H. GEISENHÖNER & F. L. STONE.

ELECTRICAL CONDUCTOR.

APPLICATION FILED MAR. 1, 1905.

**996,579.** Patented June 27, 1911.

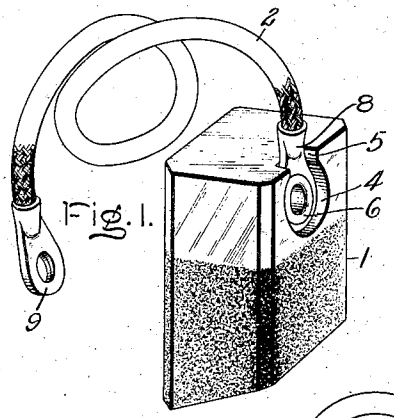


Fig. 1.

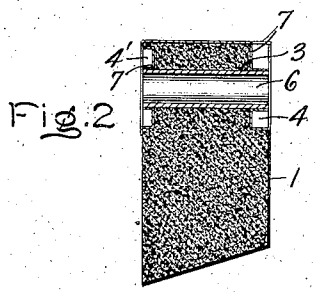


Fig. 2.

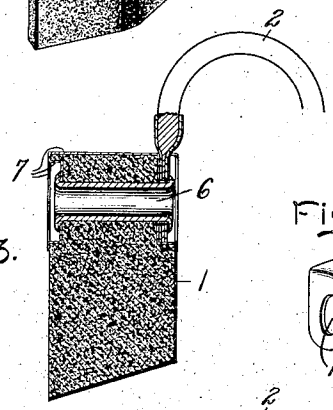


Fig. 3.

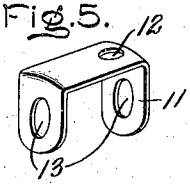


Fig. 5.

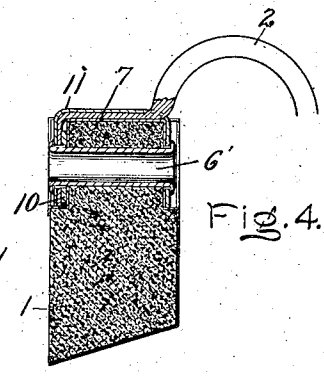


Fig. 4.

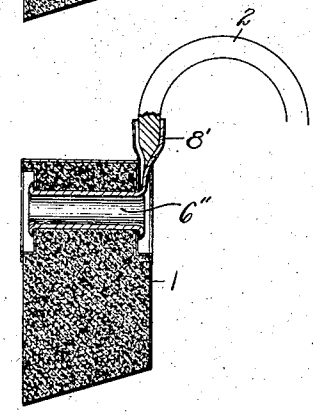


Fig. 6.

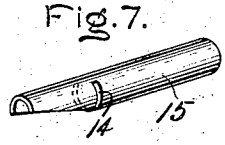


Fig. 7.

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# UNITED STATES PATENT OFFICE.

HENRY GEISENHÖNER AND FRED L. STONE, OF SCHENECTADY, NEW YORK, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## ELECTRICAL CONDUCTOR.

996,579. Specification of Letters Patent. Patented June 27, 1911.

Application filed March 1, 1905. Serial No. 247,834.

*To all whom it may concern:*

Be it known that we, HENRY GEISENHÖNER, a citizen of the United States, and FRED L. STONE, a subject of the King of Great Britain, both residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electrical Conductors, of which the following is a specification.

Our present invention has for its object an improved arrangement for connecting flexible metallic conductors to granular conducting bodies such as the carbon blocks employed as the brushes of dynamo-electric machines.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of our invention, however, reference may be had to the accompanying drawings and descriptive matter in which we have illustrated and described several of the forms in which our invention may be employed.

Of the drawings, Figure 1 is a perspective view showing one form of our present invention; Fig. 2 is a section showing the same construction as Fig. 1 in a partially completed state; Fig. 3 is a view taken similarly to Fig. 2 showing the completed construction; Fig. 4 is a sectional elevation showing a modified construction; Fig. 5 is a perspective view showing a detail of the construction shown in Fig. 4; Fig. 6 is a sectional elevation showing a third form of our invention; and Fig. 7 is a perspective view showing a blank used in the manufacture of the construction shown in Fig. 6.

In all the forms of our invention illustrated in the drawing, 1 represents a block of carbon in the form of the ordinary carbon brush to which is attached a flexible conductor or "pig-tail" 2 of the ordinary type for connecting the brush to the brush holder. The pig tail is attached to the brush by means of a single tubular rivet having relatively thin walls and of large diameter as compared with those previously used in connection with carbon brushes, and thereby a simple and cheap construction is secured for making a rigid connection between the terminal portion of the conductor and the carbon brush. A hole or passage 3 is drilled or otherwise formed in the upper end of the block, extending through the block in a direction transversely to its length. At the opposite ends of this hole recesses 4 and 4′ are formed by counterboring or otherwise. Preferably a slot 5 is cut through the block from the upper end of the recess 4 to the upper end of the brush. By providing the recesses 4 and 4′ the terminal portion of the conductor and the heads of the rivet are sunk below the surface of the brush and, consequently, the brush holder box may be made to exactly fit the carbon brush without making any allowances for protruding parts of the assembled brush and pig-tail.

In the construction shown in Figs. 1, 2 and 3, a rivet blank in the form of a tube 6 which is independent of the terminal portion and made of some good conducting metal, such as copper, is inserted in the hole 3 in which it has a good working fit. The length of this tube 6 is preferably about equal to the thickness of the carbon block 2 and the tube 6 is inserted so that its ends are substantially flush with the sides of the carbon block as shown in Fig. 2. Usually the upper end of the carbon block has a coating 7 of copper or similar good conducting metal electro-plated on it. This coating 7 may be applied after the tube 6 is inserted in the manner hereinbefore described.

The terminal 8 of the pig-tail 2, which may be in the form of the usual sheet metal shell clamped about the end of the braided conductor, is formed with an eye or opening in it just large enough to receive the end of the tube 6. The terminal 8 may be identical in construction with the terminal 9 shown in Fig. 1. The terminal 8 is placed in the recess 4 with the projecting end of the tube 6 passing through the eye of the terminal. The terminal 8 then rests against the bottom wall of the recess 4 with its shank projecting out through the slot 5. After the terminal 8 is in place the ends of the tube are expanded as shown in Fig. 3 by any suitable means as by a power press provided with suitable dies for the purpose. As shown in the drawing, the tube or pipe has relatively thin walls, so that its ends may be expanded in order to hold the terminal in place, without crushing the brush.

The connection just described possesses excellent mechanical and electrical properties. When the ends of the tube 6 are expanded and the outturned portions pressed down against the bottom wall of the recess 4′ and the outer surface of the terminal 8, respectively, in a proper manner, the tube 6 is prevented from working loose and the entrance of dirt into the joint between the tube section and the carbon is also prevented. The terminal 8 is then not only electrically connected to the carbon by reason of its engagement with the bottom wall of the recess 4, but also by virtue of its engagement with the tube 6, and the latter is in electrical contact with the carbon block throughout its length. When the copper plating is applied to the end of the carbon block after the tube 6 is in place, the expanding of the ends of the tube may be brought about without breaking the plating. In this case, the effectiveness of the electrical connection is improved through the copper coating which is integrally connected with the tube section 6 and the carbon block. The tube 6 may be simply a section cut off of a copper or brass tube or pipe, and as the operation necessary to secure the carbon block and terminal together is very simple the connection is a cheap one from a manufacturing standpoint.

By the employment of a tubular rivet of relatively large diameter there is obtained a much larger area of contact between the body and expanded ends of the rivet than would be the case with a solid rivet of equal weight. This betters the electrical connection between the carbon and the rivet. The tubular rivet insures a larger cross-sectional area of contact of the copper plating with the ends of the rivet, when the copper plating is used, and increases the mechanical strength of the copper plate connection between the rivet and the carbon.

An advantage obtained by the use of a tubular rivet over a solid rivet of the same diameter and contact surface is the decrease in weight of copper used, thus saving copper and reducing the inertia of the brush. The ends of a tubular rivet are much more easily upset or expanded in the riveting operation than are the ends of a solid rivet of the same diameter, which is an important consideration when one of the conductors is a carbon block and hence is liable to be crushed if the riveting operation is too violent.

In the construction shown in Figs. 4 and 5, instead of a terminal portion formed with a single eye, a U-shaped clip 11 may be employed for fastening the end of the flexible conductor 2 to the carbon block. This clip 11 is put in position as shown in Fig. 4, after which the ends of the rivet 6′ are expanded as previously described. The rivet 6′ may be copper plated, as above described, after which a washer 10 is placed in the recess 4 surrounding the end of the rivet 6′.

It will be observed that the end of the flexible conductor 2 which is inserted through an opening 12 in the yoke part of the U-shaped clip 11 passes along the upper end of the carbon block and extends between the washer 10 and the corresponding leg of the U-shaped clip. With this construction it is necessary to have the openings 13 in the legs of the clip elongated slightly to allow the legs to be sprung over the ends of the tubular rivet 6′ if the latter is placed in the carbon block before electroplating, and it is thought necessary to maintain the copper coat connection between the copper block and the tube unbroken.

A very good electrical connection between the flexible conductor 2 and the carbon block is obtained, even though an unbroken copper coat connection between the tube and the carbon block is not employed. The washer 10 is, of course, held firmly against the copper coat on the bottom wall of the recess 4, and the extreme inner end of the flexible conductor is clamped firmly between the washer and one leg of the U-shaped clip 11. This establishes a very good electrical connection between the flexible conductor and the carbon block. The electrical connection is improved moreover by reason of the fact that the yoke as well as a considerable portion of the pig-tail and the other leg of the clip bear against the copper coat on the carbon block. This connection possesses very excellent mechanical properties and is cheap and reliable.

In the construction shown in Fig. 6 instead of a rivet independent of the terminal portion, a tubular rivet 6″ is formed integral with the metallic socket member 8′ into which one end of the flexible conductor is secured. The rivet and socket portion may be formed from the blank 15 shown in Fig. 7. This blank is in the form of a section of a tube having a transverse kerf 14 formed in it. The portion to the left of the kerf in Fig. 7 is the portion out of which the socket part 8′ is formed. A part of this portion of the tube is beveled off to obtain a socket part of proper shape. The portion to the right of the kerf in Fig. 7 corresponds to the rivets 6 and 6′ of the two preceding constructions. In this form of our invention the blank shown in Fig. 7 has the portion to the left of the kerf in Fig. 7 turned at right angles to the remaining portion and compressed about the end of the flexible conductor, after which the portion to the right of the kerf in Fig. 7 is inserted in the carbon block just as the rivet 6 is inserted in the carbon block in the

construction first described, after which the upper end of the carbon block and the ends of the rivet may have a coating of copper electroplated on them. The ends of the rivet portion proper of the fastener are then expanded as described. This construction is substantially identical with that shown in Figs. 1 and 3 with the exception that the terminal part 8′ of the flexible conductor is integral with the rivet connections 6″.

While we have hereinbefore illustrated and described the best form of our invention now known to us it will be obvious to all those skilled in the art that changes may be made in the form of our invention without departing from its spirit.

What we claim as new and desire to secure by Letters Patent of the United States, is,—

1. The method of connecting a flexible conductor to a carbon block which consists in inserting a portion of a tubular metallic member in an opening formed for the purpose in the carbon block, electroplating the carbon block and projecting portion of the member, and then securing the flexible conductor to the member.

2. In combination, a carbon block formed with a passage through it, a rivet extending through said passage and connected to the carbon block by a metallic coating electroplated on said block and rivet, and a conductor having a terminal portion formed with an eye which fits over one end of said rivet whereby when the ends of the rivet are upset the conductor is electrically and mechanically connected to the carbon block.

3. In combination, a brush in the form of a carbon block having a hole or passage formed in it, a tubular rivet fitting the passage in said brush into which it is inserted with its ends projecting therefrom, an integral coating of some good conducting metal rigidly connected to the rivet and block, and a flexible conductor clamped firmly in contact with the tubular member.

4. The method of connecting a flexible conductor to a carbon brush which consists in forming the brush with a hole or passage in it, placing a metal member in said hole or passage with its ends projecting out of the ends of the hole or passage, electroplating the end of the carbon block and the projecting ends of said member to produce an integral metallic coating rigidly adherent both to the carbon block and to the ends of said member, and then securing the flexible conductor to the member.

5. A brush in the form of a carbon block having a hole or passage formed in it, a rivet with an external diameter substantially equal to the internal diameter of the hole located therein with its ends projecting therefrom and expanded or upset, an integral coating of copper electroplated on the carbon block and the projecting ends of the rivet, and a flexible conductor secured against the carbon block by expanding the ends of the rivet.

6. In combination, a carbon block formed with a passage through it, a rivet extending through said passage and connected to the carbon block by a copper coating electroplated on said block and rivet, a conductor having an external portion formed with an eye which fits over one end of said rivet whereby the ends of the rivet being upset electrically and mechanically connect said conductor to the carbon block.

7. In combination, a carbon block formed with a passage through it, a rivet having its ends upset or expanded extending through said passage and connected to the carbon block by an integral metallic coating electroplated thereon, and a conductor having a portion compressed between the carbon block and one of the projecting ends of said rivet whereby the conductor is electrically and mechanically connected to the carbon block.

8. In combination, a carbon block formed with a passage passing transversely through it, a rivet extending through said passage, a conductor having a terminal portion engaging one of the projecting ends of said rivet, and a U-shaped clip placed over the end of the carbon block with openings in its legs through which the ends of the rivets pass, said terminal portion being located between the clip and the carbon block, and the ends of the rivet being upset to firmly secure the clip to the block and thereby clamp the terminal portion between the clip and the block.

9. In combination, a carbon block formed with a passage through it, a rivet extending through said passage and having its ends upset, a conductor having a portion clamped between one of the upset ends of the rivet and the carbon block, and a metallic coating electroplated on the rivet and the carbon block and extending between the portion of said conductor on the one hand and the rivet and carbon block on the other.

10. In combination, a carbon brush formed with a passage through it, a flexible conductor having a terminal portion formed with an eye, and means for electrically and mechanically connecting said terminal portion to said brush comprising a tubular rivet of large diameter having relatively thin walls, said tubular rivet extending through said passage and the eye of said terminal portion and having its ends upset so as to firmly connect the terminal portion to the carbon brush.

11. In combination, a carbon brush formed with a passage through it, a flexible conductor adapted to connect the carbon brush to the brush holder, and means for electrically and mechanically connecting said

conductor to said brush comprising a tubular rivet of large diameter having relatively thin walls, said tubular rivet extending through said passage and having its ends upset so as to firmly connect the conductor to the carbon brush.

12. In combination, a carbon brush formed with a passage through it, a flexible conductor adapted to connect the carbon brush to the brush holder, said brush being recessed at the ends of the passage, and means for electrically and mechanically connecting said conductor to said brush comprising a tubular rivet of large diameter having relatively thin walls, said tubular rivet extending through said passage and having its ends upset so as to firmly connect the conductor to the carbon brush, the upset ends of the rivet being contained in said recesses.

13. In combination, a carbon brush formed with a passage through it, said brush being recessed at one end of the passage, a flexible conductor having a terminal portion, and means for electrically and mechanically connecting said terminal portion of said brush comprising a tubular rivet of large diameter having relatively thin walls, said tubular rivet extending through said passage and said terminal portion and having its ends upset so as to firmly connect the terminal portion to the carbon brush, said terminal portion being contained in said recess.

14. In combination, a carbon brush formed with a passage through it, said brush being recessed at the ends of the passage, a flexible conductor having a terminal portion formed with an eye, and means for electrically and mechanically connecting said terminal portion to said brush comprising a tubular rivet of large diameter having relatively thin walls, said tubular rivet extending through said passage and the eye of said terminal portion and having its ends upset so as to firmly connect the terminal portion to the carbon brush, the upset ends of the rivet and said terminal portion being contained in the recesses.

15. A brush for dynamo-electric machines, comprising a carbon block having a channel extending therethrough, a conductor clip on one side of said brush, and a hollow rivet in said channel for connecting the clip to said brush.

In witness whereof, we have hereunto set our hands this 27th day of February, 1905.

HENRY GEISENHÖNER.
FRED L. STONE.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.