(No Model.)

D. C. VOSS.

ELECTRICAL RESISTANCE DEVICE.

No. 573,558. Patented Dec. 22, 1896.

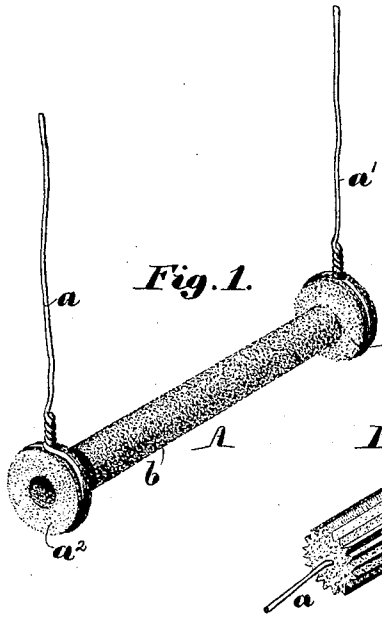

Fig. 1.

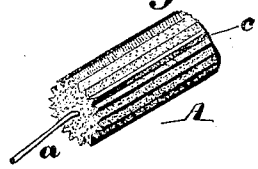

Fig. 5.

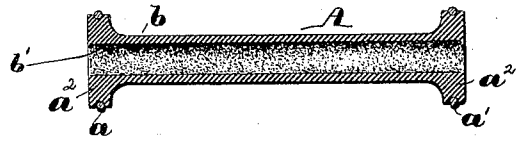

Fig. 2.

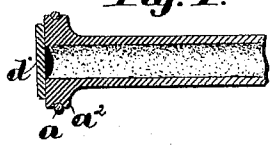

Fig. 4.

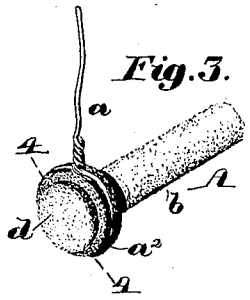

Fig. 3.

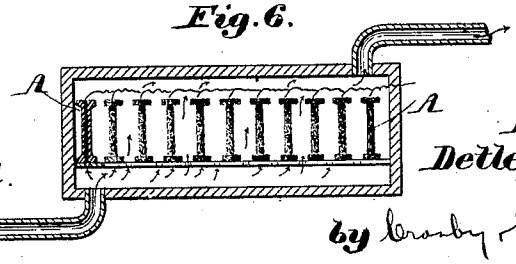

Fig. 6.

Witnesses:
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UNITED STATES PATENT OFFICE.

DETLEF C. VOSS, OF MALDEN, MASSACHUSETTS, ASSIGNOR TO HENRY HASTINGS, OF BOSTON, MASSACHUSETTS.

ELECTRICAL RESISTANCE DEVICE.

SPECIFICATION forming part of Letters Patent No. 573,558, dated December 22, 1896.

Application filed March 16, 1896. Serial No. 583,291. (No model.)

To all whom it may concern:

Be it known that I, DETLEF C. VOSS, of Malden, county of Essex, State of Massachusetts, have invented an Improvement in Electrical Resistance Devices, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The object of my invention is to provide a resistance-conductor that may be used in connection with the ordinary commercial electrical currents commonly provided for electric lighting and other purposes, and, further, to provide such a conductor that may be used without destruction when exposed in atmospheric air or in water.

My invention is particularly adapted to heating purposes, although it may be used for any resistance purpose, for example, for the starting-boxes to regulate motors and dynamos in electrical circuits, as will be more fully described hereinafter.

Prior to my invention electric heaters have usually been made in the form of a coil of fine insulated wire of great length; also compounds of carbon and clay, and carbon alone or mixed with various earthy substances, have been suggested, to be used in the form of rods inclosed in brass, porcelain, or other shells, usually of insulating substance. These heaters have, however, been found to be expensive in original cost, and also expensive in operation, being wasteful of the electricity, and also requiring very high resistance, such that if the compound were exposed directly to the action of atmospheric air it would be destroyed as a conductor either by disintegration or by oxidation or other elemental change. My invention, however, is practically indestructible in atmospheric air, under its highly-heated condition as a heater, and is normally operative for such purposes at low resistance.

Further advantages of construction and operation will more fully appear in the course of the detailed description thereof hereinafter.

In the accompanying drawings, illustrative of one form of the device embodying my invention, Figure 1 is a view in perspective of one form of my invention. Fig. 2 is a central longitudinal section thereof. Fig. 3 is a detail in perspective, showing the same provided with a cap for use as a rheostat. Fig. 4 is a longitudinal section taken on line 4 4 of Fig. 3. Fig. 5 is a view in perspective of a modified form of my invention. Fig. 6 is a partly diagrammatic view illustrating one application of my invention as a heater.

In use it is found that the compounds or mixtures heretofore proposed for electrical heaters have required an inclosing shell to protect the conducting materials from the action of the surrounding air or water, as otherwise the component materials would be destroyed by union with the air or by dissolving in the water, due to the electrochemical action of the surrounding fluid on the highly-heated compound. In order, therefore, to provide a heater that is practical without any inclosing shell, being at the same time perfectly operative without any liability to be destroyed in the surrounding air or other fluid, I have invented the resistance-conductor as herein set forth.

According to my invention, I take a convenient quantity of paper (such as straw paper, linen paper, asbestos paper, or other equivalent fibrous substance) and saturate it with a strong solution of metallic oxid, such, for instance, as any of the oxids of the abraum-salt metals, *i. e.*, magnesium, kalium, natrium, lithium, casium, and rubidium, and subject this previously-impregnated fibrous material to the action of heat sufficient to char the same. The charred mass is then ground or otherwise pulverized, preferably to an extreme degree, and then thoroughly mixed with a suitable binder, preferably a solution of molasses and gum-arabic. This plastic mixture is then molded to the desired form and preferably pressed together under considerable pressure, so as more intimately to unite the molecules thereof and expel every vestige of air, the pressure also serving to mechanically unite the binder with the comminuted matter. Having thus thoroughly prepared the mixture as stated, the molded bodies are fired to an extremely high degree. This heat should be sufficient to raise the material to incandescence. In this step of the process of my invention the character of the binder is radically changed, and while still maintaining its function as a binder

it is also transformed into a conductor. The mass also undergoes a chemical or elemental change, depending somewhat in its nature upon the composition of the mass, so that the original oxid, fiber, and binder are united into a homogeneous composition of low electrical resistance, instead of having the high resistance which the mass possessed immediately before reaching the incandescent state or thereabout. The bodies are now allowed to gradually cool and will be found thereafter to maintain their quality of low electrical resistance; also, this excessive heat transforms the composition or mixture first into a black or blackish mass, and finally into a permanently brown or brownish mass, the latter term including reddish and yellowish shades that come to the mass or to parts thereof due to extreme variations or degrees of heat.

In the particular form of resistance conductor or heater which I have herein shown for purposes of illustration, A designates the body of the resistance medium, which may be and is preferably tubular, although it may be solid, as shown in Fig. 5. Suitably connected to the body A, and preferably at either end thereof, are the connecting-wires *a a'*, which may be joined thereto in any suitable manner. I have herein shown the body A as being provided at either end with enlarged portions a^2, peripherally grooved to receive the connecting-wires, the object thereof being to neutralize the tendency of the electric current to unduly heat and thereby injure the resistance medium at the point of connection, the increased bulk or mass of the material at these points more readily receiving the electrical impulse than a smaller or thinner mass, and also serving to sustain all strains and abrading movements.

For heating purposes I prefer the tubular form of conductor, as shown in section in Fig. 2, this form presenting the two heating or radiating surfaces *b b'*, thereby serving to heat a greater quantity of the surrounding medium; also, because of the tubular form the circulation of the surrounding air or other medium is facilitated, as indicated by the arrows in Fig. 6, a plurality of the conductors being stood on end on a grid or perforated support of insulating material within a retaining box or drum. The surface or surfaces of the conductors may be plain or corrugated, as desired, the latter shape being indicated at *c*, Fig. 5.

When my improved resistance is used as a rheostat, it is desirable that the tube A should be closed, plugs or caps *d* being shown in Figs. 3 and 4 for this purpose. The effect of thus closing the tubes is to greatly enhance the efficiency of the resistance as a rheostat. As the body becomes heated by the passage therethrough of the electric current the air contained within the tube is thereby rarefied and driven out through the pores of the conductor, so that should the point of incandescence be reached a substantial vacuum would be produced within the tube, or, in other words, the heating of the tube serves to expel the air therefrom and thereby remove from the material of the conductor all tendency of self-destruction by uniting with the air in combustion. The external air alone therefore has access to the material of the conductor and can at most penetrate to an infinitesimal extent, being practically limited in its action to the external surface of the body A.

While I have shown and described certain forms and uses of my invention and of the process of making the same, I do not intend to be limited to the particular details set forth, as I have defined the true scope of my invention in the following claims; nor do I desire to be restricted to the substances herein set forth, as others may be used and these may have other substances united with them, if desired.

What I claim is—

1. As an article of manufacture, a solidified electric conductor, composed of carbonized fibrous material, a metallic oxid, and a binder, substantially as described.

2. As an article of manufacture, a solidified electric conductor, having normally low resistance, and composed of carbonized fiber metallic oxid and a binder, said conductor remaining permanent in use unprotected from the atmosphere, substantially as described.

3. A resistance-conductor, composed of a conducting substance, of carbonized fiber and metallic oxid, and a binder insoluble in liquid when heated by the normal passage of electricity, substantially as described.

4. The herein-described electrical resistance device, comprising a plurality of short, straight resistance-conductors, in the form of separate open tubes, and arranged together parallel and in close proximity, substantially as described.

5. A resistance-conductor consisting of a cylindrical body of homogeneous material, provided with enlarged portions at either end thereof, each of said portions having a circular groove formed in its periphery to receive the electrical connections, substantially as described.

6. A resistance-conductor consisting of a cylindrical body of homogeneous material, provided with enlarged portions in the form of thickened disks at either end thereof, each of said portions having a circular groove formed in its periphery to receive the electrical connections, substantially as described.

7. A resistance-conductor consisting of a corrugated cylindrical body of homogeneous material, provided with enlarged portions at either end thereof, each of said portions having a circular groove formed in its periphery to receive the electrical connections, substantially as described.

8. The combination with a suitable inclosure, of a perforated support therein, and a plurality of tubular resistance-conductors supported thereby, each conductor being cen-

tered lengthwise over a perforation of the support, thereby constituting a plurality of flues, substantially as described.

9. A short cylindrical resistance-conductor, approximately straight, and provided at either end with an annular enlargement, the whole being of homogeneous resistance material, substantially as described.

10. The herein-described process, which consists in saturating paper in a strong solution of a metallic oxid, charring the saturated paper, finely comminuting the charred paper, thoroughly mixing said comminuted mass with molasses and gum-arabic, molding the same to desired form, firing the molded mixture, having the heat of the firing raised to an extreme degree, and finally gradually cooling the molded body, substantially as described.

11. The herein-described process, which consists in saturating fibrous material with a strong solution of metallic oxid, charring the same, finely comminuting the charred material, thoroughly mixing said comminuted mass with a binder, such as molasses and gum-arabic, molding the same to desired form, subjecting the same to pressure, firing the molded mixture, under extreme heat, and finally gradually cooling the molded body, substantially as described.

12. The herein-described process, which consists in charring paper, grinding the same to a finely-pulverized condition, mixing with a binder, molding and pressing the said mixture, then firing to incandescence, and finally cooling the fired body, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

DETLEF C. VOSS.

Witnesses:
GEO. H. MAXWELL,
FRED. E. MOBERG.