No. 656,652. Patented Aug. 28, 1900.

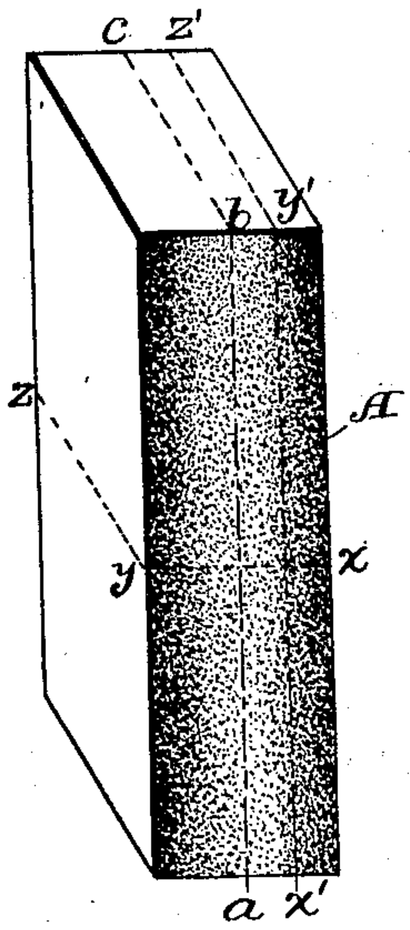
W. A. MARKEY.

CARBON BRUSH.

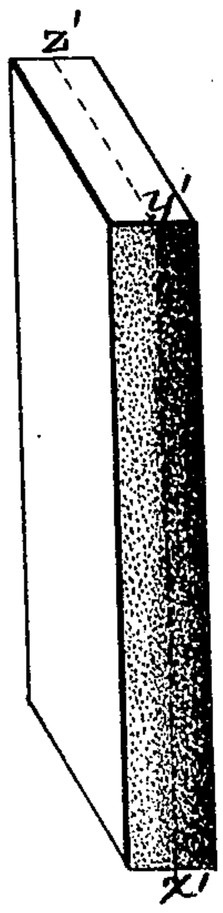
(Application filed Mar. 30, 1900.)

(No Model.)

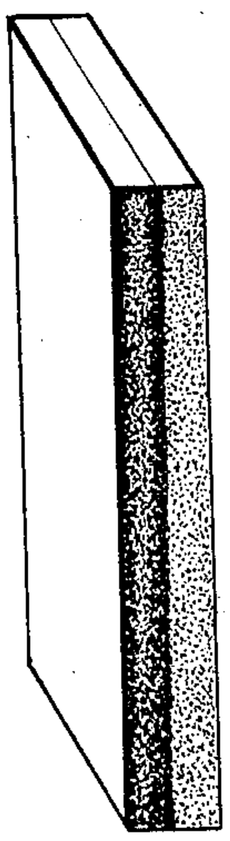
-FIG. I-



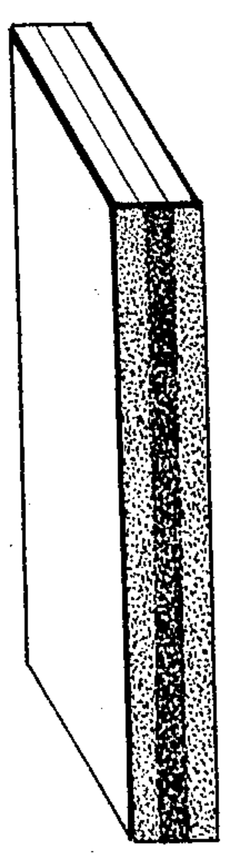
-FIG. II-



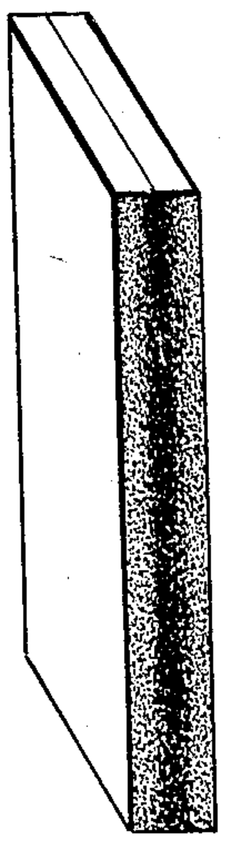
-FIG. III-



-FIG. IV-



-FIG. V-



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UNITED STATES PATENT OFFICE.

WILLIAM A. MARKEY, OF SAGINAW, MICHIGAN, ASSIGNOR TO EMMET T. BOWEN.

CARBON BRUSH.

SPECIFICATION forming part of Letters Patent No. 656,652, dated August 28, 1900.

Application filed March 30, 1900. Serial No. 10,731. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. MARKEY, a citizen of the United States, and a resident of Saginaw, county of Saginaw, and State of Michigan, have invented a new and useful Improvement in Electrical Conductors, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

My invention consists of an electrical conductor having a body which in itself is of a nature such as to combine certain disadvantages of resistance and non-conductivity with certain advantages of physical characteristics, such conductor being constructed in a manner such as to substantially eliminate or greatly reduce the degree of disadvantages. Said invention is advantageously applied to conductors, in connection with which it is desirable or necessary to use carbon, such as a carbon brush for use in dynamo-electric machines. Such brushes as heretofore constructed have been deficient in homogeneity, density, toughness, and conductivity. My invention as applied to such carbon brushes has been productive of a brush such as to present a physical structure, affording greatly-increased economical advantages both as regards its physical and its electrical characteristics. To produce such conductor, I employ a process described and claimed in an application for United States Letters Patent, Serial No. 1,550, filed by me January 15, 1900, and which it will be necessary to hereinafter briefly describe in order to understand the nature of the construction of the conductor which forms the subject-matter of this application.

The annexed drawings and the following description set forth in detail certain means embodying the invention, such disclosed means constituting but one of various forms in which the principle of the invention may be used.

In said annexed drawings, Figure I represents a perspective view of a block of carbon and illustrating the physical structure thereof upon the front face or cross-section after having been subjected to the above-mentioned process to form my improved conductor. Fig. II represents a divided portion of the structure shown in Fig. I. Fig. III represents a carbon block constructed to form a modified structure embodying the principle of my invention. Figs. IV and V represent further modifications embodying my said principle of invention, all having their molecular construction illustrated upon the front faces thereof.

In forming my improved conductor I take a block of the porous material A to be treated and distribute throughout its pores a medium of high conductivity non-uniformly and in a manner such as to form zones of conductivity varying relatively to each other, but of substantially-uniform conductivity in themselves. Such distribution may be effected in any suitable manner, and the medium may consist of any suitable material. I have, however, found it convenient and advantageous to use the metal silver for such medium and to effect its distribution by soaking the material in an aqueous solution of silver nitrate and thereupon heating same in a manner such as to reduce the silver nitrate to metallic silver, as fully described in my above-mentioned application for patent. Such metal coats the particles of carbon, uniting them mechanically and electrically, the depth to which the metal solution penetrates varying with the length of time the porous material is subjected to the soaking operation, the intensity of impregnation produced thereby varying inversely as the distance from the surface, as illustrated in Fig. I, and is hence non-uniformly distributed throughout the pores of the structure, so as to produce a conductor containing zones of varying conductivity, the conductivity in a plane indicated by lines $x\,y\,z$, Fig. I, and passing transversely through planes parallel with a given plane $x'\,y'\,z'$, passing through a zone of lesser impregnation, increasing in one direction from said given plane and decreasing in the opposite direction, the degree of conductivity varying as their distance from said given plane. Two such above-described conductors are formed by dividing a structure such as is illustrated in Fig. I longitudinally upon the plane of least impregnation, indicated by

the line *a b c*, such divided structure being illustrated in Fig. II. After such division the structure is given an exterior coat of the metal or metals by application of the above-described process or by the usual electro-plating methods.

A carbon brush constructed in the above-described manner is particularly adapted for use in a non-reversing dynamo-electric machine and is placed in a brush-holder in a manner such that the commutator of the machine will travel upon the brush-surface from the portion of more highly-impregnated construction, and hence greater conductivity toward the portion of less high degree of impregnation and hence of lower conductivity—that is, the highly-conducted portion of the brush is at the heel and the highly-resisting portion of the brush is at the toe thereof. In use the toe is cleared of the superficial metal coating for a short distance from the commutator, as is customary with copper-plated brushes, the coating at the heel being left intact. The breaking of the circuit or the forming of the difference of potential occurs at a point of high resistance, resulting in less sparking at such point and in a reduction of heat in the brush as compared with that produced in a brush of the usual construction, such reduction of heat being also effected in the commutator and in the brush-holder, attended by a corresponding gain in the efficiency of a machine using such improved brushes. The increased conductivity of brushes manufactured as above described permits of a reduction in the size of commutators and brushes, resulting in a further economical advantage in the construction of dynamo-electric machines.

The mode of construction may be varied by subjecting two carbon structures to the above-described process to produce one structure of high and another of low conductivity, then clearing one face of each superficial metal and cementing such two faces to each other to produce a compound structure, such as is illustrated in Fig. III, such structure as a whole having the general characteristics of the first-described structure and each section forming a layer of high and low conductivity, respectively, and having the specific characteristics of said structure. In place of the section treated so as to produce a structure of low conductivity untreated material may be used. The entire structure is then given a metallic outer coating, as before. For brushes used in reversible dynamo-electric machines the last-described mode of construction may be varied by cementing to both faces of the section of high conductivity a section of low conductivity or of untreated material, as illustrated in Fig. IV, or two structures, such as are illustrated in Fig. II, may be cemented to each other in a manner such as cause the zones of highest conductivity in each to be contiguous to each other, as illustrated in Fig. V.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed provided the means covered by any one of the following claims be employed.

I therefore particularly point out and distinctly claim as my invention—

1. An electrical conductor made from porous material and a conducting medium in the pores of such material, such medium forming zones of varying conductivity, substantially as set forth.

2. An electrical conductor made from porous material and a conducting medium in the pores of such material, such medium forming a zone of high and a zone of low conductivity, substantially as set forth.

3. An electrical conductor characterized by zones of varying conductivity, the conductivity in a plane passing transversely through planes parallel with a given plane, increasing in one direction from said given plane and decreasing in the opposite direction, the degree of conductivity at points in said transverse plane varying as their distance from said given plane, substantially as set forth.

4. An electrical conductor made from porous material and a conducting medium in the pores thereof and distributed therein in a manner such that the conductivity in a plane passing transverely through planes parallel with a given plane increases in one direction from said given plane and decreases in the opposite direction, the degree of conductivity at points in said transverse plane varying as the distance from said given plane, substantially as set forth.

5. An electrical conductor having zones of varying conductivity and an external coating of a material of high conductivity, substantially as set forth.

6. An electrical conductor having a zone of high and a zone of low conductivity, and an external coating of a metal or of metals of high conductivity, substantially as set forth.

7. A brush for electrical purposes consisting of a carbon body and a metal non-uniformly distributed throughout the pores of such body, substantially as set forth.

8. A brush for electrical purposes consisting of a carbon body and silver distributed throughout the pores of such body, substantially as set forth.

9. A brush for electrical purposes consisting of a carbon body and a metal distributed throughout its pores so as to produce layers of varying conductivity, substantially as set forth.

10. A brush for electrical purposes consisting of a carbon body and a metal distributed throughout its pores non-uniformly and so as to produce layers of varying conductivity, substantially as set forth.

11. A brush for electrical purposes consisting of a carbon body and a metal distributed throughout the carbon pores forming zones of varying conductivity, and having an ex-

ternal coating of metal, substantially as set forth.

12. A brush for electrical purposes consisting of a carbon body and metallic silver distributed throughout the pores of such body, substantially as set forth.

13. In a brush for electrical purposes, the combination with a block of porous material having a conducting medium in the pores of such material forming zones of varying conductivity, of a second block of such material of low conductivity as compared with said first block, substantially as set forth.

14. In a brush for electrical purposes, the combination with a block of porous material having a medium of high conductivity distributed throughout its pores, of a second block of low conductivity as compared with said first block, substantially as set forth.

15. In a brush for electrical purposes, the combination with a block of porous material having a medium of high conductivity distributed throughout its pores, of a second block free from such medium, substantially as set forth.

16. In a brush for electrical purposes, the combination with a carbon body having metallic silver distributed throughout its pores, of a second block of carbon having a high resistance as compared with said first block, substantially as set forth.

17. In a brush for electrical purposes, the combination with a carbon body having metallic silver distributed throughout its pores, of a second such body free from such silver, substantially as set forth.

Signed by me this 27th day of March, 1900.

WILLIAM A. MARKEY.

Attested by—
G. M. REYNOLDS,
FRED E. FENNO.