(No Model.)

J. J. WILLIAMSON.

ELECTRICAL CONDUCTOR.

No. 300,669. Patented June 17, 1884.

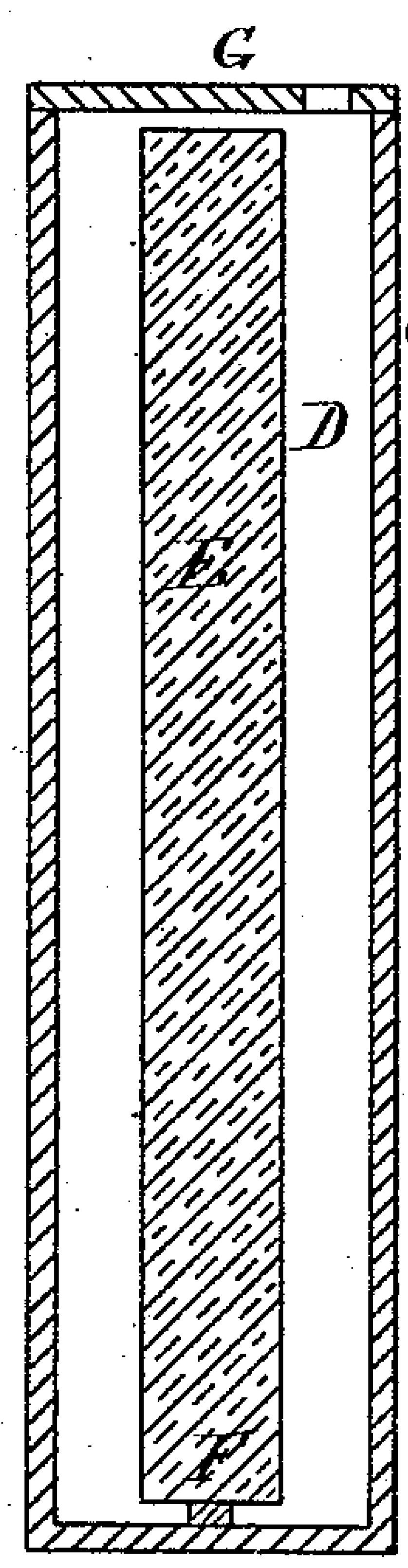

Fig. 1.

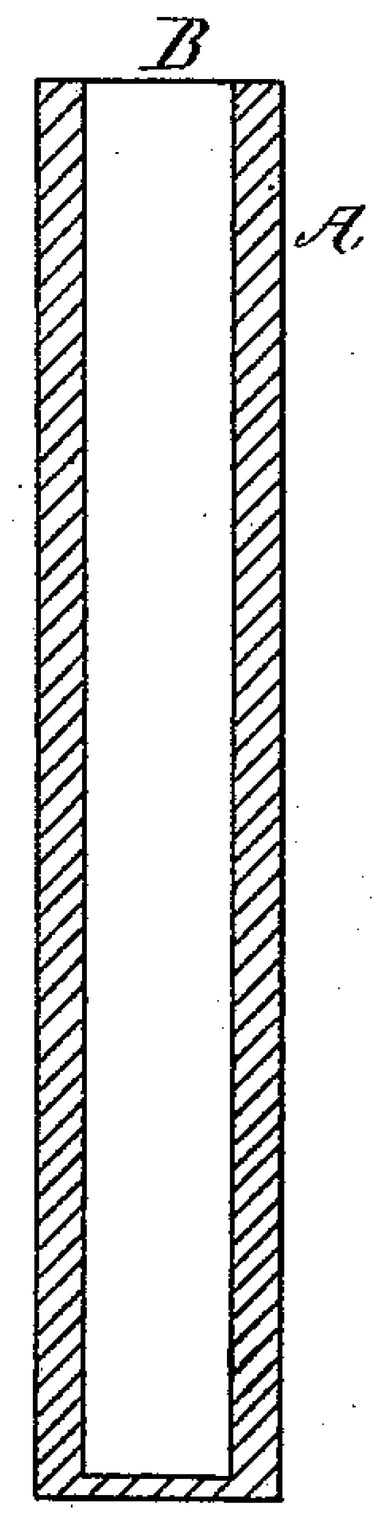

Fig 2.

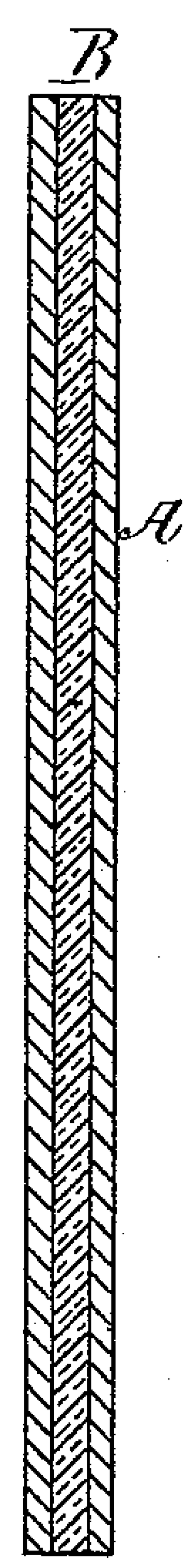

Fig. 3.

WITNESSES.

Fred. Harris

Fred. B. Dolan.

Jno. J. Williamson

INVENTOR.

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

UNITED STATES PATENT OFFICE.

JOHN J. WILLIAMSON, OF BOSTON, MASSACHUSETTS.

ELECTRICAL CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 300,669, dated June 17, 1884.

Application filed January 23, 1884. (No model.)

To all whom it may concern:

Be it known that I, JOHN J. WILLIAMSON, of Boston, in the county of Suffolk and Commonwealth of Massachusetts, a citizen of the United States, have invented certain new and useful Improvements in Electrical Conductors and in the Manufacture thereof, of which the following is a specification.

An electrical conductor, being in most instances suspended on poles above the ground, should be of a high tensile strength and high modulus of elasticity to enable it to suspend its own weight between the supporting-poles and resist the stretching effect of wind and gravity; and it should also be of high conductive properties, and as little as possible liable to disturbance by induction from adjacent electrical conductors. Inasmuch as the metals which are best for electrical conductors are of low tensile strength and very low modulus of elasticity, and the metals which are of high tensile strength and high modulus of elasticity are of inferior electrical conductivity, it is evident that a combination of metals, one for strength and one for conductivity, is desirable, if it should be practical. This fact has long been recognized. In order to make a combination of two metals, one of high conductivity and the other of high tensile strength, which shall be the best for all practical purposes, it is desirable that the coefficients of expansion between the two constituents of the conductor should be as nearly alike as possible, and also that the metals should not be so different in their natures as to originate a local galvanic action under the influence of atmospheric moisture and atmospheric chemical impurities, which would corrode the electro-negative metal and injure its tensile strength. The only commercially-practical metal of highest conductivity for the ordinary purposes of an electrical conductor is copper, whose modulus of conductivity is only exceeded, and scarcely exceeded, by silver, while its price is comparatively low, even as measured with iron. The coefficient of expansion of copper is but slightly influenced by alloying it, while its tensile strength is vastly increased and its conductivity is vastly decreased by alloying. A copper-cored or copper-covered wire is therefore indicated by the conditions required, and the core or cover of metal of high tensile strength and low conductivity is indicated to be made of an alloy of copper which shall retain the copper coefficient of expansion and be superior in all properties except that of conductivity. All or nearly all the alloys of copper with other metals have their temperatures of fusion less than that of copper. All or nearly all of the alloys of copper with other metals have physical properties equal or superior to copper for hot working. The alloys of useful strength which I propose to use are what are known as "aluminium," "bismuth," "carbon," and "ferro-zinc bronzes," the "Muntz metal," the "delta metal," which is a ferro-zinc bronze or brass, the "Ajax metal," which is a composition indifferently classified as "bronze" or "brass," "manganese," and "phosphor-bronzes," "Sterro metal," "nickel," and "silicon bronzes," because these have, or can be made of high tensile strength and high modulus of elasticity, and are very little subject to corrosion, and are but slightly electro-negative to copper; but it will be obvious that any strong alloy of copper, which is of about the same co-efficient of expansion as copper will be the equivalent of these. While such conductors will be more expensive than the compound conductors of iron or steel and copper, in the first instance, they will probably in the long run not be much more expensive, because more durable. In making the electrical conductor with a copper interior and an exterior made of these bronzes, brasses, or alloys, they may be so put together as to insure a union or weld between the copper and the bronze; or they may be so put together as to have copper and bronze in contact but not united. There will be but slight difference in tensile strength or conductivity in these two cases, but it is probable that a conductor of united metals would be better in some respects than a conductor of dissociated metals. The difference in manipulation to produce a union from that which would produce dissociation would practically be the difference between putting the two metals together, both of them being heated to about the fusing-temperature of the most fusible metal for association, or putting them together with a considerable difference between these temperatures for dissociation. The process of making these compound electrical conductors has several stages: first, the formation of the ingot; second, its reduction into billets, bars, and rods; and, third, the reduction of the rods into wire. The formation of the ingot is of the most consequence; but there is a special manipulation required whenever a partially-reduced ingot is cut for convenience of manipulation in further stages.

By reference to the drawings, Figure 1 shows a mold, C, for casting the most fusible metal around the copper bolt E, set up within it. This copper bolt E is to form the conducting-thread of the finished wire. It is set up in the center of the mold along its axis a short distance from the bottom, and should be supported upon a small block or standard of metal, F, similar to that which is about to be poured; or it may be upon wires of such metal, so as to hold its proper position within the mold and allow the fluid metal to flow all around it. I prefer to support it on a small pedestal of the metal about to be poured. This bolt of copper E must be set a little shorter than the ingot-mold, so that the molten metal D may flow over its top and inclose the upper end of the copper, as well as under the bottom of the copper bolt inclosing that. The atmospheric action which takes place during the working of an ingot thus made will be simply the surface action upon the incasing metal, and will not affect the copper interior at all, while the work to which the ingot is subjected will be work that affects the mass throughout and fiberizes the copper, and improves its conductive qualities; besides which, when the copper is completely inclosed, inequality in the reduction of the copper or of the alloyed exterior will be avoided or reduced to a minimum, while if it were unconfined at one or both ends there would be a liability to unequal reduction; and when the copper bolt is put in hot for the purpose of having the two metals united in the finished article, this covering or boxing in of the copper will be particularly important. When the copper bolt is put in hot, of course the exterior casing should be poured as rapidly as possible. In case it is desired to make the bronze exterior of the ingot first, and then pour molten copper into it, this may be done; but in such case the shell would require to be chilled on its exterior while the copper was poured, and for some little time after, so that the copper should not fuse the more fusible metal into which it is cast, but its excessive heat should be rapidly conducted off; and this chill should be applied as well to the bottom of the hollow ingot as to the sides, because of the danger of molten copper eating out the bottom of the ingot; but a small section of properly-prepared asbestus or other very inferior conductor could be placed upon the bottom of the cavity in the ingot, and this limited quantity of impurity would be cut off subsequently in the clipping of the billets, bars, or rods; and in case molten copper was inserted into the cavity of the more fusible ingot, as above described, the upper end of the ingot should be subsequently closed by molten metal of the character of the exterior by plugging with refractory material or by closing over the end in any proper way. If desired to produce an electrical conductor with a copper exterior and a center of stronger metal, a copper ingot should be first cast hollow, as shown in Fig. 2, A, and its center filled with the more fusible metal, B; and if desired to have a union between the two different metals, the hollow copper ingot should be heated to a proper temperature. So also copper may be poured upon a solid bar of the alloy or bronze, and if done quickly, and there is not too much copper, the alloy will probably not be taken up by the copper; but I do not recommend this as the best way of doing. The finished wire is shown at Fig. 3, in which A is the exterior metal, and B the interior, both of the same general nature, but differing only in electric conductivity. In case the copper absorbs the alloy, or is absorbed by it, both the electric conditions will be injured, and the tensile strength will be impaired, so that it is desirable that the two metals should be kept from anything more than mere surface-union, substantially like sweating together. Of course, the surface of that part of the ingot which is first prepared, whether it be the coring part, or whether it be the exterior, should be clean of sand, scale, or other impurities, and should be in such a condition as not to have much air adherent to it. If these surfaces are thoroughly cleaned from scale and then washed with oil and lamp-black, or other substances well known to copper-workers for making such a coating, these substances will be taken off by the molten metal and floated upon it or destroyed, removing all the air from the surface at the same time, and thus the surface of the original part of the ingot, whether it be the bolt for the center, or the hollow ingot for the exterior, will be practically chemically clean for its contact with the part subsequently to be poured into it or around it. This ingot so made has closed ends, and may be worked under the hammer or in rolls, as if it were entirely composed of the metal which forms its exterior, if that be the most fusible metal, or, at any rate, at the working temperature of the most fusible metal. If copper be the exterior metal, and its working temperature be the lower, it may be worked at the copper-working temperature. The ingot having the metal of highest tensile strength, least conductivity, and least fusing temperature on the exterior will be the preferable ingot to work, as copper is not a good metal to work at high heats. This ingot is then reduced to billets, bars, and rods in the usual way of such reductions; but in case it is necessary to cut any of these products because they are too long care must be taken before reheating or making use of either of the pieces with a cut end to hammer up the end, so as to close the exterior metal over the interior metal as much as possible, and thereby eliminate the exposure of the inclosed metal to the atmosphere and keep it in the same condition and relative position in which it was. Wire is then drawn from the rods formed in the usual way, and this wire, if it be made from the ingot with the bronze exterior and the copper interior, will have a comparatively uniform filament of copper throughout its length, surrounded by a casing of bronze of much greater tensile strength, preserving the copper from atmospheric action, and also insulating it to a certain degree, and so protecting it from induction, and what might be called the "vagabond currents" which leak from adjacent wires and disturb the usefulness of an electric conductor.

The novelties in this manufacture are as follows:

First. The wire is a new wire. It has substantially uniform qualities of expansion and contraction under normal atmospheric influences, and substantially the same magnetic and galvanic nature. It is not liable to local galvanic corrosion under ordinary conditions. It has a high degree of tensile strength. It can be made lighter for the same service than other electrical wires.

Second. The ingots which form the first stage of the manufacture are new ingots, being composed of metals possessing the qualities above enumerated for the wire.

Third. The methods described of preparing the ingots so as to secure the separation of the component metals from each other for electrical qualities, and their union with each other for physical qualities, are new methods.

Fourth. The method of treating the outer part of the composite billets, bars, or rods, which will protect the interior metal from local atmospheric action, and will preserve the relative positions of the constituent parts in later operations, is a new method. These last three things concur to produce the result of a compound electrical conductor of the properties above enumerated.

I do not claim the wire shown and described in the specification, but reserve the right to claim the same in a future application.

I therefore claim as my invention, and desire to secure by Letters Patent—

The method of producing electric conducting-wires composed of copper and copper alloys by casting or pouring molten fluid copper or copper alloys to and around a solid bar, or within a hollow ingot of copper or copper alloys, said solid bar or hollow ingot being, while the casting is effected, at such high degree of temperature that the pouring of the molten metal to it will produce metallic fusion between the sections, and afterward reducing such ingot to the diameter proper for electrical conductors by the usual suitable means.

JNO. J. WILLIAMSON.

Witnesses:

FRED. B. DOLAN,

FRED. HARRIS.