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PROCESS OF PRODUCING COATED METAL OBJECTS.

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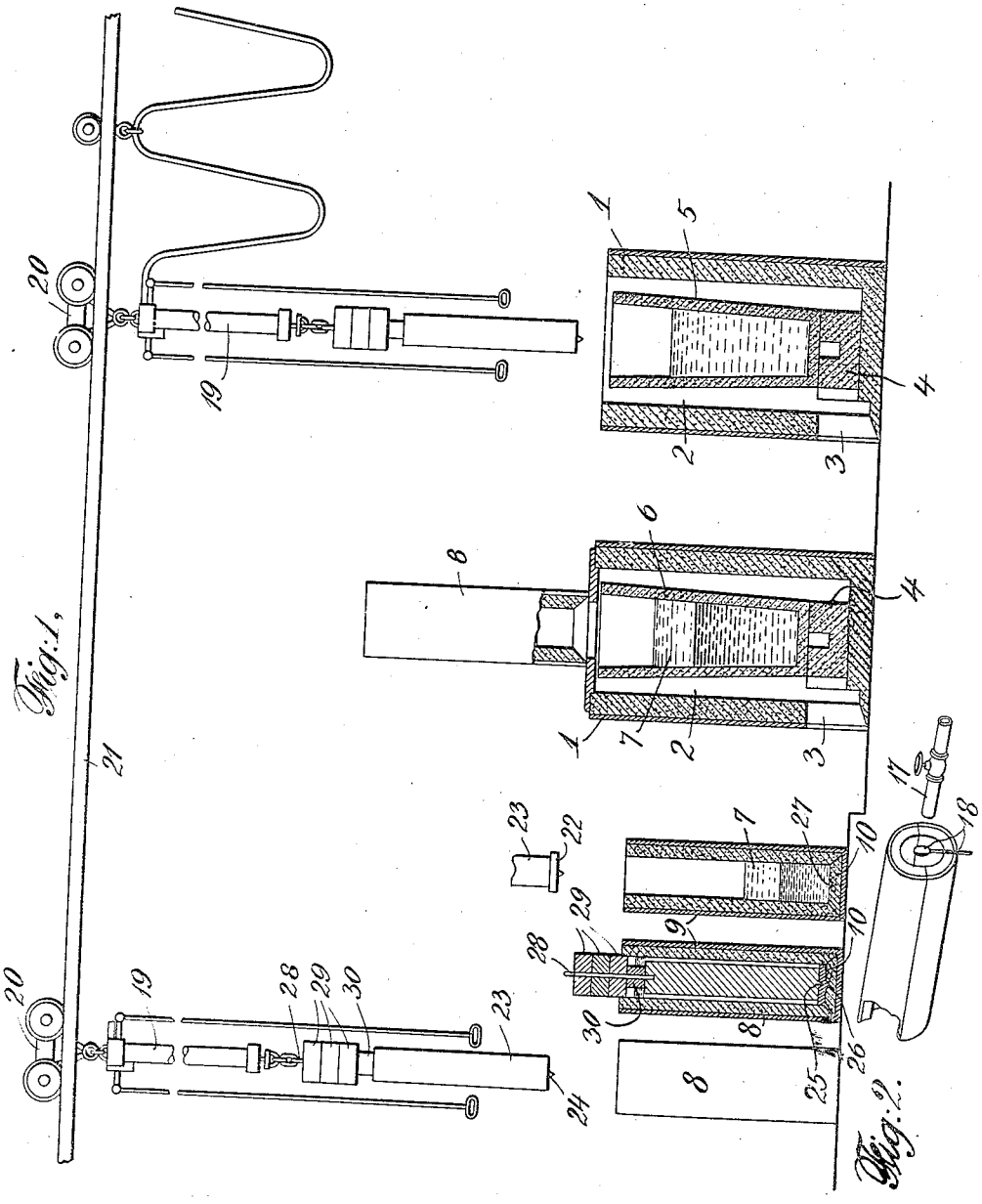

Fig. 1.

Fig. 2.

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PROCESS OF PRODUCING COATED-METAL OBJECTS.

1,042,586. Specification of Letters Patent. Patented Oct. 29, 1912.

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To all whom it may concern:

Be it known that I, JOHN FERREOL MONNOT, a citizen of the United States, and a resident of Paris, France, have invented certain new and useful Improvements in Processes of Producing Coated-Metal Objects; and I hereby declare the following to be a full and exact description thereof, such as will enable others skilled in the art to which the invention pertains to make and practise the same.

My invention relates to a process for producing ingots and like bodies of coated metals, 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.)

In Patents Nos. 851,684, 851,993, 853,716, 971,136 and 929,777, I have illustrated and described apparatus and process 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 present process comprises an improved method of applying coatings and of producing clad metal bodies such as referred to.

According to the process herein described, I submerge a cleaned core or billet in a bath of unlike metal maintained in the highly heated condition termed in my Patent 853,716 the "supermolten" condition, that is at a temperature relatively high with respect to its melting or ordinary casting temperature, and after momentary contact of such core or billet with such supermolten metal, said core or billet is withdrawn covered with a clinging film of the metal of the bath, protected as hereinafter described from oxidation, and introduced into a mold previously charged as herein described, with a proper mass of molten coating metal which likewise may be at a temperature very much above its melting or its ordinary casting temperature. The molten metal in this mold is then permitted to solidify on the core or billet and after solidification the ingot thus produced is worked, usually after submission to a soaking heat. Preferably the core or billet to be coated is preliminarily heated, before submersion in the first or supermolten bath; and this preliminary heating is conveniently conducted in a bath of highly heated fusible mineral material such as borax, water glass or a mixture of both, or a bath of lead covered with flux. In this heating it is not necessary that the steel should be heated uniformly throughout; it is sufficient if the billet acquires a high temperature superficially. The surface of the supermolten metal is preferably covered and protected from oxidation by a molten layer of similar fusible mineral material, whereby the billet when withdrawn from the supermolten bath will be covered with an adhering coating of such mineral material, serving to protect the highly heated surface of the said billet from oxidation; and the charge of molten metal in the mold is also preferably covered with a similar protective layer of fusible mineral material, such layer and the molten metal in the mold being of such temperature that when the billet is dipped into the molten metal in such mold the protective coating on its surface will be progressively removed exposing a clean metallic surface to contact with the molten metal in the mold.

As explained in my said Patent No. 853,716, when a clean metallic surface is contacted momentarily with a body of supermolten unlike metal and then withdrawn from such contact, it is covered with a thin film of cohering metal from said supermolten bath, there being perhaps an intermediate layer of alloy between the metal of the billet and the metal derived from the bath; the film coating so formed being united to the surface of said billet by a union equivalent to, and probably constituting, a weld union. Such coating so applied after solidification is inseparable from the billet by temperature changes, as by quenching after heating; or by anything short of the action of abrasives, solvents or sufficient heat to melt the coating bodily. In most cases the metal of the filming bath is the same as that to be subsequently applied to form the main coating or is a component of such second metal in case the main coating metal be an alloy; and in either case the metal of the main coating will unite readily to this film

coating. In cases where the metal of the film coating is a different metal from that of the main coating, the metal chosen for the film coating is one with which the metal of the main coating would readily unite. For example, when the main coating is to be one of commercial grades of silver, the film coating may be copper.

In the accompanying drawings I illustrate more or less diagrammatically, apparatus such as may be used in carrying out my invention.

In said drawings: Figure 1 is a view showing said apparatus in elevation and partly in sectional elevation; and Fig. 2 is a detail perspective view illustrating a method of preliminarily heating the molds.

In said drawings, 1, 1 designate heating furnaces comprising heating chambers 2, and provided with an opening 3 through which a flame jet may be projected from a suitable burner not shown, the flame being caused to impinge against a suitable pedestal or spreader 4 and then to rise up through the chamber, finally passing therefrom through an opening in the top thereof. Within said furnaces are crucibles, 5 and 6, of which 5 customarily contains the molten material (flux, lead, etc.) for preliminarily heating, and crucible 6 customarily contains the supermolten filming bath, the surface of the metal in crucible 6 being protected by a layer 7 of fusible mineral material such as referred to. Within convenient range of the furnace are one or more molds 8, which may conveniently have a body of a highly refractory material, such as carborundum mixed together with a small amount of binder such as sodium silicate (water glass) fire clay, lime or a mixture of two or more of these substances, surrounded by an outer metal jacket 9. Said molds also have bottoms 10 of similar material. It is desirable that these molds be made in two or more sections held together by suitable fastening. They may advantageously be made with any "draft" and in three sections. Suitable molds for the present purpose are described in my Patent 928,470. Before charging these molds with molten metal, and in order to avoid chilling of the molten metal by these molds, they are commonly heated to a high temperature. To this end they may be placed over furnaces 1, as shown in Fig. 1, so that the flame and heat of these furnaces passes through them; or, as illustrated in Fig. 2, a flame from a suitable burner 17 may be directed axially through the mold, and spread out so as to lick the inner surface of the mold, by a suitable spreader 18 of refractory material. Customarily the molds are heated to or nearly to a red heat inside before the introduction of the molten metal; but so low is the heat conductivity of the granular carborundum compacted as described that it may be so heated at the inner surface of the mold without materially weakening the metal jacket 9.

For handling the billets any convenient means may be provided or they may be raised and lowered by hand by means of suitable porter bars or tongs. I have illustrated for handling the billet, an ordinary pneumatic hoist 19 carried by a truck 20 running on a track 21. Accurate centering of the billets in the mold is desirable; and likewise it is necessary, in many cases, particularly when electric conductors are to be made from the coated billets, to guard against solvent action of the metal in the mold on the billet; for supermolten copper, for example, appears to have a marked solvent action on steel, or at least on highly heated steel, and as is well known, the presence of a very small percentage of iron in copper reduces the electric conductivity of the copper enormously; so that it is often necessary to guard against contamination of the metal in the molds by metal dissolved from the billets. To guard against this, and to insure accurate centering of the billets in the molds, I commonly provide each billet, before the billet is introduced into the mold, with a bottom piece 22 of refractory material (compacted carborundum for example or graphite) said bottom piece being centered with respect to the billet (23) by means of a centering point 24 on said billet entering a centering recess 25 of the bottom piece; and said bottom piece is in turn provided with a centering point 26 adapted to enter a centering recess 27 in the bottom of the mold. The bottom piece 22 is affixed by being pressed up against the bottom of the billet after said billet has been withdrawn from the filming bath 6 and will be adhesively held to said billet by the action of the coating of flux or protecting material adhering to the surface and lower edge of the billet. Said bottom piece is slightly larger in diameter than the said billet and therefore serves not only to prevent contact of the molten metal in the mold with the possibly unfilmed end face of the billet, but also to prevent erosion of the billet by the molten metal in the mold as the billet is lowered into such molten metal. As will be seen, by conducting operations in this manner, contact of the metal in the mold with the metal of the billet is absolutely avoided, such metal in the mold contacting only with the film coating on the surface of the billet. This film coating being extremely thin, and constituting an infinitesimal portion of the coating finally formed, slight contamination of the metal of the filming bath with metal dissolved from the billets is not material; and such contamination of the metal in the filming bath will be slow, because the billets

when introduced in the filming bath will ordinarily be considerably lower in temperature than said bath and will be removed from said bath by the time they have acquired superficially approximately the temperature of such bath, the billets remaining in the filming bath only a few seconds ordinarily, and being raised to the temperature of such bath superficially only.

To insure submersion of the billets in the molten metal, the porter bar 28 by which the billet is handled customarily carries weights 29. Between these weights and the billet there will commonly be a collar or spacing piece 30, of less diameter and of refractory material. It is important that there shall be an excess of molten metal in the mold above the billet to supply metal to compensate for shrinkage of the copper; and such excess is provided for by making the collar 30 of relatively small diameter, so as to have considerable space in the mold and above the billet for molten metal.

It is highly important that the molten metal in the mold shall be of good quality when introduced therein; that is to say, that it shall not contain oxid, and entrained or occluded gases; therefore I customarily pour said molten metal into the mold through a layer of molten "wiping liquid" as set forth in the specification of my Patent No. 929,777, which "wiping liquid" may be of the same nature as the protective material on the surface of the supermolten bath. Such wiping material, in molten or solid state, is first placed in the mold, and then the molten metal is poured into the mold, displacing the wiping liquid as it flows to the bottom of the mold, and being wiped free by such wiping liquid of all entrained gases, superficial oxid, etc. In addition I commonly pole the molten metal while in the mold and just before the introduction of the billet.

As a specific illustration of my process, I will cite the making of copper-coated billets—billets from which electric conductors are to formed, for example, by my process. A steel billet or base of suitable size, the surface of which has preferably been thoroughly freed from oxid, scale, etc., as by sandblasting, is immersed in the preliminary heating or flux bath 5, and when sufficiently heated therein, say to a red heat, is removed from that bath and immersed in the supermolten metal in crucible 6, said metal (copper) having a temperature as nearly as I am able to determine, of from 2400 to 2800 degrees F.; though in practice it is not necessary to know the temperature in degrees, as the workmen soon learn to know from the surface appearance when the metal is at the proper temperature, and also it is easy to introduce test pieces and then, withdrawing them and allowing them to cool under conditions precluding oxidation, determine whether the film of copper formed on such test pieces is firmly welded on, as it will be if the metal is supermolten. The heated steel billet, in passing down through the protective coating 7, is freed of any superficial oxid it may have upon it, so that a true metallic surface is exposed to the supermolten metal. After the billet has remained in the supermolten metal for a time, say 30 seconds (too prolonged contact is injurious, the copper attacking and "rotting" the steel—but the exact duration of the contact varies somewhat according to the temperature to which the billet has been heated in bath 5) said billet is withdrawn; and as it emerges a layer of protective material from the coating 7 adheres to and covers its surface, preventing oxidation of the thin welded-on coating formed by the supermolten metal. The coated billet is then fitted with the bottom piece 22 and is introduced into a mold 8, previously heated and charged with highly heated molten copper purified as described by being poured through a layer 7 of protective "wiping" material and by poling and, if desired, by the addition of a deoxidizing reagent, such as is well known; for example, metallic magnesium. As the billet descends the coating 7 wipes from it all adhering air or gases, and said coating, or the metal beneath, melts off the adhering protective coating which it has carried with it from the supermolten bath, so exposing a true metallic surface of the film coating to the molten metal in the mold. Said molten metal, being partly displaced, rises up along the surface of the billet, filling the space between said billet and the surface of the mold, the upper portion of such molten metal finally filling, partly or completely, the space around the collar 30. The billet is centered at the bottom through the entry of the point 26 into the recess 27 in the bottom of the mold; and at its upper end the billet may be centered by means well known to molders. The molten metal is then permitted to solidify; and as it does so, the molten metal around the collar 30 supplies any deficiency in molten metal due to contraction of the metal below as it solidifies. When the cast metal has solidified, the coated billet is removed and is worked, or extended, in a direction parallel to the weld formed; such working being by rolling, pressing, hammering, forcing through dies, etc., and being done either immediately or after the billet has been subjected to a "soaking" heating. Since the mold has no draft, vertically, the mold itself is parted to permit the removal of the billet; after which the surfaces of the mold are dressed or re-surfaced, if necessary, and the mold is in condition for use again.

The metal in the mold need not be precisely at the supermolten temperature, when

the billet is introduced, but must be at a temperature high enough to enable it to melt off the adhering protective coating of fusible mineral material on the billet, and is preferably at nearly the supermolten temperature. The layer 7 above it enables it to be at this temperature for some time without loss of purity.

As the molten metal rises along the surface of the billet the bottom piece 22 prevents contact of the molten metal with the bottom of the billet and tends to prevent erosion of the surface of the billet by the molten metal, so avoiding solution of iron from the billet in the molten metal, and preserving such molten metal in the desired condition of purity.

Instead of using carborundum-lined molds as above described, I may use molds lined with compacted carbon the material of which is similar to that of the ordinary electric light carbons. This material formed in slabs under pressure, is exceedingly hard and strong and likewise can be furnished with true surfaces. I preferably use it in the form of slabs as described in my Patent 928,470.

What I claim is:—

1. The process of producing compound metal objects which comprises film coating the object to be coated by submerging same momentarily in a bath of supermolten coating metal having a covering of molten protective material, withdrawing said object from such bath with an adhering coating of such protecting material therearound, and introducing such object so protected into a mold containing molten coating metal at a temperature high enough to melt the protective coating on such film-coated object, and permitting such molten metal to solidify on the film coating.

2. The process of producing compound metal objects which comprises film coating the object to be coated by submerging same momentarily in a bath of supermolten coating metal having a covering of molten protective material, withdrawing said object from such bath with an adhering coating of such protecting material therearound, and introducing such object so protected into a mold containing molten coating metal and a supernatent layer of protective material at a temperature high enough to melt the protective coating on such film-coated object, and permitting such molten metal to solidify on the film coating.

3. The process of producing compound metal objects which comprises film-coating an object to be coated by submerging same in a bath of supermolten coating metal, withdrawing said object from said bath under conditions precluding oxidation, applying to its end a protector of larger diameter and immersing said object with such protector thereon in molten metal contained within a suitable mold and by means of such protector preventing solvent action of such molten metal on the end of the object to be coated and erosion of sides of the object by such molten metal.

4. The process of producing compound bodies of unlike metal welded together, which comprises heating the object to be coated in a bath of molten relatively neutral material, and thereby avoiding contamination of the surface of such object, removing said object from such bath and immersing same in a bath of supermolten unlike metal, and thereby forming a film coating thereof on the surface of said object, and then causing a body of molten coating metal of substantial thickness to solidify on such film coated surface.

5. The process of producing compound bodies of unlike metals welded together, which comprises heating the object to be coated in a bath of molten relatively neutral material, and thereby avoiding contamination of the surface of such object, removing said object from such bath and immersing same in a bath of supermolten unlike metal and thereby forming a film coating thereof on the surface of said object, and then removing the film coated object from such bath and immersing same in a mold containing molten coating metal and permitting such coating metal to solidify against its film-coated surface.

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

JOHN F. MONNOT.

Witnesses:
H. M. MARBLE,
D. A. DAVIES.