Dec. 19, 1961 D. J. LESLIE 3,014,192

MERCURY SLIP RING ASSEMBLY

Filed Dec. 26, 1958

FIG. 1.

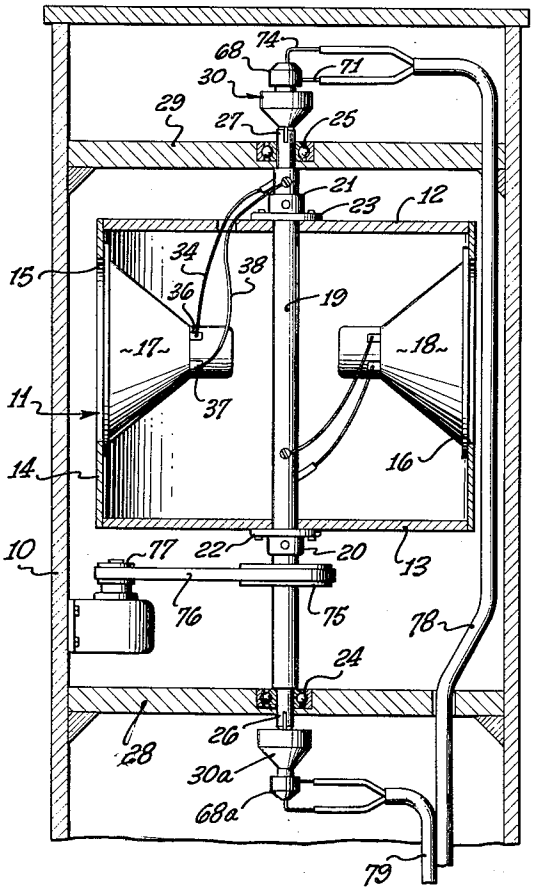


FIG. 2.

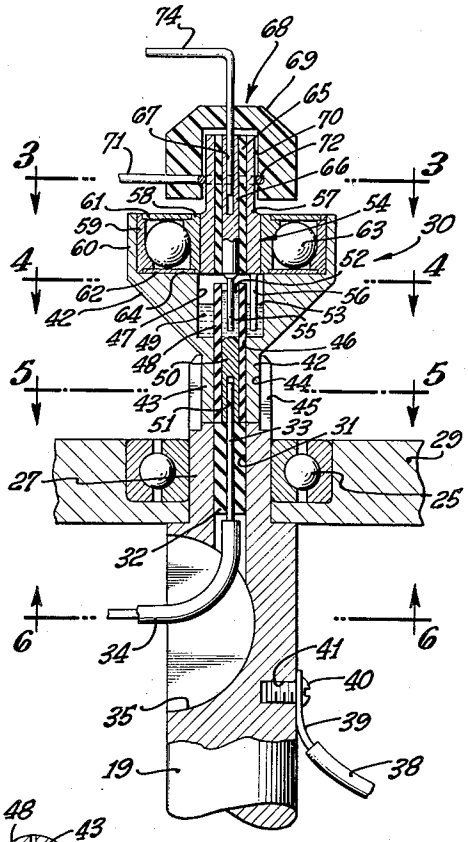


FIG. 5.

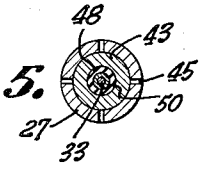


FIG. 4.

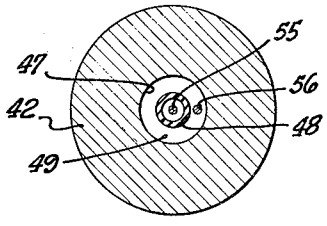


FIG. 3.

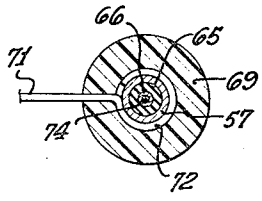
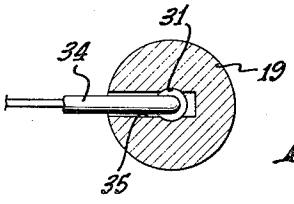


FIG. 6.



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MERCURY SLIP RING ASSEMBLY

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5 Claims. (Cl. 339—5)

This invention relates to speaker structures and particularly to speakers for electronic organs in which tremulant is added acoustically. Devices of this general character are shown and described in my prior Patents No. 2,489,653, issued November 29, 1949, entitled "Rotatable Tremulant Sound Producer," and No. 2,618,352, issued November 18, 1952, also entitled "Rotatable Tremulant Sound Producer."

In some instances, tremulant is added by the aid of a rotary sound channel or reflector plate cooperable with a stationary speaker. In other instances, the speakers themselves are rotated. One disadvantage of rotating speakers is that brush structures are required to maintain connections as the speakers are rotated. Maintenance of brushes has heretofore been a substantial problem.

The primary object of this invention is to provide a simple, self-contained, detachable slip ring structure cooperable in a simple manner with a rotary shaft by the aid of which connections to rotary speakers are readily established and maintained.

It is another object of this invention to provide a simplified slip ring structure that is readily removable.

Still another object of this invention is to provide an improved mercury slip-ring structure in which the mercury pools are effectively contained.

In some instances, it is desirable to provide separate connections to a pair of speakers, both mounted upon a common support. For example, one reason for this may be to maintain electrical segregation between impulses corresponding to tones in alternate half-tone relationship with respect to each other in order to avoid certain "beat effects" as described, for example, in my prior Patent No. 2,596,258, issued May 13, 1952, and entitled "Electric Organ Speaker System."

It is, accordingly, an object of this invention to provide a simple structure in which separate slip rings of identical construction may be used to establish separate speaker connections and by cooperation with opposite ends of a shaft.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

FIGURE 1 is a fragmentary sectional view of a speaker enclosure together with a rotary speaker structure therein and incorporating the present invention;

FIG. 2 is an enlarged view of a portion of the apparatus illustrated in FIG. 1;

FIGS. 3, 4, 5 and 6 are sectional views taken along planes corresponding, respectively, to lines 3—3, 4—4, 5—5 and 6—6 of FIG. 2.

In FIG. 1 there is illustrated a speaker cabinet 10 in which a rotary speaker assembly 11 is mounted for purposes of adding tremulant acoustically.

The speaker assembly 11 is in the form of a drum having, in this instance, upper and lower circular walls 12 and 13 between which a generally cylindrical wall 14 is supported. The cylindrical wall 14, in this instance,

has two diametrically disposed openings 15 and 16. Speakers 17 and 18, located within the speaker assembly 11, are mounted, respectively, at the openings 15 and 16 in a suitable manner.

The speaker assembly 11 is mounted for rotation by the aid of a shaft 19. Mounting collars 20 and 21 carried by the shaft have flanges 22 and 23 fastened, respectively, to the outer sides of the upper and lower walls 12 and 13.

The shaft 19 is supported by the aid of a pair of ball bearing structures 24 and 25 at opposite ends. Inner races of the bearings 24 and 25 are accommodated upon reduced extensions 26 and 27 formed at the ends of the shaft 19. The outer races of the bearing structures 24 and 25 are supported upon interior partition walls 28 and 29 forming a part of the speaker enclosure 10. The shaft extensions 26 and 27 project beyond the bearings and the walls 28 and 29 for access and for purposes to be presently described.

The upper end of the shaft 19 forms a means for establishing two connections to one of the speakers 17 and in cooperation with a removable slip ring unit 30. The construction of the upper end of the shaft 19 is illustrated clearly in FIG. 2.

The shaft 19 has an axial recess 31 extending inwardly from its end. In this recess an insulation sleeve 32 is fitted. Projecting upwardly through the insulation sleeve 32 and held thereby is the bared end 33 of a conductor 34. The conductor 34 extends into the lower end of the sleeve 32 by way of an access slot 35 (see also FIG. 6) located beneath the bearing 25 and intersecting the inner end of the recess 31. The conductor 34 extends to one of the terminals 36 of the speaker structure 17 and as illustrated in FIG. 1.

The shaft 19, which is made of conductive material, serves as a common or ground connection cooperable with the other terminal 37 of the speaker structure 17. For this purpose, a conductor 38 has one bared end 39 cooperable with a screw 40 threadedly accommodated in a laterally disposed recess 41 of the shaft 19. The other end of the conductor 38 is secured to the terminal 37 and as illustrated in FIG. 1.

The slip ring unit 30 has one end 42 provided with a reduced extension 43 received in an enlarged outer end 44 of the shaft recess 31 to form a detachable connector that causes the unit 30 to rotate with the shaft 19.

The upper end of the shaft extension 27 is diametrically slotted, as at 45 (see also FIG. 5), whereby a frictional grip is established between the peripheral portion of the reduced extension 43 of the slip ring 30 and the shaft 19.

The slip ring part 42 has a through bore 46 substantially enlarged at its upper end, as at 47, to form an upwardly opening recess. An insulation sleeve 48 is fitted in the bore 46. The sleeve extends upwardly from the end of the extension 43 into the recess 47. A circular space within the upper end of the sleeve 48 and an annular space 49, electrically isolated therefrom between the recess 47 and the sleeve 48, are thereby formed.

Press-fitted in the lower portion of the insulation sleeve 48 is a conducting rod 50 having a downwardly opening socket 51 in which the upper end of the conductor 33 is received. The sleeve 48 abuts the upper end of the shaft-mounted sleeve 32 when the parts are engaged.

A mercury pool 52 is accommodated in the sleeve 48 above the rod 50, and it is, of course, in electrical conducting relationship with the socket 51 and the conductor end 33. The mercury pool 52 is electrically isolated from the shaft 19 and the part 42 by the sleeve 48. The rod 50 likewise abuts the upper end of the shaft-mounted insulation sleeve 32 and well within the peripheral boundary of the sleeve 32 to ensure electrical isolation with respect to the shaft 19.

The annular space 49 of the slip ring part 42 accommodates a second mercury pool 53 forming a liquid slip ring, that is electrically common to the other conductor 38, a conductive path being established from the pool via the part 42, reduced extension 43, the upper shaft extension 27, terminal screw 40, and the bared conductor end 39.

The slip ring unit 30 has an upper non-rotary part 54 provided with conductive projections or pins 55 and 56 respectively cooperable with the mercury pools 52 and 53 whereby external connections are established. Conductive relationship between the pools and the pins 55 and 56 (see also FIG. 4) is maintained despite rotation of the slip ring part 42 by virtue of the fluid characteristics of the pools 52 and 53.

The part 54 includes an elongate tubular element 57 from the lower end of which the pin 56 eccentrically projects. The tubular part 57 and the slip ring part 42 are mutually supported for relative rotation with respect to each other by the aid of a thrust ball bearing structure. The inner race 58 of the bearing structure is fitted upon the lower end of the tubular part 57. The bearing structure has an outer race 59 press-fitted within a cylindrical flange 60 extending upwardly from and formed integrally with the lower part 42. Upper and lower seal rings 61 and 62 enclose balls 63 of the bearing structure cooperable respectively with the inner and outer races 58 and 59 for containing lubricant. The bearing structure abuts the upper end surface 64 of the part 42 that is located within the flange 60, and the lower end of the tubular part 57 together with the inner race 58 closes the upper end of the recess 47.

For supporting and insulating the pin 55, an insulation sleeve 65 is provided. This sleeve extends throughout the length of the bore in the tubular part 57. The conducting pin 55 is formed at the end of a rod 66 press-fitted within the sleeve 65. The rod 66 and the tubular part 57 thus together provide conductive paths to the speaker leads 34 and 38. A detachable jack 68 cooperates with a socket 67 in the upper end of the rod 66 and with part 57 to provide connections to an exterior circuit.

The jack 68 is in the form of a cap 69 made of molded insulating material. It provides a recess 70 in which the upper end of the tubular part 57 is received. One conductor 71 is mounted by the cap 69 and extends radially from an area adjacent the outer end of the recess 70. The conductor 71 has a circular end 72 (FIG. 3) extending about and slightly into the recess 70, there being an annular groove 73 mounting the conductor end 72. The conductor end loop 72 is expanded outwardly to permit passage of the tubular part 57 into the recess 70. A firm frictional engagement between the conductor end loop 72 and the tubular part 57 is established for an appropriate electrical conductive relationship.

The cap 69 also mounts a second conductor 74 that projects inwardly of the recess 70 through its inner end for detachable reception into the socket 67.

As the shaft 19 is rotated, as, for example, by the aid of a pulley 75 mounted upon the shaft, a belt 76, and a motor-driven pulley 77, the slip ring part 42 together with the mercury pools 52 and 53 are both rotated. The tubular part 57 remains stationary, the bearing structure 58—59—63 appropriately permitting this relative motion. A connection is established to an external circuit as from the output of a power amplifier by the aid of the separate conductors 71 and 74 of the jack 68.

The quantity of mercury introduced into the recess 47 is carefully controlled to ensure that the level of the outer mercury pool 53 is substantially beneath the upper end of the insulation sleeve 48 to avoid any short-circuiting relationship between the two mercury pools.

For purposes of installation of an organ speaker in cooperation with an electronic organ, it is merely necessary that the jack 68 be provided at the end of a twin conductor 78 extending from the power amplifier. The jack is simply slipped upon the tubular part 57. Should it be deemed necessary or desirable to remove or replace the slip ring unit 54, this is readily accomplished by simple axial separations.

The unit 54 can also be used reversibly, that is, at the lower end of the shaft. But the recesses for the mercury pools must be upwardly oriented. This is possible since the rod 50 provides a socket equal in dimension to that of the rod 66, and the tubular part 57 corresponds in dimension to that of the reduced extension 43 of the part 42.

As illustrated in FIG. 1, a second slip ring unit 30*a* is thus used at the lower end of the shaft 19 and for purposes of establishing connections to the other speaker 18. The lower shaft extension 26 is formed in the identical fashion as the upper shaft extension 27. Thus, it provides a socket that may cooperate with the tubular part 57 of the part 54. The reduced extension 43 of the part 54*a* in this instance detachably cooperates with a jack 68*a* that is identical to the jack 68. In this instance, the tubular part 57 and the pins 55 and 56 rotate with the shaft 19, and, instead, the slip ring unit part 42 is non-rotary. Connections are readily established to a twin conductor 79, and separate electrical connections to the respective speakers 17 and 18 are expeditiously provided.

In order to avoid confusion as to the internal orientation of the recesses for the mercury pools, the part 42 has a conical configuration adjoining the extension 43. This also reduces the bulk of the unit as a whole.

Once assembled, the slip ring unit 54 requires no special handling. The recess accommodating the inner mercury pool 52 has only slight clearance with respect to the pin 55, and the surface tension of the mercury ensures that an adequate mercury pool remains within the sleeve 48 despite jarring or actual inversion of the unit during shipment. The outer mercury pool 53 assumes its appropriate orientation as soon as the unit is installed, and the entire recess 47 in which the mercury pools are accommodated is entirely sealed to prevent any mercury from escaping therefrom.

The inventor claims:

1. In a slip ring connector structure: two electrically conductive members; bearing means supporting the members for relative rotation about an axis; said members having interior surface means defining an enclosed space encompassing the said axis of rotation; a first insulation sleeve of uniform cross-section concentrically mounted by one of the members and extending from an exterior boundary of said one member and with clearance into said enclosed space to form a circularly extending channel about the inwardly projecting end of said first insulation sleeve; a second insulation sleeve of uniform cross-section concentrically mounted by the other of said members and extending from an exterior boundary of said other member to a position accessible to the said enclosed space; an electrically conductive pin mounted within the first insulation sleeve and terminating within the inner end of said first insulation sleeve; a second electrically conductive pin mounted within the second insulation sleeve and projecting with clearance into the inner end of said first insulation sleeve; said other conductive member having a projection spaced from said axis of rotation and extending with clearance into said circularly extending channel; a mercury pool in the circularly extending channel and in contact with said projection; and a second mercury pool in the inner end of said one insulation sleeve; the outer ends of said pins having exteriorly accessible, axially extending surfaces; said conductive members also having exteriorly accessible, axially extending surfaces spaced from those of the corresponding pins for providing an electrical and mechanical connection by axial movement with a connector or the like.

2. The combination as set forth in claim 1 in which the level of the mercury pool in the circularly extending channel is substantially below the inner end of said first

sleeve when said axis is vertical, the said first sleeve having clearance with respect to said second pin adequate to cause surface tension to retain mercury in said first sleeve despite inversion.

3. The combination as set forth in claim 1, in which said axially extending surfaces of said members are formed about oppositely extending coaxial cylindrical projections of the members, in which the exteriorly accessible axially extending surfaces of the pins are formed within inwardly extending coaxial cylindrical recesses therein; said combination further including a shaft of conductive material having a recess at one end detachably receiving the projection of one of the members, said shaft having a projecting insulated conductor received in the exteriorly accessible recess of the corresponding pin; and a cap having a recess detachably receiving the projection of the other member, said cap having a pair of conductive parts separately connected to the said projection and the corresponding pin at the recess of said pin.

4. The combination as set forth in claim 1 together with a shaft of conductive material, and having an axial recess at one end receiving one of the conductive members at its axially extending surface; an insulation sleeve mounted in the bottom of said recess; and a conductor having a bared end extending through the sleeve and

received in the corresponding pin at its axially extending surface.

5. The combination as set forth in claim 1 together with a shaft of conductive material, and having an axial recess at one end receiving one of the conductive members at its axially extending surface; an insulation sleeve mounted in the bottom of said recess; a conductor having a bared end extending through the sleeve and received in the corresponding pin at its axially extending surface; an insulation cap having a socket receiving the other of the conducting members at its axially extending surface; a conductive loop supported in the recess and engaging the axially extending surface of said other member; and a conductor mounted centrally of the cap and received in the corresponding pin at its axially extending surface.

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