J. F. MONNOT.

COMPOUND METAL BODY AND PROCESS OF MAKING SAME.

APPLICATION FILED NOV. 26, 1907. RENEWED JUNE 16, 1909.

947,392. Patented Jan. 25, 1910.

Fig. 1.

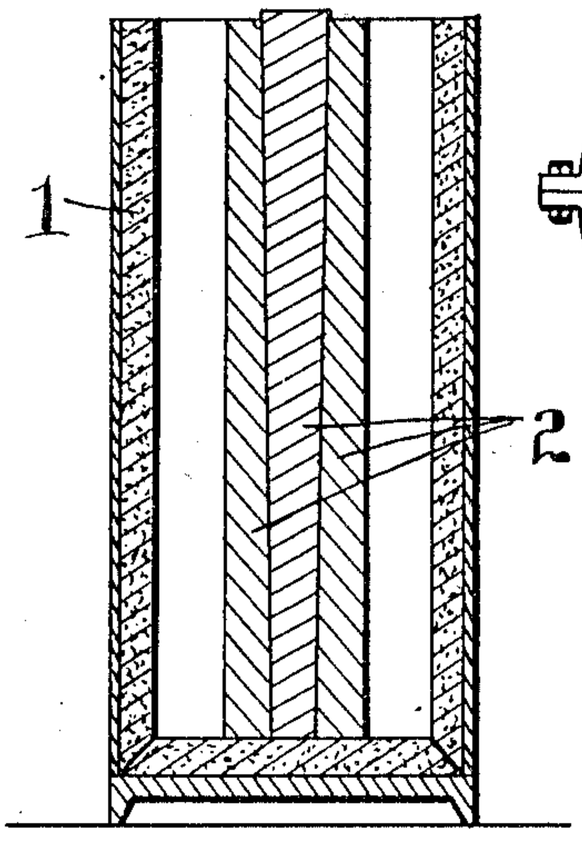


Fig. 2.

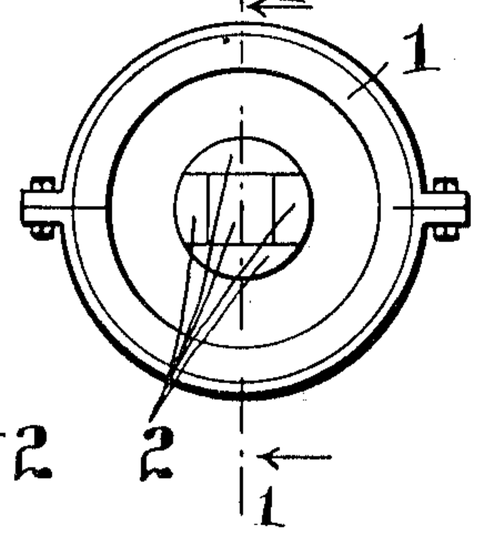


Fig. 3.

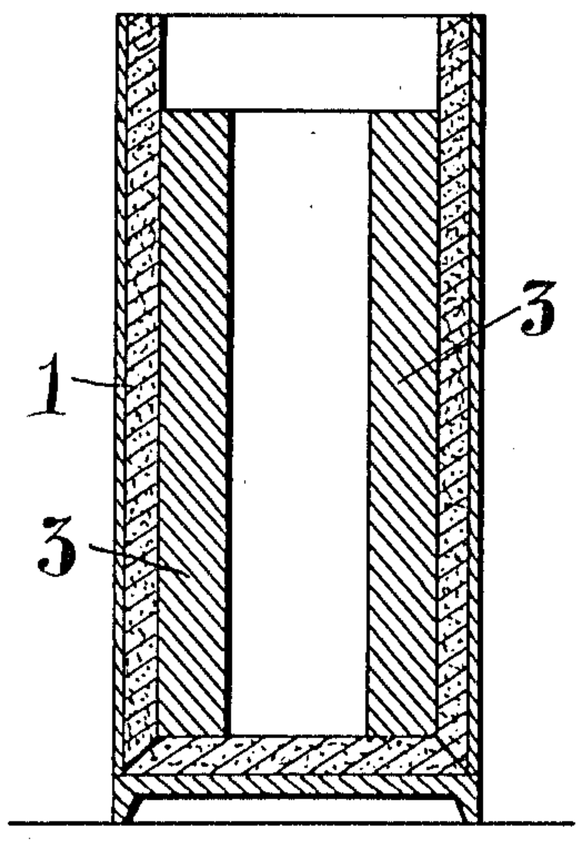


Fig. 6.

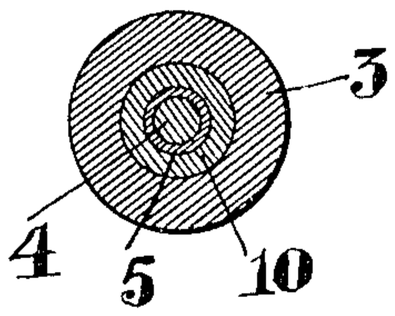


Fig. 4.

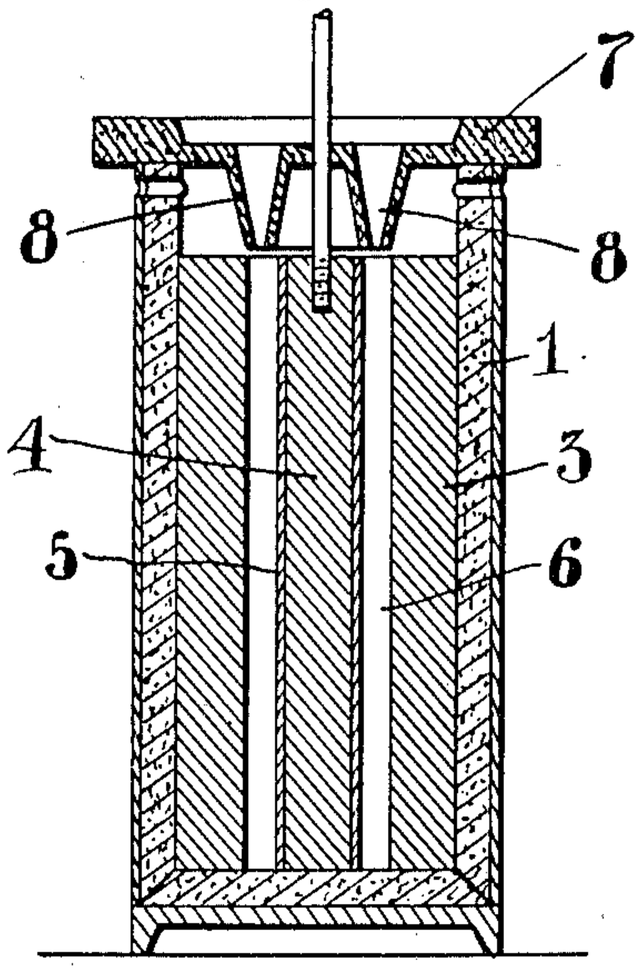
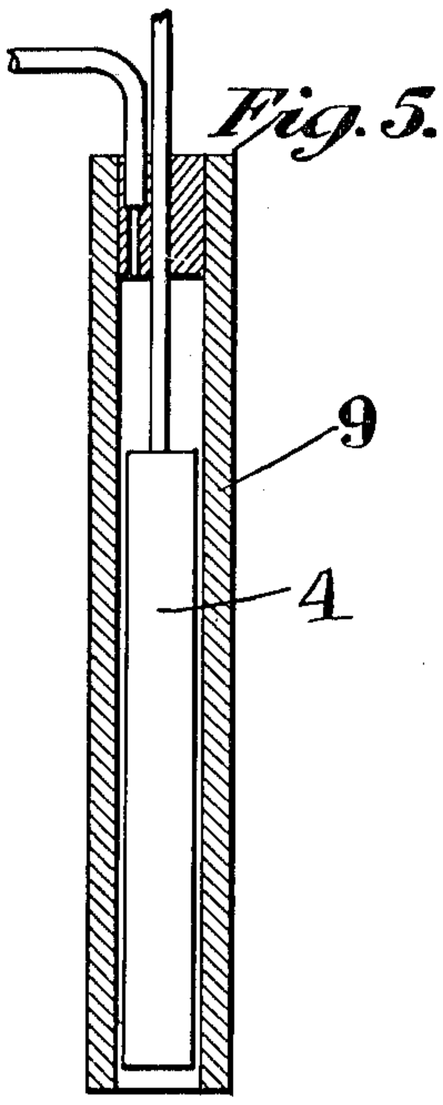


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN FERREOL MONNOT, OF NEW YORK, N. Y., ASSIGNOR TO DUPLEX METALS COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

COMPOUND METAL BODY AND PROCESS OF MAKING SAME.

947,392. Specification of Letters Patent. Patented Jan. 25, 1910.

Application filed November 26, 1907, Serial No. 403,881. Renewed June 16, 1909. Serial No. 502,445.

To all whom it may concern:

Be it known that I, JOHN FERREOL MONNOT, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Compound Metal Bodies and Processes of Making Same; and I do hereby declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a process for producing ingots and like bodies of compound metals and to compound metal bodies produced thereby, and more particularly to a process for producing clad metals, by which term is meant bodies comprising a core or base of one metal, (iron or steel for instance) having united thereto and preferably inseparably united or welded thereto, a substantial coating of an unlike metal, (for instance, copper, silver, gold, aluminum, brass, bronze, aluminum bronze, etc.); and to the clad metals produced thereby.

In Patents Nos. 851,684, 851,993 and 853,716, and in various pending applications, including particularly applications Sr. Nos. 281,680, filed October 6, 1905, 391,673 filed September 6, 1907 and 400,843 filed November 5, 1907, I have illustrated and described apparatus and processes for producing clad metal bodies such as referred to, and comprising various pairs of unlike metals such as referred to inseparably welded together, the pairs of metals being in some cases united by an intermediate thin layer of a third metal inseparably welded to both.

The process set forth in my Patent No. 853,716 and in various of my applications, is based upon the discovery by me that when a clean metallic surface of one metal (iron or steel for example) is contacted momentarily with a molten body of an unlike metal (copper for example) maintained at a temperature far above the melting and ordinary casting temperatures, and in what appears to be an active condition to which, in said patent, I have applied the term "supermolten condition," the said supermolten metal will unite to the first metal by a union equivalent to and probably constituting a true weld union, the metals so joined being inseparable, after the molten metal has solidified and cooled, by any mere stripping action such as may be exerted by means of a cold chisel or by changes of temperature or other treatment which usually suffices to separate metals which are merely adherent and not coherent to each other.

It is well known that in order to obtain high electrical conductivity in highly conductive metals, such as copper, silver and the like, extreme purity of the said metal is necessary; a small fraction of one per cent. of impurity in copper reducing the conductivity of the copper enormously. While there is no particular difficulty in casting copper in the ordinary manner, and at ordinary casting temperatures, into molds, even into iron molds and obtaining thereby ingots substantially as pure as was the metal when cast, it is found extremely difficult to maintain high purity of supermolten copper united to iron or steel by the processes of my said former applications; the supermolten copper appearing to have an action, solvent or otherwise, on the iron or steel, which is lacking with copper at the ordinary casting temperature and which results in the penetration of traces of iron a considerable distance into the supermolten copper; such penetration occurring even when the copper mass in supermolten condition is in contact with the iron or steel for a few seconds only. The object of the present invention is to overcome this difficulty and to produce ingots, bars, wires, etc., the main portion of which is uncontaminated by metal from the core or base to which the cast metal is united.

According to the process herein described, a coating of substantially uncontaminated metal, copper for instance, is applied to an iron or steel base or core, in the following manner: A suitable mold such as is commonly used in making copper ingots of the desired size, is provided with a collapsible and removable core, and molten copper of the desired degree of purity is cast into the annular space between this core and the sides of the mold, such casting being done at ordinary casting temperature so that there may be no action of the molten copper upon the said core or upon the sides of the mold if, (as is permissible) such mold be of iron. Meanwhile, a core or base of metal to be coated (steel for example) has applied to it by processes such as set forth in my said Patent No. 853,716 or my said application Sr. No. 400,843 filed Nov. 5, 1907, or any

other process by which absolute union can be assured, a coating of suitable metal, usually the same as that of the main coating to be formed on it. As soon as the metal in the mold has solidified, the collapsible core is removed and the object coated as just described is inserted in its place, such object and its coating being of such diameter that there remains between the coating and the cast annulus in the mold, a slight space into which molten metal may be poured. Molten metal, usually the same metal as that from which the said annulus was cast, is then poured into this annular space. When this last body of metal solidifies it unites the cast annulus and the coating of the object within the annulus, so uniting all into one unitary mass. The metal is then compacted by working in the usual manner, that is to say, by rolling, pressing, drawing through dies or the like. By proceeding in this manner contact of the supermolten metal with the unlike metal of the base is avoided in forming the main body of the coating, and therefore there can be no contamination of the main portion at least of the coating as it finally exists, with metal from this base.

The accompanying drawings illustrate more or less diagrammatically, the carrying out of my said process and show apparatus such as may be used in carrying it out.

In said drawings: Figure 1 shows a central vertical section of a mold such as may be used for casting the said annulus and a collapsible core within it; Fig. 2 shows a top view of the same parts, the core being in place; Fig. 3 shows a central vertical section of the mold and cast annulus after the collapsible core has been withdrawn; Fig. 4 shows a section of the said mold and annulus with the thinly coated base in place therein ready for the pouring of the molten metal to unite such base and annulus; and Fig. 5 shows a central vertical section of the thinly coated base as prepared for insertion within the said cast annulus. Fig. 6 shows a transverse section of an ingot such as produced by the process herein described.

In the drawings, 1 designates a mold such as may be used for forming pure coper ingots, and 2 designates a collapsible core comprising a plurality of sections of tapering form which may be removed separately; the mold and the core as a whole having no draft. Into this mold molten coating metal of the desired purity is cast to form an annulus 3. The sections of the core 2 are then withdrawn. Meanwhile, a billet 4 of steel or other metal forming the base has a thin coating formed on it by a process which will unite the metal of such thin coating firmly to the said base 4, such metal of the thin coating being usually the same metal as that of which the annulus 3 is formed; though in certain cases, as hereinafter explained, it may be a different metal. In this particular instance it will be assumed that the metal of such thin coating is copper. Said thin coating may be formed on base 4 by merely dipping the base momentarily in supermolten copper and then withdrawing the base under conditions precluding oxidation, or a somewhat thicker coating may be formed by "segregating" a thin layer of the supermolten metal by the method described in my said Patent No. 853,716, or by first film coating the base by momentary contact with supermolten coating metal and then coating a thicker coating upon such film coating by the method set forth in my said application filed November 5, 1907 Sr. No. 400,843. While the annulus 3 is still very hot, and while the base 4 and the coating 5 formed thereon as just described, are also still very hot, said coated base is inserted within the annulus, and molten metal, usually the same metal as that of which the annulus is formed, is poured into the annular space 6 (Fig. 4) between said base and the annulus 3. This metal last poured need not be supermolten as it will unite readily at ordinary casting temperature to the metal of the annulus 3 and also to the coating of the base 4. It should, however, be quite hot in order that it may be highly fluid and may fill the said annular space completely; and to avoid washing away of the metal of the annulus or of the coating of the base, the molten metal to fill this annular space 6 should preferably be poured directly downward. For this purpose means may be used such as indicated in Fig. 4, comprising a pouring tile 7, of suitable refractory material, having suitable ducts 8 directed toward the annlar space 6. The casting of the metal in this annular space 6, and also the casting of the metal of the annulus 3 should preferably be conducted as described in my applications filed September 6, 1907, Sr. No. 391,673 and Sr. No. 391,674, namely, by casting through a body of molten "wiping liquid" which in this case may be cyanid of potassium or other neutral body of suitable melting point, such wiping liquid having the effect of freeing the molten metal cast through it from oxid impurities, entrained and occluded gases etc., and also of dissolving off from the surfaces of the annulus and the coated base any traces of oxid impurities thereon; or I may provide the surface of the annulus and the coating of the base with a protective coating of suitable material, such as zinc chlorid, which will be driven off by the heat of the molten metal. The coated base 4 is preferably transferred from the point where its thin coating is applied to it, to the said mold 1, under conditions precluding oxidation of its surface, for example, its surface may be covered with a flux-coating such as may be formed by drawing it through a bath

of molten flux or like metal, as described in my said application filed Nov. 5, 1907 Sr. No. 400,843, or the transfer may be effected in a bell jar such as illustrated in my said Patent No. 853,716 and also indicated more or less diagrammatically in Fig. 5, such bell jar being filled with a non-oxidizing or protective atmosphere (such as producer gas made from charcoal). In Fig. 5 9 designates the said bell jar. If the thin coating of the billet be of copper, as assumed, and if the annulus be of copper, as also assumed, it will be seen that molten copper cast into the annular space 6 will unite readily with the highly heated but solid surfaces of copper on both sides, uniting both bodies of copper into one.

In some cases, for example, when the main portion of the final coating is to be of a metal of relatively low melting point or containing a readily volatilizable ingredient, for example, when the metal of the main coating is to be of brass, the metal of the thin coating 5 formed on the base 4, may be a metal capable of being heated to a supermolten temperature at which it will unite with steel, and with which the brass readily unites, for example, copper; and in such case the metal poured into the annular space 6 may be either molten brass or molten copper. Likewise, if the coating to be formed is to consist mainly of aluminum, the annulus 3 may be cast from aluminum, the thin coating 5 may be copper and the metal cast into the annular space 6 may be either molten aluminum or molten copper.

The product of the process above described consists, as will be seen, of a core or base of one metal having weld united thereto a coating of an unlike metal, an annulus of relatively pure metal surrounding said core and an intermediate layer of metal uniting said annulus and weld-coating, all of these various layers of metal being firmly and inseparably united. If the annulus, uniting layer, and the first coating of the ingot be all of the same metal, in general such different layers will be indistinguishable one from another, except that probably a cross section of such a core, properly etched, will upon examination under the microscope disclose the different layers of metal. But if the intermediate or binding layer be a different metal from the annulus 3 and first coating of the core, (for example, if said binding layer be of aluminum, the annulus and the first coating of the core being of copper) the three layers of compound coating will be clearly distinguished from each other, although the metals will be so united as to be, for practical purposes, one integral mass. Fig. 6 shows a cross section of a compound metal object (wire for example) such as may be produced by extending an ingot produced as above described, 4 designates the base, 5 the first coating thereof, 3 the main coating or annulus and 10 the uniting layer.

It will be seen that extremely high conductivity of the metal of the annulus 3 and uniting layer 10 may be insured in objects produced as described herein, since the metal of these layers has no opportunity whatever to contact with the metal of the base 4.

What I claim is:—

1. The process of producing compound metal bodies which comprises applying to a body to be coated a protective layer of an unlike metal, assembling with the object so coated a solid body of the desired coating metal spaced away from said object and while both said body and said object to be coated are hot, casting into the space between them a molten body of metal capable of uniting with said body of coating metal and the said protective coating of the object to be coated, and permitting the metal so cast to solidify.

2. The process of producing compound metal bodies which comprises applying to a body to be coated a protective layer of an unlike metal, assembling concentrically with the object to be coated a solid body of the desired coating metal spaced away from said object and while both said body and said object to be coated are hot, casting into the space between them a molten body of metal capable of uniting with said body of coating metal and the said protective coating of the object to be coated, and permitting the metal so cast to solidify.

3. The process of producing compound metal bodies which comprises applying to a body to be coated a welded on protective layer of an unlike metal, assembling with the object so coated a solid body of the desired coating metal spaced away from said object and while both said body and said object to be coated are hot, casting into the space between them a molten body of metal capable of uniting with said body of coating metal and the said protective coating of the object to be coated, and permitting the metal so cast to solidify.

4. The process of producing compound metal bodies which comprises applying to a body to be coated a welded on protective layer of an unlike metal, assembling concentrically with the object so coated but spaced away therefrom a solid body of the desired coating metal and while both said body and said object to be coated are hot, casting into the space between them a molten body of metal capable of uniting with said body of coating metal and the said protective coating of the object to be coated, and permitting the metal so cast to solidify.

5. The process of producing compound metal bodies which comprises weld coating a ferrous metal base with a non-ferrous metal of high melting point, assembling with

the base so coated a body of the desired coating metal of the character desired spaced away from said base, and while both are hot casting in the space between them a body of molten metal capable of uniting with both the coating of said base and with the said body of coating metal, and permitting the molten metal so cast to solidify.

6. The process of producing compound metal bodies which comprises weld coating a ferrous metal base with a non-ferrous metal of high melting point, assembling with the base so coated a body of copper spaced away from said base, and while both are hot casting in the space between them a body of molten metal capable of uniting with both the coating of said base and with the said copper body, and permitting the molten metal so cast to solidify.

7. The process of producing compound metal bodies which comprises weld-coating a ferrous metal base by contact with a supermolten mass of non-ferrous coating metal of high melting point, forming an annulus of the desired coating metal somewhat larger than said weld-coated base and while both said annulus and said coated base are highly heated placing the base within said annulus and pouring into the space between its coating and the said annulus, a molten metal capable of uniting both with said coating and with said annulus, and permitting the molten metal to solidify.

8. The process of producing compound metal bodies which comprises weld coating a ferrous metal base by contact with supermolten copper, forming an annulus of copper somewhat larger than said weld-coated base and while both said annulus and the coated base are hot placing said base in the annulus and casting molten copper into the space between them and permitting the metal so cast to solidify.

9. The process of producing compound metal bodies which comprises weld-coating a ferrous metal base by contact with a supermolten mass of non-ferrous coating metal of high melting point, forming an annulus of the desired coating metal somewhat larger than said weld-coated base and while both said annulus and said coated base are highly heated, placing the base within said annulus and pouring molten metal into the space between its coating and the said annulus, through a layer of wiping material, and then permitting the metal so cast to solidify.

10. The process of producing compound metal bodies which comprises weld coating a ferrous metal base by contact with supermolten copper, forming an annulus of copper somewhat larger than said weld-coated base and while both said annulus and the coated base are hot, placing said base in the annulus and casting molten copper into the space between them through a layer of wiping material, and permitting the metal so cast to solidify.

11. A compound metal body comprising a ferrous metal base and an annular body of non-ferrous metal surrounding said base and united thereto by a weld-coating of non-ferrous metal on the base, and a layer of metal intermediate said weld-coating and annulus and united to both.

12. A compound metal body comprising a ferrous metal base and a copper annulus surrounding said base and united thereto by a weld-coating of copper on said base and a layer of copper intermediate said annulus and weld-coating and united to both.

In testimony whereof I affix my signature, in the presence of two witnesses.

JOHN FERREOL MONNOT.

Witnesses:
H. M. MARBLE,
K. P. MCELROY.