facilitated by providing the rollers with pins 28A for guiding the appertaining springs. The pin can have a small volume relative to the springs when the latter are in the unloaded position. This prevents the springs from falling off the rollers.

During the assembly of the conductor connection, the plates 22 and 23 are held together with an auxiliary device not shown in the drawing. In this condition, the plates are inserted into the opening of casting 9 that extends with leg 14 into the opening of casting 10. The shaft 16 is then pushed through. The screws 30 which are now tightened affix the plate 23 at leg 12 and the plate 22 at leg 14. The nonillustrated auxiliary device is now removed.

In the illustrated embodiment, the outer legs 11 and 13 are provided with hubs 33 and 34 of cast aluminum which are af-

fixed by screws **35**. The hubs evenly distribute the electric field so that no corona effects occur even at high voltages.

The rollers **27** and plate surfaces **22, 23** provided for passing current are dustproof enclosed by means of an annular cord ring **37**. Under certain circumstances, this type of sealing may be adequate for outdoor switches due to the protection afforded by legs **11** and **14** coacting with hubs **33** and **34**. If required, a tighter seal can be provided by using the rim of one plate to enclose the rim of the other plate with a slight clearance.

The conductor connection, which is suitable for swinging and rotation movements about arbitrary angles, has shown excellent results in tests. The disclosed embodiment has been found to withstand test currents of more than **50** *k*A.

As already mentioned, the number of rollers is determined by the required current. FIG. **3** illustrates an embodiment of the invention wherein a double conical ring opening is formed between the conductor plates **22** and **23**. The rollers are grouped in pairs and are positioned in this double conical opening. Each roller pair is loaded by a spring **28** in radial direction against the mutually opposing conical surfaces facing one another in this direction. Such roller pairs are disposed about the rotary axis in accordance with the required current carrying capacity.

Upon studying this disclosure it will be obvious to those skilled in the art that my invention is amenable to various modifications with respect to details and can be given embodiments other than that particularly illustrated and described herein, without departing from the essential features of my invention and within the scope of the claims annexed hereto.

I claim:

1. An articulated conductor connection having a rotation axis, said connection comprising two conductor plates situated perpendicular to said axis and having respective surfaces facing each other, said surfaces each having conical annular grooves coaxial with said axis, said plates being sufficiently closed to each other so that said grooves define an annular channel of wedge-shaped cross section, a plurality of arcuate contact bearings disposed in said channel for transmitting current between said plates, and a plurality of springs disposed intermediate said plates for radially pressing said contact bearings into said channel, each of said springs radially pressing a corresponding one of said contact bearings into said channel.

2. An articulated conductor connection according to claim **1**, wherein said contact bearings are respective spherical rollers, said connection comprising disc means disposed intermediate said plates, said disc means having a plurality of mutually separate openings each for positioning a corresponding one of said spherical rollers.

3. An articulated conductor connection according to claim **2**, wherein said rollers include a plurality of guide pins each for guiding a corresponding one of said springs.

4. An articulated conductor connection having a rotation axis, said connection comprising two conductor plates situated perpendicular to said axis and having respective surfaces facing each other, said surfaces each having conical annular grooves coaxial with said axis, said plates being sufficiently close to each other so that said grooves define an annular channel of wedge-shaped cross section, a plurality of arcuate contact bearings disposed in said channel for transmitting current between said plates, said bearings being grouped into a plurality of pairs, and a plurality of springs disposed intermediate said plates for radially pressing said bearings into said channel, each of said springs radially pressing a corresponding pair of said bearing pairs.

5. An articulated conductor connection having a rotation axis, said connection comprising two conductor plates situated perpendicular to said axis and having respective surfaces facing each other, said surfaces each having conical annular grooves coaxial with said axis, said plates being sufficiently close to each other so that said grooves define an annular channel of wedge-shaped cross section, arcuate contact bearing means disposed in said channel for transmitting current between said plates, spring means disposed intermediate said plates for radially pressing said contact bearing means into said channel, two U-shaped holding members extending into each other perpendicular to said axis, one of said plates being mounted on one of the legs of one of said holding members, and the other of said plates being mounted one one of the legs of the other of said holding members, and shaft means disposed along said axis and passing through said plates and said legs for pivoting the latter.