(No Model.)

J. J. WILLIAMSON.

MANUFACTURE OF ELECTRICAL CONDUCTORS.

No. 369,144. Patented Aug. 30, 1887.

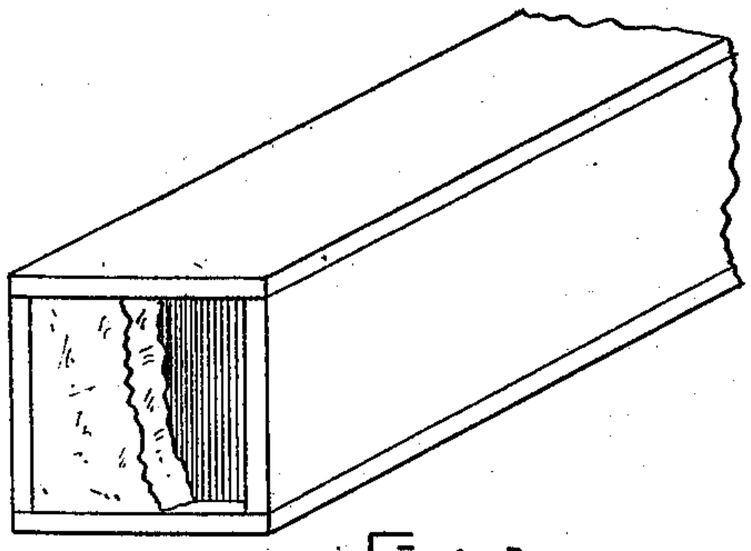

Fig. 1.

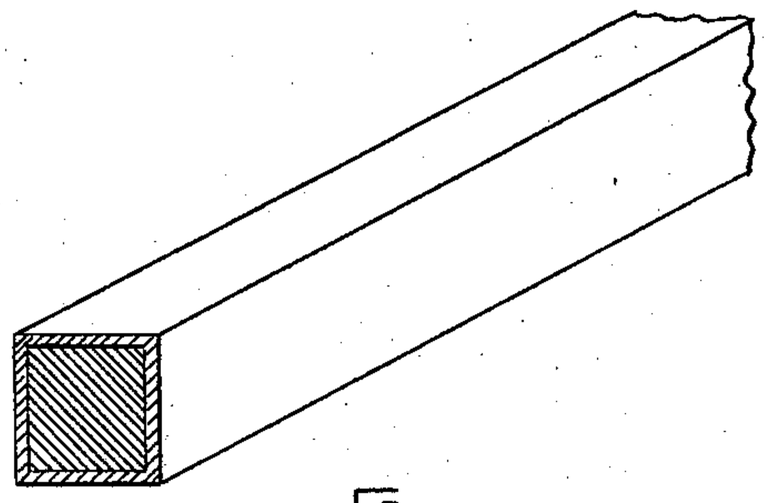

Fig. 2.

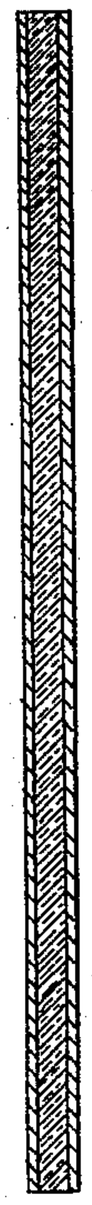

Fig. 3.

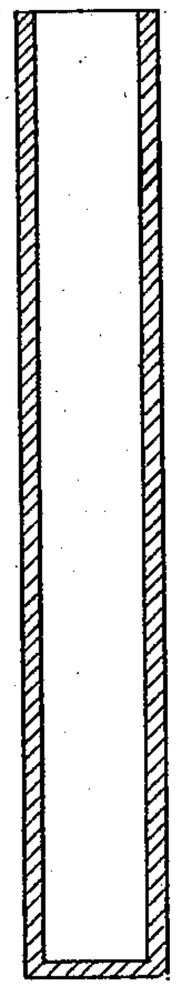

Fig. 4.

WITNESSES.

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UNITED STATES PATENT OFFICE.

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MANUFACTURE OF ELECTRICAL CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 369,144, dated August 30, 1887.

Application filed December 11, 1886. Serial No. 221,255. (No model.)

To all whom it may concern:

Be it known that I, JOHN J. WILLIAMSON, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Iron Electric Conductors and Method of Making the Same, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in explaining its nature.

This invention relates to improvement in the metallurgy of iron and steel destined to form electrical conductors, and particularly to the selection and manipulation of the materials of composite wires or those formed of two or more natures of metal, so as to get the lowest electrical resistance possible in iron or steel wire with, at the same time, a proper degree of tensile strength and toughness.

It is well known that the presence of manganese and of those metalloids most common to iron, particularly carbon, sulphur, silicon, and phosphorus, in connection with iron increases the electrical resistance of the metal and impairs it for electrical purposes. It is also well known that iron properly treated by the pneumatic process, and if the nature of the iron requires it by the basic process, is in the state called technically "blown metal," and may be practically iron in the purest condition known to the art of iron-manufacture. If care be exercised in the treatment, the metal will not be "overblown" and oxidized, which would cause difficulty in subsequent manipulations and impair its electric efficiency. The purer metallic iron is the better is its condition for an electric conductor.

Iron in the condition of blown metal excels any other form known to the arts in electrical conductivity; but it has been found very difficult, if not impossible, to successfully treat or manipulate it to obtain a commercial product except by adding to it, as is done in the Bessemer and basic processes, ingredients which impair its electrical conditions, or of stopping the process of blowing before completion and finishing the manufacture of commercial iron by puddling, which leaves it also with inferior electric conductivity. It has, however, been announced in United States Letters Patent No. 213,856 of April 1, 1879, that blown metal can be worked and merchantable iron made if it be inclosed in a close-fitting riveted and strapped box of sheet-iron. I am not aware, however, that any practical results have come of this information.

In concentric metallic electrical conductors of composite character a conductor of slight resistance inclosed in and in contact with a conductor of greater resistance is somewhat insulated by the exterior metallic shell—probably to the extent of the initial resistance.

The researches which have led to the present invention have aimed at the selection, preparation, proportioning, and combination of two different natures of metallic iron or steel, so as to produce at least expense the highest mechanical condition and greatest conductivity in electrical conductors of iron or steel.

The inclosure of steel in iron for the purpose of working and welding was described by Sanderson in English Patent No. 10,921 of 1845, and box-piling by Lees in English Patent No. 12,234 of 1848. Schuman in this country described this method in a particular application by his United States patent of May 12, 1863, No. 38,504, and in the patent granted to me No. 295,965, of April 1, 1884, the combination of two or more steels in a workable ingot was described. From this state of the art it will be observed that the mechanical operations required to practice the present invention are to a great degree old operations.

I form a box-pile or hollow ingot of iron or steel which should be capable of working hot and not "red-short" and fill it with blown metal free from the metalloids referred to and from manganese. These terms "iron" and "steel" include not only the metal made by puddling and fagotting and cast malleable metal of any percentage of carbon, but also metal purified by the pneumatic and basic processes followed by puddling, balling, &c., and what is known as "mitis," which is wrought-iron melted, slightly alloyed with aluminum, and then cast, and which can be wrought.

The proportion which the incasing metal shall bear to the inclosed metal will be determined by the condition of the inclosing metal. More is required with puddle-bar than with a purer form of iron. The purer the inclosing metal may be the higher will be the conduc-

tivity of the ultimate conductor. The inclosing metal should be neither red-short nor cold-short, and must be in sufficient relative quantity to support and sustain the inclosed metal in working both hot and cold and to allow for waste. Blown metal is apt to be exceedingly red-short, and also takes up oxygen readily, and hence it is necessary to protect it from air and support it in hot reduction. The ends of this pile or hollow ingot need not be of metal; but may be stopped during the first heating by plastic puddler's clay or sand, which will exclude the air, and after the reduction performed in the first heat the exposed end surface will be so small that it may be unprotected if inconvenient to cover it.

This plastic or sand stopping will remain in place until the heating is complete, and ordinarily until the first passes in the rolls have been taken.

Instead of pouring the blown metal into a box-pile or hollow ingot, it may be cast into a solid ingot and incased with slabs of iron or steel strapped or tied to its exterior; or a solid ingot of blown metal may be set up as a core and molten malleable metal cast round it. If a fused union between the incasing and inclosed metal be desired, the incasing metal must be capable of standing the heat and pressure of welding; but a fused union is not absolutely necessary, although preferable, as rods and wire may be made without it. A partial or imperfect union could be made by raising the temperature of the blown-metal ingot or of the casing as high as possible without deterioration before pouring the cast malleable exterior or the blown-metal interior; but I do not recommend this practice.

Usually a proportion of incasing metal should be used which shall give in the finished wire about a quarter of its section, or more, but always in sufficient quantity to shield, protect, and sustain the blown-metal interior in working and leave the finished article sufficiently strong.

As manganese in iron deteriorates greatly its electrical properties, while it increases many of its mechanical, blown metal to which spiegeleisen or manganese has been added should be avoided; but the casing may be made with a steel high in manganese on account of its mechanical qualities and comparative insulating and non-magnetic properties.

The ingot or bloom being formed is worked into billets and wire rod by hot-rolling and then wire-drawn into wire. The cold-working of the blown metal does not injure its electrical quality, but improves its mechanical properties for electric conductors.

In the drawings, Figure 1 shows in perspective a part of a box-pile filled with blown metal and having the end stopped with clay, a portion of the clay being broken out to represent the blown metal. Fig. 2 is a view representing in perspective a billet. Fig. 3 is a vertical section of the electric conductor or wire. Fig. 4 is a view in section of a malleable ingot having a hollow core, into which the blown metal is adapted to be poured, and it takes the place of the box represented in Fig. 1.

I claim as my invention and desire to secure by Letters Patent of the United States—

1. A composite ingot or bloom of two concentric layers of metallic iron or steel, in contact with or welded to each other, of different natures, the exterior layer of which is ductile and malleable when hot and the interior of which is blown metal practically free from manganese and the metalloids, carbon, sulphur, silicon, and phosphorus, substantially as and for the purpose described.

2. Composite billets and rods for making electrical conductors of two natures of metallic iron or steel, the exterior layer of which is ductile and malleable when hot and the interior of which is blown metal practically free from phosphorus, sulphur, carbon, silicon, and manganese, substantially as and for the purpose described.

3. Wire for electrical conductors formed of an interior of blown metal, which is metallic iron free from phosphorus, sulphur, silicon, carbon, and manganese incased in a shell of malleable and ductile iron or steel which may contain these elements, substantially as and for the purpose described.

4. The electrical conductor of iron or steel having two natures of metal in its composition arranged concentrically, the exterior of which is ductile and malleable at high temperatures and the interior of which is blown metal practically free from phosphorus, sulphur, silicon, manganese, and carbon, substantially as and for the purpose described.

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Witnesses:
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