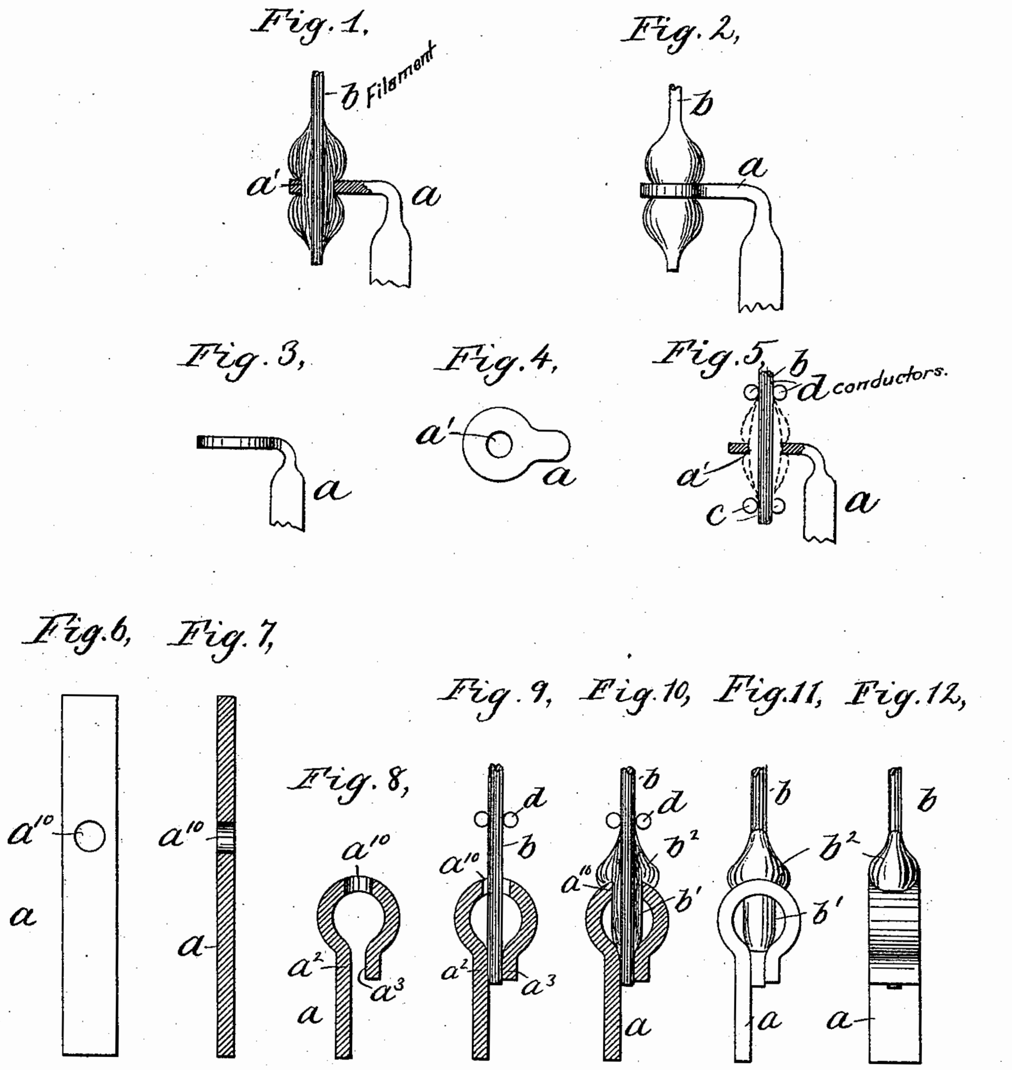
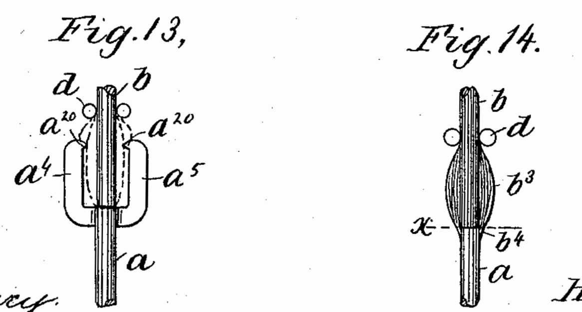
(No Model.)

H. LEMP.

METHOD OF CONNECTING FILAMENTS TO LEADING-IN WIRES.

No. 392,158. Patented Oct. 30, 1888.





Witnesses,
Jas. J. Maloney.
M. E. Hill.

Inventor.
Hermann Lemp,
by Jos. P. Livermore
Att'y.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

HERMANN LEMP, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

METHOD OF CONNECTING FILAMENTS TO LEADING-IN WIRES.

SPECIFICATION forming part of Letters Patent No. 392,158, dated October 30, 1888.

Application filed May 31, 1888. Serial No. 275,637. (No model.)

To all whom it may concern:

Be it known that I, HERMANN LEMP, of Lynn, county of Essex, and State of Massachusetts, have invented an Improvement in the Method of Making Connections with Carbon, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to a method of making connections between carbon, or material having similar properties, and other bodies, which method may be used for making the connection between the filament of an incandescent electric lamp and the metallic conductors which are commonly sealed into the glass bulb or globe that contains the filament, and which serves to connect the filament with the external circuit. Considerable difficulty has been experienced in securing a permanent electrical connection or contact and at the same time strong mechanical connection or joint between the ends of the carbon filament and the metallic conductors or supports for the said filaments. One method that has been practiced consists in connecting the parts by deposition of carbon upon the joint, which has been done by bringing the ends of the filament and metallic conductors into electric contact, immersing them in a liquid or gas which deposits carbon under the action of heat, and passing a current through the said metallic and carbon conductors and the contact between them of sufficient strength to heat the conductors to a high temperature and cause a deposit of carbon upon them over and around the point of contact, which deposit fastens the metallic and carbon conductors together. In other words, the method heretofore practiced involves the passage of the current from one to the other conductor through a point of contact, the two parts to be united by the deposit being in circuit in series with one another, and the deposit upon both the conductors being depended upon to make the joint. This method is objectionable for several reasons, and among them because, owing to the unequal conductivity of the carbon and of the body to be connected with it, there is an unequal deposit, that upon the carbon being usually much greater than that upon the other body, so that the enlarged bulb of deposited carbon is mainly on the end of the carbon filament and but slightly passes the division-line between it and the metallic conductor abutted against it, thus making a joint that is weak mechanically and is likely to be of poor conductivity. Further than this, it is obvious that only conductive materials can be connected with carbon in this manner, and when metals are connected with the carbon in this way there is great danger of fusing the metal, and it has heretofore been possible to make such joint only between carbon and metals that withstand a very high temperature without fusion. All these objections are overcome by the present invention, which consists, mainly, in making the joint by means of the deposit on the carbon only, the other body with which the carbon is to be connected not forming a part of the circuit, but being retained in such position with relation to the carbon that the deposit upon the latter, as it increases in size, will engage the adjacent body, and thus connect it with the carbon. By this method it is not essential that the body to be connected with the carbon should be of conductive material, it being necessary only that it shall be of proper material to withstand the heat and actions accompanying the deposit of the carbon upon the adjacent carbon conductor.

In practicing this invention it may in some cases be necessary or desirable to convey the current to the portion of the carbon upon which the deposit is being made by a portion of the material to which the carbon is to be connected, and in this case a part of the deposit may be upon both bodies and tend to join them in the method heretofore practiced; but such joint made by the old method is not the one depended upon to mechanically unite and electrically connect the two bodies, which will be further united by a deposit formed wholly upon the carbon and extending therefrom, so as to engage and preferably embrace a portion of the other body that is not in circuit while said deposit is being made.

Figures 1 and 2 are a sectional view and side elevation, respectively, of a joint made by the method forming the subject of this invention; Figs. 3 and 4, a side elevation and plan view, respectively, of the body connected with the carbon to make the joint represented in Figs. 1 and 2; Fig. 5, a diagram illustrating the method of making the joint shown in Figs. 1 and 2, in which the current is introduced to the carbon wholly independently of the body with which the carbon is to be connected, which body need not necessarily be of conductive material. Figs. 6, 7, and 8 represent another form of body to be connected with the carbon; and Figs. 9 to 12, inclusive, represent the formation of the joint with such body, a portion of which is depended upon to convey the current to the carbon. Fig. 13 illustrates another modification of the joint made by the method forming the subject of this invention, and Fig. 14 illustrates a joint made by the method commonly employed prior to this invention.

In making a joint between carbon or other material having similar properties and another body in accordance with the method forming the subject of this invention the body to be connected with the carbon is held in proximity to a portion of the carbon and in such relation thereto that a deposit formed upon or building out from the said portion of the carbon will finally engage the said adjacent body and fasten it to the carbon. To accomplish this result most effectively, it is desirable that the body to be connected with the carbon should have portions at opposite sides of the carbon or wholly surrounding the same, so that the deposit in building out upon the carbon will enter or wedge in, as it were, between the opposite portions of the body to be connected with the carbon.

In order to make a joint such as represented in Figs. 1 and 2, which is a very strong and effective joint for uniting a filament with the metallic conductor of an electric lamp, the ends of said metallic conductors *a* are preferably formed into a loop or eye, *a'*, through which the carbon *b* is passed, as shown in Fig. 5. As it is not essential in practicing this method that the metallic conductor should be extremely refractory, copper may be used, and has several advantages as a conductor for an incandescent electric lamp, which will be hereinafter mentioned.

When the metallic conductor is made of copper wire, it may be prepared for uniting with the carbon, as shown in Figs. 3 and 4, by flattening a portion of the end of the wire and then piercing the said flattened portion to make the opening *a'*, through which the carbon is passed. After the carbon *b* has been placed in proximity to the conductor *a*, as shown in Fig. 5, the parts are placed in a fluid that will deposit carbon in the well-known manner, and a current passed through the portion of the carbon *b* adjacent to the conductor *a*, the said current being conveyed to said carbon by conductors *c* and *d*, which, as shown in Fig. 5, are wholly independent of the body *a* to be connected with the carbon, which body is not in circuit. Owing to the refractory nature of the carbon, a very large current can be passed through it, causing a rapid deposit of carbon upon it, which builds out from the carbon until finally it engages the body *a*, as indicated in Fig. 5, and owing to the fact that the body *a* has portions at opposite sides of the carbon, or, in fact, wholly surrounding it, the deposit wedges between the said portions, and if continued will build out upon the body *a*, embedding it in the deposit to a greater or less extent, as indicated in Figs 1 and 2, thus forming a joint of great strength mechanically and affording a very close electrical connection. In the construction illustrated in Figs. 1 and 2 the deposit builds up at both sides of the connected body, forming a mechanical connection similar to that of a rivet, which does not depend upon the adhesion between the two bodies united, but upon the actual strength of the said bodies, which cannot be separated without rupture of one or the other of them. It is also apparent that, as the current does not pass through the body *a* in forming the joint, the joint does not depend at all upon the conductivity of the part *a*, and the carbon might be connected with a non-conducting material by this method when desired. It is not, however, essential that the body *a* to be connected with the carbon should be wholly out of circuit, as a portion of said body may be depended upon to convey the current to the carbon, the deposit upon which will then engage another portion of said body to form the joint or a part of the joint.

As shown in Figs. 6, 7, and 8, the body *a* to be connected with the carbon is a flat strip of conducting material provided with an opening, a^{10}, of larger diameter than the carbon, the said strip being then bent, as shown in Fig. 8, to form a pair of jaws, a^2 a^3, between which the end of the carbon *b* is held, as shown in Fig. 9, with the carbon passing through the opening a^{10} without touching the conductor *a* around said opening. The conductor *d* is then placed in contact with the carbon beyond the opening a^{10} and the current passed from the conductor *a* to the conductor *d* through the portion of the carbon *b* that extends from the jaws a^2 a^3 to the conductor *d*. This will cause a deposit to be formed on the carbon *b*, which will finally fill the opening a^{10}, as shown at *b'*, Figs. 10 and 11, and thus fasten the carbon to the conductor *a*, as before described. If the current is continued after the opening a^{10} has been thus filled, there will be a secondary action, as the current will pass mainly through the metal to the point a^{10} and the deposit will subsequently be formed mainly on the portion of the carbon between the opening a^{10} and the conductors *d*, as shown at b^2, Figs. 10, 11, and 12, and by the combined effect of the two deposits b' b^2 a very strong joint can be made.

The operation in making the joint shown in

Fig. 13 is substantially the same as that last described; but in this construction the body a has arms a^4 a^5 at opposite sides of the carbon b, said arms having inwardly-projecting prongs or fingers a^{20} at opposite sides of the carbon, which rest in contact with the body a at the base of the arms a^4 a^5. The current is passed from a through the carbon b to the conductor d beyond the prongs a^{20}, making a deposit on the said carbon, which finally engages the said prongs a^{20}, after which a secondary deposit is formed between the said prongs and the conductor d.

In the method of joining carbons with conductors heretofore commonly practiced, and illustrated in Fig. 14, the current is passed from the metallic conductor a through the carbon b to the conductor d; but the portion b^3 of the deposit formed on the carbon itself does not contribute at all to the strength of the joint, which depends wholly upon the continuation b^4 of said deposit below the dotted line x, which deposit b^4 surrounds the extremity of the conductor a. A joint made by this method depends wholly upon the adhesion of the conductor a and portion b^4 of the deposit, or upon the strength of the said small portion b^4 of the deposit, and is not only weak mechanically, but is of poorer conductivity than the joint formed by the herein-described method.

An important advantage in the use of copper as a connector for a conductor to be connected with a carbon filament arises from the greater expansibility of the copper when heated, from which it results that if the carbon has partially broken away from the metal, making a joint of poor conductivity, the rise in temperature due to the increased resistance will expand the copper and press it into close contact with the carbon, thus diminishing the resistance.

In another application filed herewith I have shown and described an instrument suitable for holding the carbon and bodies to be connected therewith in proper position with relation to one another and for conveying the current to the carbon, in order to make a joint in accordance with the herein-described method.

I claim—

1. The herein-described method of connecting a carbon conductor with another body, which consists in forming a deposit upon said carbon by passing a current through the carbon while the portion of the body to be connected therewith by said deposit is in position to be engaged by said deposit, but out of circuit, substantially as described.

2. The method of connecting a carbon filament with another body, which consists in placing the body to be connected in proximity to the said filament and then depositing carbon upon the said filament until it engages the adjacent body or parts thereof, substantially as described.

3. The method of connecting a carbon filament with another body, which consists in placing portions of said body adjacent to the said filament and passing an electric current through the portion of the filament that extends past the adjacent body while surrounded by a carbon-depositing fluid, substantially as described.

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

HERMANN LEMP.

Witnesses:

A. L. ROHRER,

E. WILBUR RICE, Jr.