Dec. 23, 1952 R. G. LE TOURNEAU ET AL 2,623,188

SLIP RING ARRANGEMENT

Filed Sept. 24, 1949 2 SHEETS—SHEET 1

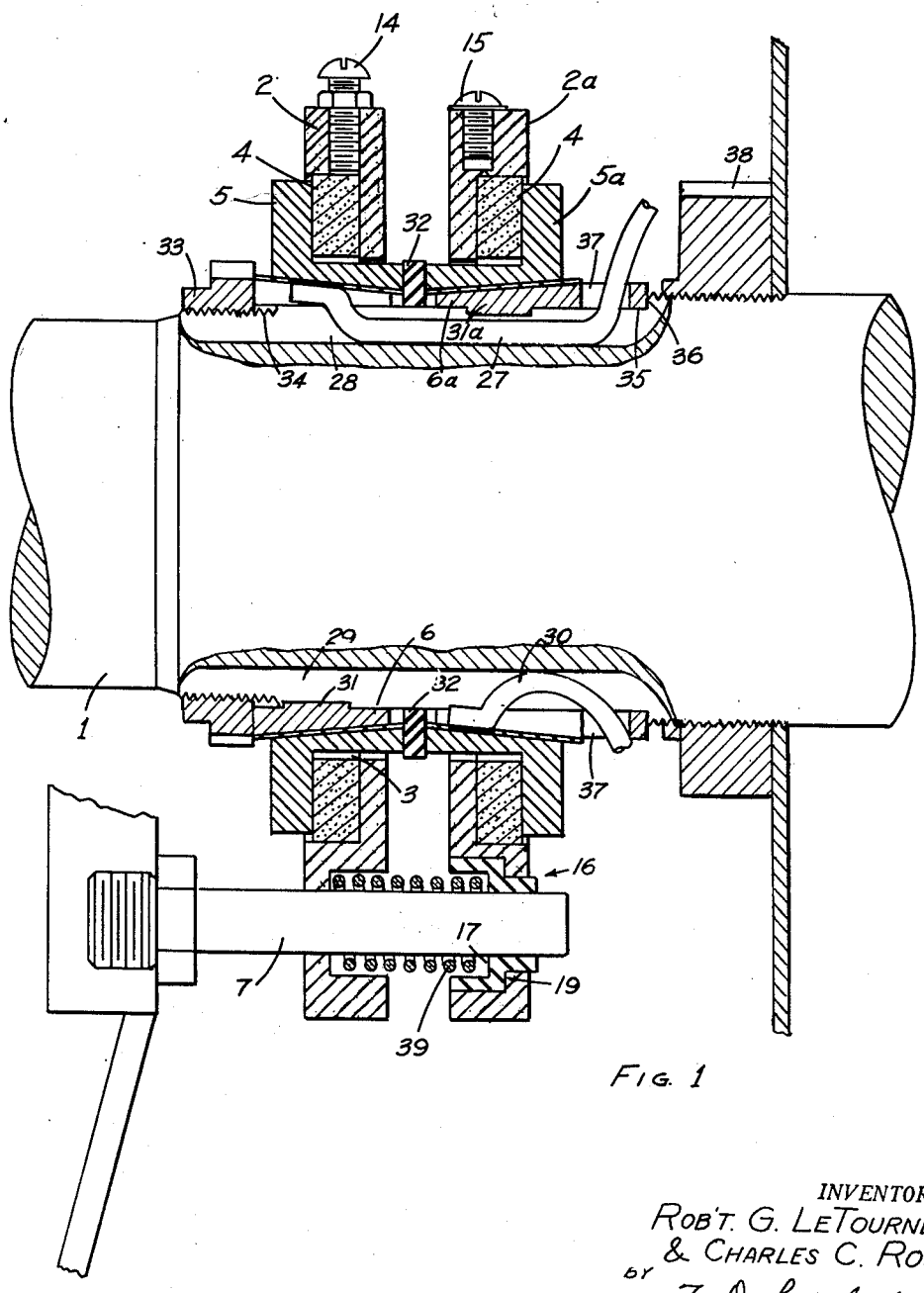

FIG. 1

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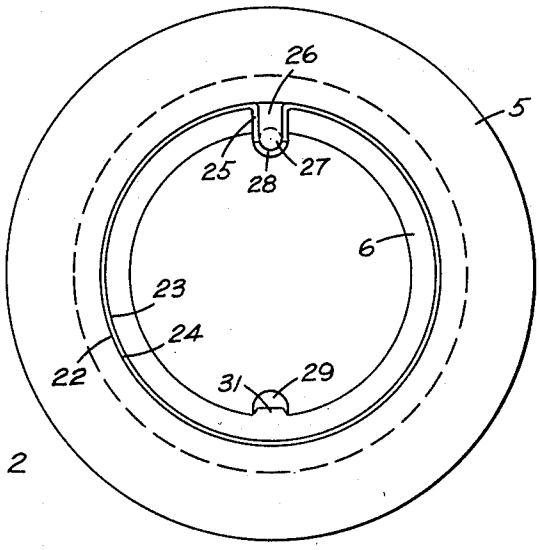

FIG. 2

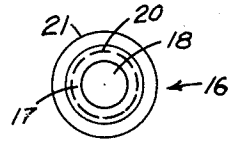

FIG. 4

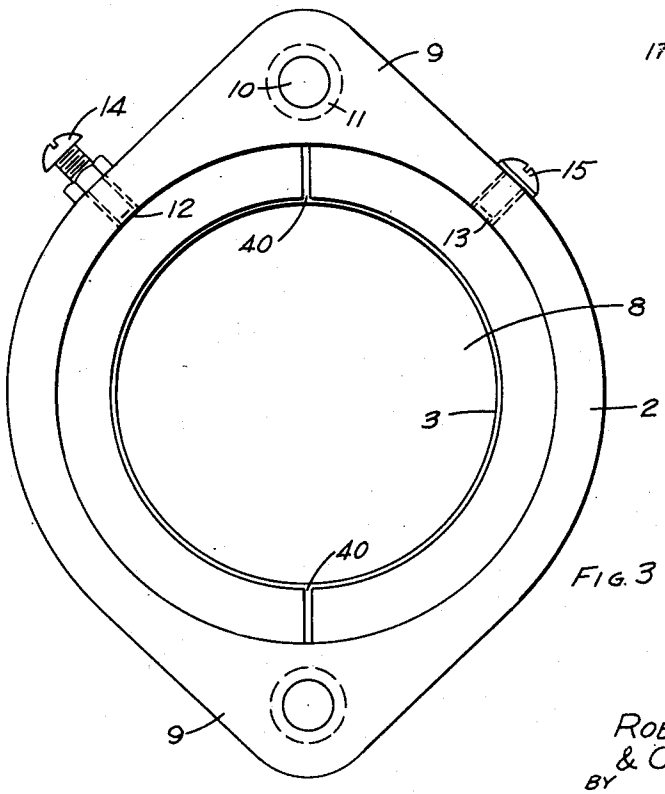

FIG. 3

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Patented Dec. 23, 1952

2,623,188

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2,623,188

SLIP RING ARRANGEMENT

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Application September 24, 1949, Serial No. 117,582

18 Claims. (Cl. 310—232)

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This invention relates generally to a device for connecting an external electric circuit with rotor windings of a dynamo-electric machine, and more particularly to an arrangement of contact between a stationary brush holder and slip rings mounted on a rotor shaft.

The primary object of this invention is to provide a unique arrangement whereby the rotor slip rings are each provided with a radial face for contact with a radial face of its corresponding brush, and all the radial surfaces are held in contact by common pressure means.

An additional object is to provide a brush holder for cooperation with radial slip rings wherein the brushes and slip rings will remain in contact regardless of the vibration of the rotor or wear of the brushes.

A further object is to provide a holder for using a continuous ring carbon brush in this slip ring arrangement.

Another object is to provide a means of attaching slip rings to a rotor shaft in a secure but easily removable manner.

Yet another object is to provide a means for supporting a brush holder which permits removal and replacement of brushes without manipulation of screws, clamps, or other securing devices and affords virtually instantaneous replacement.

A still further object is to provide a brush holder and slip rings which in combination virtually surround the brushes, so that the brushes and the metal surfaces they contact are free from exposure to grit, dust, and foreign matter, and the metal surfaces not subject to oxidation as on conventional devices where a brush with relatively small surface cooperates with a slip ring of a much larger surface.

Other features of novelty will become apparent from a perusal of the following specification and claims.

In the drawing:

Fig. 1 represents a sectional elevation of this slip ring arrangement installed on a rotor shaft.

Fig. 2 is an end view of the brush end of the rotor shaft showing the installation thereon of one slip ring and its retainer bushing.

Fig. 3 is an elevation view of one brush holder with its continuous ring brush installed.

Fig. 4 is an end view of the combination insulator and spring retainer used with this invention.

Referring now more particularly to the characters of reference on the drawing, in Fig. 1 this slip ring arrangement installed on a rotor shaft

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1 is seen to consist basically of an assembly including a pair of opposed aluminum brush holders 2 and 2*a* which include a recessed portion 3 to receive a split continuous ring carbon brush 4, brass or bronze slip rings 5 and 5*a* which are mounted on tapered steel collars 6 and 6*a*, and a pair of studs 7 for securing the stationary part of the assembly against rotation with the shaft.

Examining one of the brush holders more in detail, in Fig. 3, it is seen to include in addition to recess 3, an enlarged center opening 8, diametrically opposed ears 9 which include a bore 10 and counterbore 11, radially drilled holes 12 and 13 for receiving respectively a holding screw 14 and a terminal screw 15. The other brush holder 2*a* is identical to holder 2 except its bore 10 and counterbore 11 are sufficiently larger to receive an insulating bushing 16. This bushing is shown in Fig. 4 and Fig. 1 and includes a spring seat counterbore 17, a central bore 18 of a slightly larger diameter than stud 7, and an external shoulder 19 joining its smaller circumference 20 with its outer circumference 21.

The revolving portion of this device is seen from Fig. 1 to include the two slip rings and their collars installed on rotor shaft 1. An assembly of one collar and ring will be seen in Fig. 2 to consist of slip ring 5 pressed onto tapered collar 6 which surrounds shaft 1. Between the mating tapered surfaces 22 of the slip ring and 23 of the collar there is installed a thin insulator 24 which here assumes a circular form except for its ends 25 which are bent over the edges of slot 26 of the collar to permit direct passage of return lead 27 from its position in longitudinal groove 28 of the shaft 1. A similar groove 29 is machined into the shaft in a diametrically opposed position. Groove 28 in addition to providing passage for return lead 27 provides a means for preventing relative rotation of the shaft 1 and collar 6*a* by engaging a small projection 31*a* of the latter, in the same manner as shown for groove 29 and projection 31.

In the assembly of both slip ring-collar groups on the shaft, each group is spaced and insulated from the other by an insulating washer 32 and both groups are held securely in place by lock nut 33 which by tightening onto threads 34 of shaft 1 causes both groups and spacer 35 to secure against shoulder 36 of the shaft. This spacer includes diametrically opposed lead openings 37 and is employed only in cases where the shoulder 36 is too close to lock nut 38 to permit passage of leads 27 and 30 from their respective

grooves 28 and 29 in the shaft. Lead 30 carries the input current to windings (not shown) of a rotor employing this slip ring arrangement while lead 27 provides for the return thereof. Separate external supply current leads (not shown) are subsequently attached to terminal screw 15 of each brush holder.

Exciter current for the field windings on a generator rotor, or D. C. current for a wound rotor machine is introduced thru terminal screw 15 of brush holder 2*a*. This direct current is conducted from the brush holder thru brush 4 into slip ring 5*a* which is directly attached to lead 30 which carries current to the rotor windings thru spacer 35 (if used). Since the recess 3 of the brush holder surrounds brush 4 on two sides, and since the radial surface of slip ring 5*a* is in direct contact with brush 4 and the horizontal surface of the slip ring is in close juxtaposition with the brush, there is practically no metal surface with which the brush comes in contact that is exposed to dirt or foreign matter, or subject to oxidation. These factors which are known to be detrimental to brush life have thus been virtually eliminated by the construction of this invention. The return lead 27 connects the field windings at the opposite end thereof from lead 30, and by way of groove 28 connects to slip ring 5 and from there thru the brush and holder 2 to its terminal 15.

The brush holders, brushes, and slip rings are all securely held in operative contact by the pressure of springs 39. These springs are shown in this embodiment to be located at the diametrically opposed ears 9 and seated in counterbore 11 of brush holder 2 and counterbore 17 of insulated bushing 16 which is itself secured in the enlarged bore 10*a* and counterbore 11*a* of holder 2*a*. The shoulder 19 of bushing 16 prevents the bushing from being forced thru the holder under the spring pressure. The brush holders 2 and 2*a* are secured against rotation by the studs 7 which pass thru corresponding bores 10 and 10*a* of the holders and bore 18 of the bushing; studs 7 further act as a guard to prevent springs 39 from jumping out of alignment during installation, replacement of brushes, etc.

In operation the use of holding screw 14 is optional, as it has been found advantageous to permit the brush 4 to turn freely within recess 3 of the brush holder. What actually takes place in this situation is that the centrifugal force of the rotor causes the two sections of the split continuous ring brush 4 to be forced out and drag at its O. D. against the brush holder; this action, together with the pressure of springs 39, forces the radial faces of the brush, brush holder and slip ring all together, and results in a creeping motion of the brush around the recess 3. This creeping motion is desirable as it distributes the wear evenly about the brush to compensate for any irregularities of the contacting radial surfaces and for unequal spring pressure.

It should be understood that brushes 4 have the same operational effect as if they were a continuous ring. They are, however, split as at 40 to facilitate installation. When it is desired to replace the brushes on a machine employing this arrangement, it is merely necessary to pull one of the holders, for instance 2, toward the other holder 2*a* with sufficient force to overcome the pressure of springs 39. This will usually cause the brushes to drop from the slip ring when their supporting holder has thus been removed. In other cases a slight manipulation of the holder or brush will permit it to fall clear of its housing. Comparable ease is experienced in installing the brushes which is simply the reverse of the removal: the brush holder is pulled back against the springs and the brush installed in two pieces. This installation is noticeably faster and simpler than the delicate installation and adjustment required on most conventional machines.

From the foregoing description, it will be readily seen that we have produced such an implement as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of this slip ring arrangement, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention as described in the appended claims.

Having thus described the invention, the following is claimed as new and useful and upon which Letters Patent is desired:

1. A slip ring arrangement for dynamo-electric machines including a rotor shaft and rotor windings, comprising: a radial face slip ring supported on the shaft, a brush holder spaced from said slip ring, and a circular brush surrounding said shaft and disposed between said slip ring and said brush holder and said brush being free to move both with respect to said slip ring and with respect to said brush holder.

2. A slip ring arrangement for dynamo-electric machines including a rotor shaft and rotor windings, comprising: a pair of radial face slip rings supported on the shaft, a pair of brush holders spaced from said slip rings, semi-circular brushes disposed between said slip rings and said brush holders, and a common means operating between the brush holders to urge said brushes into contact with said slip rings.

3. A slip ring arrangement for dynamo-electric machines including a rotor shaft and rotor windings, comprising: a pair of radial face slip rings spaced apart longitudinally on the shaft, a pair of generally circular brush holders surrounding the shaft between the slip rings, a continuous ring brush disposed between each adjacent slip ring and brush holder and means between said brush holders to cause forcible engagement of said brushes and slip rings, said means being circumferentially spaced compression springs.

4. A slip ring arrangement for dynamo-electric machines including a rotor shaft and rotor windings, comprising: a pair of radial face slip rings spaced apart longitudinally on the shaft, a pair of generally circular brush holders surrounding the shaft between the slip rings, an annular recess in the radial face of each brush holder on the side adjacent its corresponding slip ring, a continuous ring brush inserted in said recess and free to move radially with respect to said slip rings and said brush holders, the radial face of said brush adapted to forcibly engage the radial face of said corresponding slip ring.

5. A slip ring arrangement for dynamo-electric machines including a rotor shaft and rotor windings, comprising: a pair of radial face slip rings spaced apart longitudinally on the shaft, said slip rings being L-shaped in cross section, a pair of generally circular brush holders surrounding the shaft, said brush holders being L-shaped in cross section, each brush holder being associated with one slip ring to form a pair of corresponding elements, the L-shaped sections of each element of the pair cooperating with the other to form an enclosure of box-shaped cross section,

and brush of box-shaped cross section inserted in said enclosure.

6. A slip ring arrangement for dynamo-electric machines including a rotor shaft, rotor winding, and a stationary frame, comprising: a pair of cylindrical slip rings with a radial face and a horizontal surface; a generally circular brush holder, including a large central bore, an annular recess surrounding the bore and enlarged ears radially beyond said recess, associated with each slip ring; said recess including a radial surface parallel to said radial face; and a continuous ring brush disposed between said vertical surface and said radial face of corresponding slip ring and brush holder; said ears including a central bore therethru, a plurality of studs projecting horizontally from said stationary frame thru said central bores to prevent rotation of said brush holders.

7. In a slip ring arrangement for dynamo-electric machines including a rotor shaft and rotor winding, a pair of generally circular brush holders spaced longitudinally on said shaft, each comprising an enlarged center opening surrounding the shaft, enlarged ears radially beyond said bore, each ear including a central bore and a counterbore with a shoulder therebetween, one brush holder including an electrical input terminal, the other brush holder including an electrical return terminal, the central bore and counterbore of said one brush holder being larger than on said other brush holder, an insulating bushing including an internal shoulder and being symmetrical with said larger bore and counterbore inserted therein, the shoulder of the bushing on the shoulder of said other brush holder being positioned in horizontally aligned but opposed relationship; and a compression spring having one end seated on each named shoulder urging said brush holders apart.

8. A slip ring arrangement for a dynamo-electric machine, including a rotor shaft and rotor windings, comprising: grooves in the rotor shaft, a shoulder on the shaft, split cylindrical collars with an internal projection and a tapered external circumferential surface installed on the shaft so that one of said collar projections lies in one of said grooves, and another collar projection lies in a different groove, generally cylindrical slip rings with a tapered internal surface adapted to engage corresponding tapers on said collars, a thin layer of insulating material separating said tapers but opening into one groove in the rotor shaft at the split section of the collars, leads positioned in the grooves for electrically connecting the slip rings with said rotor windings, said leads attaching to said slip rings adjacent the split section of collars.

9. A slip ring arrangement for a dynamo-electric machine including a rotor shaft and rotor windings, comprising: a shoulder on the shaft, split cylindrical collars secured against rotation on the shaft, said collars having an external taper, generally cylindrical slip rings with a tapered internal surface adapted to engage corresponding tapers on said collars, insulating material separating said tapers, an insulating washer surrounding the shaft and separating said slip rings axially, a spacer inserted between said shoulder and the adjacent collar, means for electrically connecting said slip rings and said rotor windings, said means passing thru said spacer, and fastening means associated with the shaft acting in cooperation with said shoulder to urge said corresponding tapers into binding engagement and to secure said collars against axial displacement.

10. A slip ring arrangement for a dynamo-electric machine including a rotor shaft, a winding on the shaft, slip rings spaced on the shaft and insulated therefrom and from each other but connected to opposite ends of the rotor winding, said slip rings having opposed radial faces, continuous ring brushes each having two sides, each brush receiving current of a different polarity, one side of each having a radial surface corresponding to said slip ring radial face, and spring means associated with the other side of said brushes for urging said radial face and said radial surface into engagement so that a continuous D. C. current will flow through the rotor winding.

11. A slip ring arrangement for dynamo-electric machines including a rotor shaft, rotor windings and a stationary frame, comprising diametrically opposed grooves in said shaft, a shoulder on the shaft, threads on the shaft spaced axially from said shoulder, split cylindrical collars surrounding said shaft between said threads and shoulder, said collars including an internal projection diametrically opposite the split therein, said projections engaging alternate grooves of the shaft for securing said collars against relative rotation thereon, said collars including an external taper, vertical face slip rings including an internal taper engaging corresponding collar tapers but being separated therefrom, a thin cylinder of insulating material causing this separation, a pair of generally circular brush holders inserted between the vertical faces of said slip rings, said brush holders including projecting ears with a bore and counterbore therein and each brush holder including an annular recess and terminal screws, said annular recess of each brush holder opening toward the vertical face of its corresponding slip ring, a continuous ring carbon brush inserted into said recess, said brush being split to assist installation, common spring means associated with corresponding counterbores of the adjacent brush holders to urge said brush holders and brushes into engagement with the vertical faces of said slip rings, a lead positioned in each groove to electrically alternate slip rings with the rotor windings, and studs associated with the stationary frame and said bores to prevent rotation of the brush holders, insulating washers associated with one brush holder to prevent a short circuit thru the studs.

12. A slip ring arrangement for a dynamo-electric machine including a frame and a rotor shaft, comprising slip rings on the shaft, a generally circular brush holder surrounding the shaft and stationary with respect to the frame associated with each slip ring, an annular recess in brush holder, a continuous ring brush inserted in said recess, means associated with said brush holders to apply a force sufficient to move the brush into cooperative engagement with both the brush holder and slip ring, but permitting relative creeping movement of the brush around the shaft to distribute wear on the brush.

13. A slip ring arrangement for dynamo-electric machines including a rotor shaft and rotor windings, comprising: a radial face slip ring supported on the shaft, a brush holder spaced from said slip ring, and brush means between said slip ring and said brush holder, said brush means contacting said slip ring throughout a major portion of said radial face and free to move radially with respect to said slip ring.

14. A slip ring arrangement for dynamo-electric machines including a rotor shaft and rotor windings, comprising: a radial face slip ring supported on the shaft, a brush holder spaced from said slip ring and brush means between said slip ring and said brush holder, said brush means contacting said slip ring throughout a major portion of said radial face and being free to move with respect to both said slip ring and with respect to said brush holder.

15. The arrangement set forth in claim 13 in which said brush means is free to move with respect to both said slip ring and with respect to said brush holder.

16. A dynamo-electric machine having a rotor, a winding on said rotor having a pair of terminals, a pair of slip rings mounted in spaced relationship on said rotor with corresponding slip rings connected to corresponding winding terminals, each of said slip rings having a radial face, brush holding means spaced from said slip rings and being positioned between said slip rings, and said brush holding means being free to move generally parallel with the rotor axis and with respect to said slip rings, and a plurality of brush means between, on the one hand, said brush holding means and the radial face of corresponding slip rings, each of said brush means contacting a corresponding slip ring throughout a major portion of said radial face.

17. The arrangement set forth in claim 16 in which said brush means are free to move both with respect to said brush holding means and with respect to the corresponding slip ring.

18. A dynamo-electric machine having a rotor, a winding on said rotor, said winding having a pair of terminals, a pair of slip rings mounted in spaced relationship on said shaft, and each of said slip rings having a radial face, brush holding means spaced from said slip rings and positioned therebetween, a plurality of brush means between, on the one hand, said brush holding means, and on the other hand, a corresponding one of said slip rings, each of said brush means contacting a corresponding slip ring throughout a major portion of said radial face and being free to move with respect to both said brush holding means and with respect to the corresponding slip ring.

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