

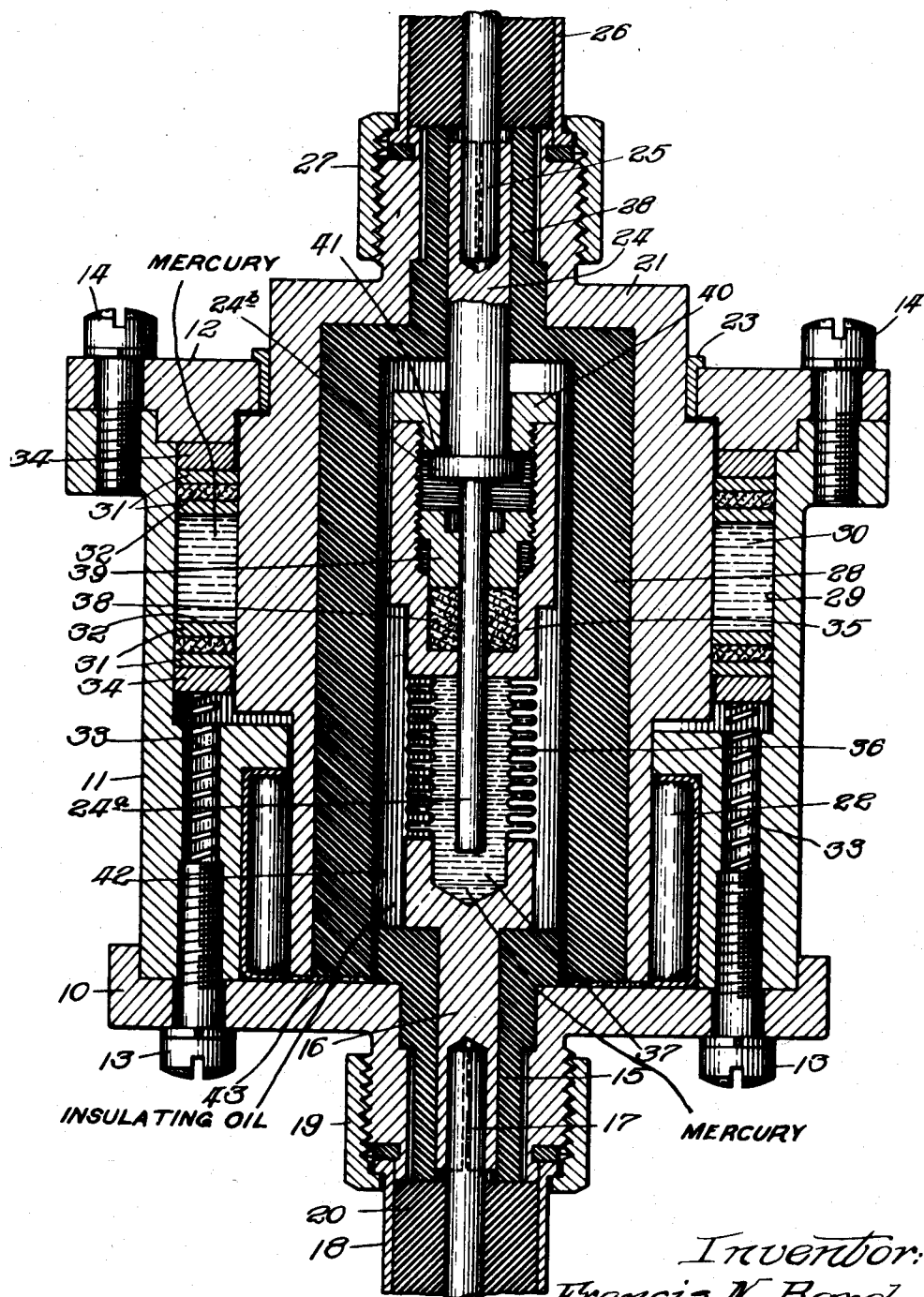
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REVOLVING ELECTRICALLY CONDUCTIVE JOINT

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REVOLVING ELECTRICALLY
CONDUCTIVE JOINT

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This invention relates to a revolving joint, and more particularly to a joint adapted to provide two concentric electrical connections.

One feature of this invention is that it provides an improved revolving electrical connection having low resistance and good mechanical and electrical characteristics at relatively high speeds of rotation; another feature of this invention is that it provides a connecting joint particularly adapted to connect two portions of a co-axial cable; yet another feature of this invention is that electrical connection is made through a body of mercury completely filling a chamber and under moderate pressure. Other features and advantages of this invention will be apparent from the following specification and the drawing, which is a transverse sectional view of an embodiment of my invention particularly designed for use in a co-axial cable.

While electrical connection between a stationary part and a rotating part has heretofore been made by the use of an open pool of mercury, this arrangement is impracticable where relatively high speeds of rotation are desired, as in the neighborhood of 1,000 R. P. M. Such rotation of a part in an open pool of mercury breaks the mercury into balls and throws it around, the centrifugal force throwing the mercury away from the revolving element and destroying any chance of achieving a good electrical contact with low resistance. Moreover, an open pool arrangement cannot be used where the connection may be twisted and turned at high speed and through considerable angles, as in an airplane.

Certain present day radio equipment requires connection between the set and a rotating aerial, which connection must be made through a co-axial cable, and this has presented a number of problems. The particular embodiment of my invention disclosed herewith is especially designed for use in such a situation, connecting both the sheath and central conductors of two portions of a co-axial cable while permitting relatively high speeds of rotation between them. This is done by making the connection through a solid body of liquid of good electrical conductivity, as mercury, under moderate pressure to keep it from breaking up or splashing during rotation between the two parts with which it is in contact.

The lone figure on the drawing shows the revolving joint.

Referring now more particularly to the drawing, the joint is shown as comprising two parts, the lower part being hereafter termed the sta-

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tionary part, and the upper part the rotatable part, although it will be understood that this is relative and that either part could rotate with respect to the other, or both could rotate differently at the same time. The lower part comprises an end plate 10 adapted to be fastened to other apparatus in any desired manner (as by being provided with bolt holes not shown here because they fall in a different section line), a main body casting 11, and an upper cap 12. All of these elements may be of cast metal or other appropriate material, being removably connected together as by the studs 13 and 14. The end plate 10 is provided with a central opening having a sleeve 15 of insulating material therein and a central metal member 16 within such sleeve. The insulating sleeve may be of polystyrene or other appropriate material having good high frequency insulating characteristics. The member 16 has a central opening adapted to receive the prong 17 of a connector at the end of one portion of the co-axial cable, this end portion of the cable being here shown as having its sheath 18 mechanically and electrically connected to the end plate 10 by the threaded cap member 19. The co-axial cable may have merely the end or connector portion filled with a solid dielectric, as 20, or the entire cable may be so arranged.

The upper part is here shown as comprising a generally cylindrical metal casting 21 adapted to be received within the lower part, as shown, needle bearings 22 and a bushing 23 providing for rotation between the two parts. The upper end of the upper part is provided with an arrangement similar to that just described to make connection to the other portion of the co-axial cable, a central member 24 being adapted to receive and grippingly engage a prong 25 of the central conductor of the cable, the sheath 26 of the cable being mechanically and electrically connected to the member 21 by a threaded cap 27. The central member 24 is spaced from the generally cylindrical member 21 by an insulating sleeve 28. It will be noted that the lower insulating sleeve 15 extends up within the lower end of the insulating sleeve 28 so that there is no direct radial air gap.

The two parts provide an outer chamber 29 adapted to receive a body of liquid of high electrical conductivity, as mercury, here indicated as 30. The mercury is sealed in the annular chamber thus provided by sealing means here shown as synthetic rubber gaskets 31, these having oil-soaked leather gaskets 32 associated therewith to provide lubrication. Springs 33 are

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spaced radially around the outer casing in openings provided therefor, and these act through an annular metal member 34 to put moderate pressure on the mercury 30. The body of mercury makes a large contact area with cooperating metal walls of the two parts, is sealed so that it does not escape from the chamber during rotation between the parts, and is maintained under a few pounds pressure to the square inch by the springs 33. The result is a very good electrical connection of low resistance.

In order to provide a connection between the central conductors of the cable, another central member 35 is provided, this being connected to the member 16 by a Sylphon or metal bellows 36 so that a central chamber is provided containing another body of mercury, here identified as 37. This chamber lies along the axis of rotation between the parts of the joint, which axis coincides with that of the cable, and the outer previously described insulating chamber is concentric with such axis. The central member 24 of the upper part terminates in a rod portion 24a which extends down into the body of mercury 37 a seal around this rod portion being provided by the gasket 38 held in place by any appropriate means, as the cap member 39. Some space is provided between this cap member 39 and the second cap member 40, as illustrated, the member 24 being provided, in this space, with an annular shoulder portion 24b. A washer 41 or other suitable bearing means may be interposed between the cap 40 and the shoulder portion 24b.

In order to supplement the dielectric effect of the solid material 28, the chamber 42 may be filled with a liquid of the desired dielectric characteristics, as oil, a sealing washer 43 preventing loss of the liquid during rotation.

When the central parts are assembled, the central chamber is first filled with a measured quantity of mercury and then the rod portion is inserted therein. This forces the Sylphon to expand and provides a desired amount of pressure on the body of mercury in the central chamber, the bellows acting not only as a seal but also as a spring or pressure member. In addition, the bellows is capable of a slight amount of "wobble" so that any slight misalignment between the central and outer portions of the joint parts is compensated for during rotation. The rod portion 24a may be of any metal, but is preferably nickel, since this has better electrical characteristics with mercury, and there is less loss of mercury around a sealed rotatable nickel part than a similar part made of another metal.

It will be seen that the arrangement disclosed provides large electrical contact areas at both the inner and outer points of connection, and enables a relatively high speed of rotation between the joint parts without the introduction of high resistance. Moreover, there are no radial air gaps at any point causing introduction of different insulating characteristics; and yet there is enough air space between the solid parts to permit some change in volume of the mercury.

While I have described and claimed certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. A revolving electrically conductive joint of the character described, including: a first joint part, at least a portion thereof being electrically

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conductive; a second joint part, at least a portion thereof being electrically conductive, the two parts being connected for swivelling about an axis, at least one of said parts having a portion concentric with said axis and adjacent at least a portion of said other part; means cooperating with said portions to provide a sealed chamber; and a body of electrically conductive liquid under positive static pressure completely filling said chamber and confined therein and making contact with the electrically conductive portions.

2. A revolving electrically conductive joint of the character described, including: a first joint part, at least a portion thereof being electrically conductive; a second joint part, at least a portion thereof being electrically conductive, the two parts being connected for swivelling about an axis and providing a chamber concentric with said axis; a body of electrically conductive liquid under positive static pressure completely filling said chamber and making contact with the electrically conductive portions; and means sealing said liquid in the chamber to confine it therein during rotation between the parts.

3. A revolving electrically conductive joint of the character described, including: a first joint part, at least a portion thereof being electrically conductive; a second joint part, at least a portion thereof being electrically conductive, the two parts being connected for swivelling about an axis and providing a chamber concentric with said axis; a body of mercury completely filling said chamber and making contact with the electrically conductive portions; and means for sealing the mercury in the chamber and maintaining positive static pressure thereon during rotation between the parts, said means including a spring for maintaining said pressure.

4. A revolving electrically conductive joint adapted to provide two concentric current paths, including: a first joint part, at least two portions thereof being electrically conductive; a second joint part, at least two portions thereof being electrically conductive, the two parts being connected for swivelling about an axis and providing a chamber at said axis and a separate concentric annular chamber; a body of mercury in each of the chambers completely filling it and each body making contact with an electrically conductive portion of each part to provide a current path, whereby two separate current paths are provided through the joint; and means associated with each of the chambers for sealing the mercury in the chamber and maintaining positive static pressure thereon during rotation between the parts, said means including a spring for maintaining said pressure.

5. A revolving joint for a co-axial cable, including: a first joint part connected to one portion of said cable, at least two portions of said part being electrically conductive; a second joint part connected to another portion of the cable, at least two portions of said second part being electrically conductive, the two parts being connected for swivelling about the axis of said cable and providing a chamber at said axis and a separate concentric annular chamber; a body of mercury in each of the chambers completely filling it and each body making contact with an electrically conductive portion of each part to provide a current path, whereby two separate current paths are provided through the joint; and means associated with each of the chambers for sealing the mercury in the chamber and maintaining positive static pressure thereon dur-

ing rotation between the parts, said means including a spring for maintaining said pressure.

6. A joint of the character claimed in claim 5, wherein the chamber at the axis is formed by a portion in one joint part and the other joint part has an electrically conductive rod portion extending into said chamber along said axis.

7. A revolving electrically conductive joint adapted to provide two concentric current paths, including: a first joint part; a second joint part, the two parts being connected for relative rotation about an axis and providing a chamber at said axis formed by a portion in one part and having electrically conductive wall portions, the other part having an electrically conductive rod portion extending into said chamber along said axis; a body of liquid of high conductivity completely filling said chamber and making contact with the electrically conductive portions; and means for sealing the liquid in the chamber and maintaining positive static pressure thereon during rotation between the parts, said means including a spring for maintaining said pressure.

8. A joint of the character claimed in claim 2, wherein said parts include an outer relatively rotatable casing portion on one part and an inner portion on the other part providing a second chamber concentric with said first mentioned chamber, and an insulating liquid in said second chamber.

9. A revolving joint for a co-axial cable, including: a first joint part connected to one portion of said cable; a second joint part connected to another portion of the cable, the two parts being connected for swivelling about the axis of said cable and providing a first chamber at said axis, a second concentric annular chamber, and a third concentric annular chamber, each of the parts having inner and outer electrically conductive portions connecting with the cable and forming at least part of the walls of the first and third chambers; a body of mercury in the first and third chambers, each such body completely filling its chamber, being under positive static pressure therein, and making contact with the electrically conductive portions; a body of insulating liquid in said second chamber; and means associated with each of the chambers for sealing the liquid therein during rotation between the parts.

10. A revolving electrically conductive joint of the character described, including: a first joint part, at least a portion thereof being electrically conductive; a second joint part, at least a portion thereof being electrically and conductive, the two parts being connected for swivelling about an axis and providing a chamber concentric with said axis; a body of electrically conductive liquid under positive static pressure completely filling said chamber and making contact with the electrically conductive portions; means for maintaining the liquid under positive static pressure, this means including a metal bellows constituting at least a portion of the outer wall of

said chamber; and means sealing said liquid in the chamber during rotation between the parts.

11. A revolving joint for a co-axial cable, including: a first joint part connected to one portion of said cable, at least two portions of said part being electrically conductive; a second joint part connected to another portion of the cable, at least two portions of said second part being electrically conductive, the two parts being connected for swivelling about the axis of said cable and providing a chamber at said axis and a separate concentric annular chamber; a body of mercury in each of the chambers completely filling it and each body making contact with an electrically conductive portion of each part to provide a current path, whereby two separate current paths are provided through the joint; and means associated with each of the chambers for sealing the mercury in the chamber and maintaining positive static pressure thereon during rotation between the parts, this last mentioned means including a metal bellows at the axis providing at least a portion of the outer wall of the chamber at the axis to provide limited movement compensating for slight misalignment of contacting portions of said parts.

12. A revolving joint for a co-axial cable, including: a first joint part connected to one portion of said cable, at least two portions of said part being electrically conductive; a second joint part connected to another portion of the cable, at least two portions of said second part being electrically conductive, the two parts being connected for swivelling about the axis of said cable and providing a chamber at said axis and a separate concentric annular chamber, and a third chamber concentric with said axis and between the outer two chambers; a body of mercury in each of the first mentioned two chambers completely filling such chambers and each body making contact with an electrically conductive portion of each part to provide a current path, whereby two separate current paths are provided through the joint, and an insulating liquid in said third chamber; and means associated with each of the two first mentioned chambers for sealing the mercury in the chamber and maintaining positive static pressure thereon during rotation between the parts.

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