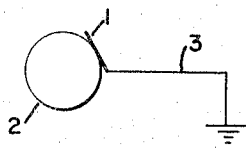
May 2, 1967 L. P. GROBEL 3,317,759

ROTATING ELECTRICAL CONTACTS

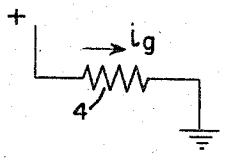
Filed July 31, 1964

FIG. 1



PRIOR ART

FIG. 2



PRIOR ART

FIG. 3

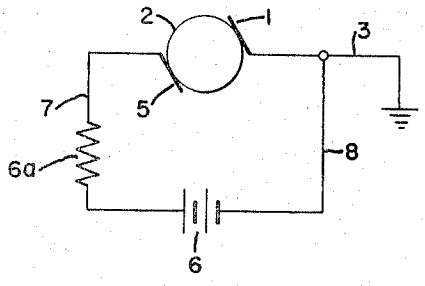


FIG. 4

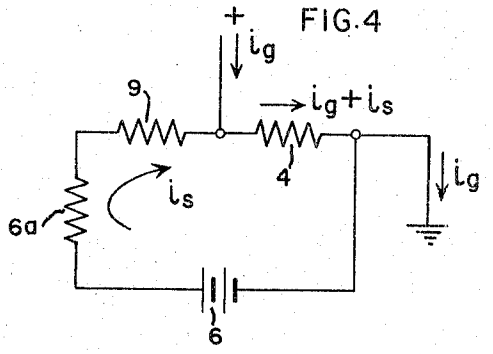
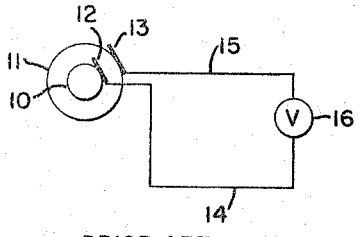
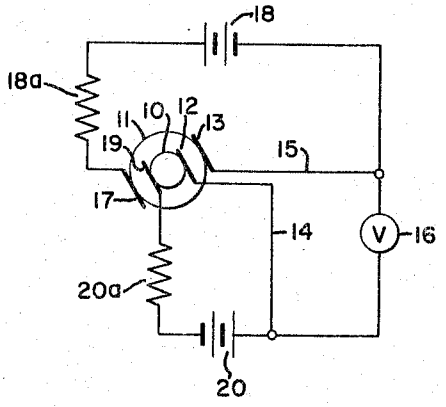


FIG. 5



PRIOR ART

FIG. 6



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United States Patent Office 3,317,759 Patented May 2, 1967

3,317,759

ROTATING ELECTRICAL CONTACTS

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Filed July 31, 1964, Ser. No. 386,602
3 Claims. (Cl. 307—145)

This invention relates to problems encountered when conducting low electrical currents from rotating members by means of brushes, and more particularly, to a method for reducing the high contact resistances between rotating and stationary contacts caused by "filming" at low current density. This is particularly noticeable in the case of carbon brushes, where is has been observed that the contact resistance becomes very high due to filming when the brushes are carrying very low currents or intermittent currents.

It is well known that under steady current, the contact resistance of carbon brushes decreases greatly with an increase in current density. In many places where brushes are used, very low currents flow between the rotating and stationary members, leading to troublesome filming with subsequent high resistance at the contact point.

One such problem has been encountered with so-called "grounding" brushes in large steam trubine-generators. The rotating shaft is prone to build up a direct current voltage by electrostatic action in the wet stages of the turbine. Voltages as high as 150 volts have been measured, and such voltages seem to build up and discharge intermittently. To alleviate this, the shaft is connected to ground by means of a system of brushes. Due to the low currents from the electrostatic voltage, the aforementioned problem becomes evident.

Another problem occurs when measuring voltages generated in windings on a rotating member.

In measuring voltages between two slip rings connected to the windings, a high impedance voltmeter, for example, would draw very little current. Hence, if carbon brushes were employed to take the readings, erroneous readings might be produced due to variations in contact resistance of the brushes.

Accordingly, one object of the present invention is to provide an improved method for reduction of brush contact resistance, where a low current would normally be expected to flow through the brush to a grounding or instrument connection.

Another object of the invention is to provide an improved method for reducing filming when low current-carrying carbon brushes are employed.

Still another object of the invention is to provide an improved method for increasing the accuracy of instrument readings of voltages and currents taken from a rotating member through brushes.

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of practice, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which:

FIG. 1 and FIG. 2 are a schematic view and equivalent circuit respectively of a prior art shaft grounding device,

FIG. 3 and FIG. 4 are schematic view and equivalent circuit respectively of the invention as employed in an improved shaft grounding device, and

FIG. 5 is a schematic view of a prior art arrangement for measuring voltage from two points on a rotating member, and

FIG. 6 is a schematic view of the improved voltage measuring system according to the present invention.

Briefly stated, the invention is practiced by providing a supplementary brush and supplementary current source to be connected in series with the original low current-carrying brush member so as to superimpose an additional current through the original brush member to increase current density and thereby maintain a low contact resistance.

Referring now to FIG. 1 of the drawing, one prior art system of grounding voltages produced on a rotating member comprises a brush **1** applied to a rotating slip ring or shaft portion **2** and connected to ground via a conductor **3**.

Referring to FIG. 2, the equivalent circuit for FIG. 1 comprises a resistance for representing the contact resistance between brush **1** and shaft **2**, and carrying a current i_g to ground.

Referring to FIG. 3 of the drawing, where the same elements have the same reference numbers as in FIG. 1, it will be observed that there are also provided a supplementary brush **5** and a supplementary voltage source **6** shown diagrammatically as a battery. A conductor **7** connects one side of the voltage source **6** to brush **5**, while a conductor **8** connects the other side of the voltage source to a point on conductor **3**. It will be observed that a series loop is established from voltage source **6** through brush **5**, shaft **2**, brush **1**, back to the voltage source. A fixed resistance **6***a* is employed to control the current through the series loop.

Referring to FIG. 4 of the drawing, the equivalent circuit shows the resistance **4** representing the contact resistance between brush **1** and the shaft portion **2** and also includes an additional resistance **9** representing the contact resistance between supplementary brush **5** and shaft portion **2**.

By elementary analysis, it will be seen that a supplementary current i_s is caused to flow through resistances **6***a*, **9** and **4** due to the supplementary voltage source **6**. In resistance **4**, the supplementary current i_s is superimposed upon the ground current i_g.

Due to the added current i_s flowing from shaft portion **2** to brush **1**, the current density is higher and the resistance is thereby reduced. By a mechanism known in the art but not entirely understood, higher current densities through the brush **1** also reduce "filming" or deposition of carbon on the shaft portion which would normally take place if the current density were low.

FIG. 5 represents schematically a prior art method of measuring voltages from two rotating shaft portions or slip rings **10**, **11**. Rings **10**, **11** might be connected to a shaft-disposed winding, for example, and are at different electrical potentials. A brush **12** is disposed in rubbing contact with ring **10** while brush **13** is disposed in rubbing contact with ring **11**. Leads **14**, **15** connect brushes **12**, **13** respectively to a high impedance voltmeter **16**. Due to the high impedance of the voltmeter, relatively small currents flow through the external circuit. The low currents through the rubbing contacts often result in erroneous measurements, due to filming.

Reference to FIG. 6 shows schematically an improved voltage measuring scheme wherein the same reference numbers are used to represent the same elements shown in FIG. 5. In order to superimpose an additional current so as to increase the current density at brush **13**, a supplementary brush **17**, a supplementary voltage source **18**, and a resistance **18***a* are connected in a series loop as shown. Similarly, in order to increase current density at brush **12**, a second supplementary brush **19**, a second supplementary voltage source **20**, and a resistance **20***a* are connected as shown in a second series loop. An analysis of an equivalent circuit is omitted, but it should be appar-

ent that the currents flowing through the supplementary series loops are merely superimposed on the original current as before at the location of the brush contact area. The effect of the foregoing is to reduce filming and to cause more accurate voltage readings to be obtained.

Although the specific embodiments described have been with respect to a grounding circuit and a voltage measurement circuit, it should be apparent to those skilled in the art that there are other applications for the invention. An A.-C. voltage source can be used as a substitute for a D.-C. supplemental voltage source, but it would not be as effective because of intermittent application of the superimposed current i_s on the base current i_g.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a device of the type having a rotating conductive member at a first electrical potential and a primary brush in rubbing contact with said member connected to a stationary conductor at a second potential and carrying a low current, the improvement comprising:

a supplemental source of electrical current and a supplemental brush in rubbing contact with said member, said primary brush, supplemental brush and said supplemental current source being connected in series to superimpose a supplemental current on said original current flowing between said member and said primary brush.

2. In a grounding device for a turbine-generator of the type having a rotating conductive shaft portion and a grounding brush disposed in rubbing contact shaft portion and connected to ground, the improvement comprising:

a supplemental source of electrical current and a supplemental brush disposed in rubbing contact with said shaft portion, said grounding brush, supplemental brush, and supplemental current source being connected in series to cause a supplemental current to flow through said shaft portion-grounding brush rubbing contact in addition to grounding currents.

3. In a device of the type measuring voltages between first and second rotating conductive members through first and second brushes disposed in rubbing contact with the first and second members respectively which are at different electrical potentials, the improvement comprising:

a first supplemental source of electrical current and a third brush connected in a series loop with the first brush and first member to provide a first supplemental current flowing through the first brush, and

a second supplemental source of electrical current and a fourth brush connected in a series loop with the second brush and second member to provide a second supplemental current flowing through the second brush.

No references cited.

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