No. 894,163. PATENTED JULY 21, 1908.

J. F. MONNOT.

COMPOUND METAL BODY AND PROCESS OF PRODUCING SAME.

APPLICATION FILED APR. 17, 1907.

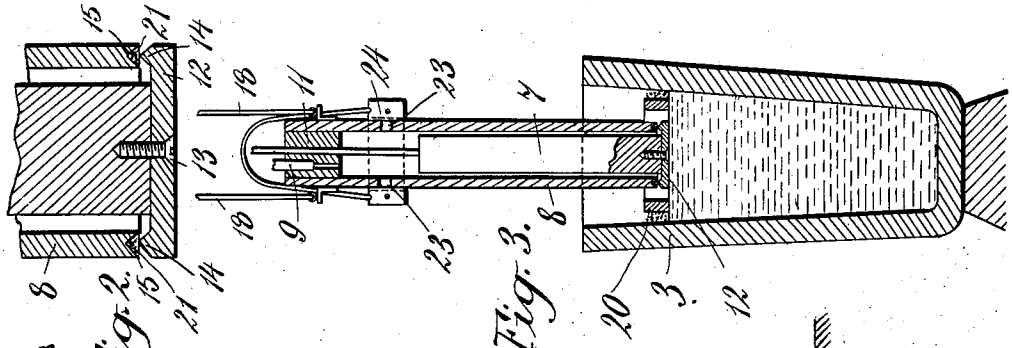


Fig. 2.

Fig. 3.

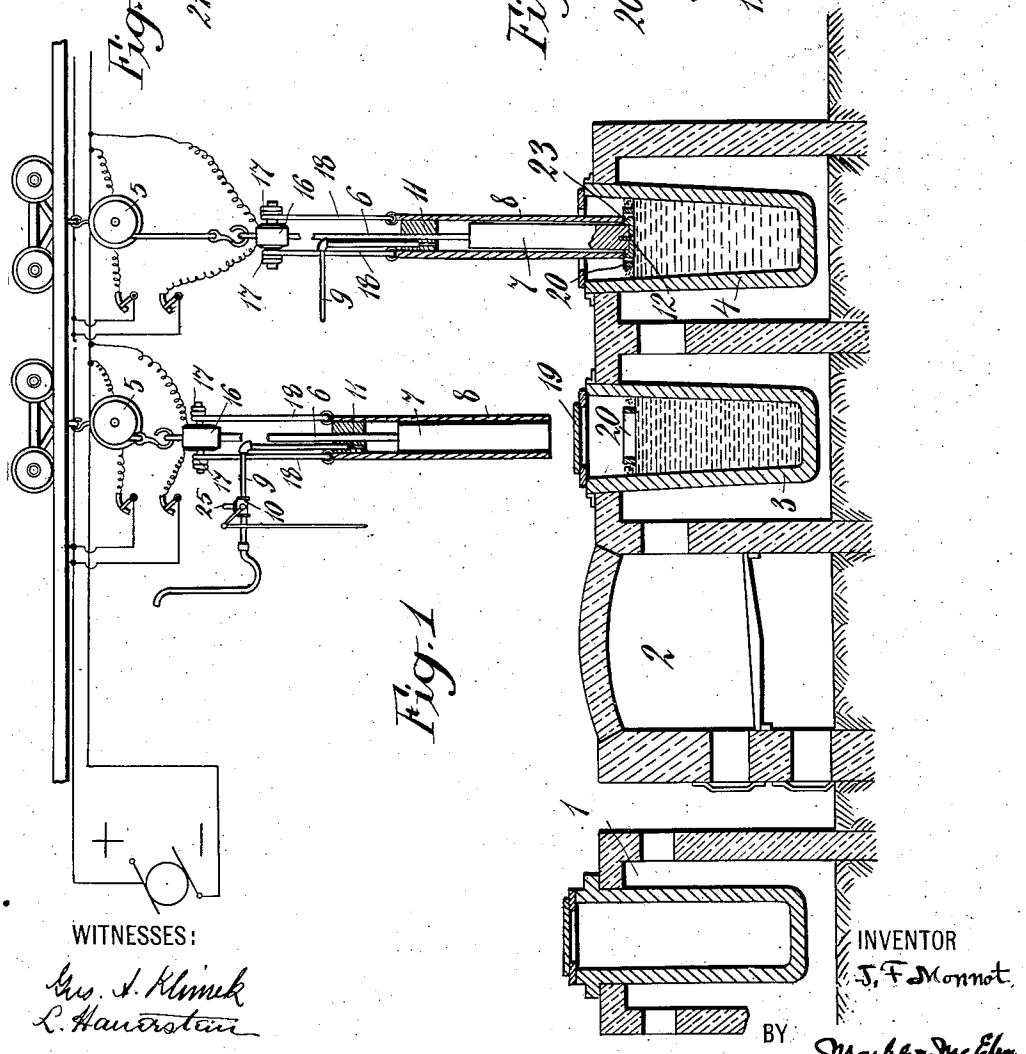


Fig. 1.

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COMPOUND METAL BODY AND PROCESS OF PRODUCING SAME.

No. 894,163. Specification of Letters Patent. Patented July 21, 1908.

Original application filed September 6, 1906, Serial No. 333,570. Divided and this application filed April 17, 1907. Serial No. 368,770.

To all whom it may concern:

Be it known that I, JOHN F. 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 Improvements in Compound Metal Bodies and Processes of Producing 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.

This invention relates to compound metal bodies and processes of producing the same, and consists in a compound metal body comprising a metal of relatively low melting point or volatilization point, or an alloy or metal-mixture containing such a metal, permanently and indissolubly united to a metal of high melting point, and in the process of producing such compound metal bodies; also, broadly, in metals of unlike nature permanently and indissolubly united by an intermediate layer of a third metal, and in the process of producing such compound metal bodies.

The present application is a division of my prior application filed Sept. 6, 1906, Sr. No. 333,570, upon which has issued Patent No. 853,716, dated May 14, 1907 itself based upon an earlier application filed June 16, 1905, Sr. No. 265,508, in which patent and prior application the subject-matter of this invention is substantially disclosed, but not specifically claimed.

Steel and the ferrous metals generally do not readily unite to wholly unlike metals, such as copper, silver, etc., either by cast-on unions or even by electro-plating, and even when an apparent union is produced, the two metals usually (and, so far as I am aware, always, when the unions are produced by the methods described in the prior art) separate during subsequent working, if the working be carried far enough, or may be separated readily by the action of heat or shock or by means of a cutting tool, the tool following readily the line of juncture. In my said prior applications I have set forth a discovery made by me, which is that the lack of affinity between ferrous metals (steel, for example) and such unlike metals, which subsists at all common temperatures and which renders difficult their direct union by any of the known processes, although existing at the common casting temperature of copper and silver, disappears when these metals are raised to temperatures much above their melting temperatures. To the condition of silver, copper, and other metals of which the same is true, in which they become capable of entering into permanent union with iron, steel and like ferrous metals, I have applied the term "supermolten condition", and in my said Patent No. 853,716 I have claimed broadly the process of uniting such unlike metals involving the bringing of one of them to the supermolten condition. Iron or steel unites with unlike metals, such as mentioned, when the latter are in this supermolten condition, in a manner and for a reason not well understood; but probably the supermolten metal when first contacted with the iron or steel surface immediately "wets" the same thoroughly. The resulting union seems to be, for all practical purposes, equivalent to a perfect weld, but I do not confine myself to any particular theory as to whether such union is in fact a weld, or is produced by an intermediate layer of the two metals alloyed or intermingled together or in solution one in the other, or by an extremely efficient mechanical interlocking. The supermolten temperature of copper appears to be from 2500° to 2800° or higher; it being difficult to determine accurately such high temperatures; and the supermolten temperatures of silver, gold, and other metals of approximately the same melting point are in the same neighborhood.

When it is desired to unite brass or other alloys or metal-mixtures containing tin or other metal of relatively low volatilization temperature to iron or steel or like ferrous metal, or when it is desired to unite tin or like readily-volatilizable metal in the same manner, practical difficulties are encountered, owing to the fact that these metals volatilize below the desired supermolten temperature. However, these metals and alloys unite readily, at ordinary casting temperatures, or thereabouts, with copper, silver, aluminum, and like non-ferrous metals; which metals, in turn, are capable of being heated to a supermolten temperature at which they will unite readily with ferrous metals. When I desire to unite brass and other alloys containing readily-volatilizable

ingredients, or which for other reasons should not or cannot be heated to the desired high temperatures, to iron or steel or like metals of high melting point, or when I desire to unite any metal or alloy which for any reason it is not possible or desirable to heat to a high temperature, I first form on the iron or steel or like metal a coating, preferably a thin coating or film, of copper, silver or other metal capable of being heated to the desired supermolten temperature and capable of uniting at a lower temperature to the desired metal, and then unite this desired metal with the coating of copper or the like so formed.

In the accompanying drawings I illustrate apparatus such as may be used in carrying out my said process.

In said drawings: Figure 1 represents a sectional view of one form of apparatus for carrying out the said process. Fig. 2 shows in detail section the construction of the bottom plate and lower portion of the casing of such apparatus. Fig. 3 shows a sectional view of an alternative form of casing which may be employed.

In Fig. 1, 1 is a preliminary heating chamber for the ingot or core or object to be coated; 2 is a furnace for heating a crucible 3 containing the supermolten metal for forming the intermediate coating to unite the two metals; and 4 is a second similar crucible, which may contain the brass or other metal of which the second or main coating is to be formed.

It will be understood that in practice the furnace or heating means will be so constructed as to maintain in each crucible the desired temperature and, when necessary, to maintain a considerable difference of temperature of the metals in the two crucibles. Means for accomplishing this are well known to those skilled in the art.

5 designates a power hoist, here shown as an electrical hoist, mounted on a suitable track so that it can be moved from place to place; and from said hoist is suspended, by means of a porter bar 6, the ingot 7, which is the object to be coated. Said ingot is shown surrounded by a casing 8 having an internal diameter slightly larger than the external diameter of the ingot, and to said casing is connected a pipe 9, a portion of which is flexible, said pipe provided with a three-way valve 10. This pipe and the valve 10 are provided for supplying to the casing, when desired, an atmosphere of indifferent or neutral gas, such as producer gas. Casing 8 has a weighted head 11 which insures that when the casing is lowered into the molten metal it shall sink therein to the desired depth.

12 designates a bottom plate for the casing arranged to be secured to the ingot 7 itself, by means of a screw 13. Said bottom plate is provided with a raised rib or ring 14 matching a corresponding groove 15 in the lower edge of the casing, and adapted to coact with said groove to make a tight joint. For raising and lowering the casing 8 with respect to the ingot 7, a special hoist 16, suspended like porter bar 6 from hoist 5, is provided. It has, as shown, two winding drums 17 upon which are wound two cables 18 connected to opposite sides of the casing, so that said casing may be raised and lowered truly vertically.

I customarily provide each crucible with a loose removable cover 19, only one of which is shown in Fig. 1, which cover is designed to exclude air from the molten metal so far as possible, and is removed only when and so long as necessary to lower an ingot and casing into the crucible, or to inspect the molten metal, or for similar reason. To further exclude air from the surface of the molten metal, I cover so much of its surface as possible with a layer of charcoal, a ring 20 of refractory material which floats on the surface of the molten metal serving to maintain a clear space in the center for the passage of the ingot and casing. To assist in forming a tight joint between the bottom plate and casing, I provide in the groove 15 suitable packing material 21.

The casing and associated parts shown in Fig. 3 are substantially the same as above described; but the casing 8 is provided in addition with inlets 23 near its upper end, said inlets arranged to be closed at will by a sliding shield or valve 24.

In carrying out the process, a core or ingot 7, previously prepared by sandblasting and pickling, or in any other suitable way, is placed within the heating chamber 1, which I customarily heat by passing around it hot producer gas or products of combustion. When the core has been heated to the proper degree, the hoist 5 with the casing 8 suspended therefrom is moved over chamber 1, the porter bar 6 is lowered and attached to the ingot, and then said ingot is raised into casing 8, then preferably filled with a neutral protective atmosphere, such as that producer gas made from charcoal or coke. The casing and ingot are then moved over the crucible 3 containing the supermolten metal, the casing and ingot are then lowered to about the surface of the molten metal, and the ingot is lowered from the casing into the supermolten metal, and after a few seconds, during which the supermolten metal is forming a film coating on the surface of said ingot, said ingot is raised into the casing 8 again (said casing being still filled with the protective atmosphere) the bottom plate 12 is applied to the ingot, the casing and ingot are moved over the second bath 4, and lowered to near the surface of the molten metal therein, and then the ingot and bottom plate are

lowered into the molten metal and immediately thereafter the casing is lowered into the molten metal until it contacts with the bottom plate, segregating from the molten metal as it descends the layer of such molten metal in immediate contact with the film-coated surface of the ingot. The filled casing, closed at the bottom by the bottom plate, is then raised, and the molten metal is permitted to solidify, after which the coated ingot is removed from the casing and is worked between rolls, in a press, under a hammer, or otherwise, either immediately or after submission to a soaking heating.

By the method just described, an ingot is produced the intermediate layer (copper for example) is inseparably united to the core or base (steel for example) and the outer layer (brass for example) is inseparably united to the intermediate layer. Said intermediate layer is very thin—so much so as to be inappreciable or nearly so.

The operation with the form of casing shown in Fig. 3 is substantially the same, except that the bottom plate is applied and caused to close the bottom of the casing, before dipping the casing in the second bath 4; and said casing, closed at the bottom, is then lowered into the metal in bath 4, and as the openings 23 near the surface of the molten metal the closure 24 is raised so that the casing fills through said openings.

The above-described process is applicable not only to the coating of iron or steel with brass, bronzes, tin, etc., but is applicable to the coating of iron or steel with metals of higher melting point when, for any reason, it is desired to unite such metal to the iron or steel base or core by means of an intermediate layer of another metal. For example, instead of uniting aluminum directly to the iron or steel base, said base may first be film-coated with supermolten copper or silver, and then the aluminum applied in the second bath 4, said bath being maintained at a temperature, above the melting point, convenient for the handling of aluminum.

In an application filed April 13, 1907, Sr. No. 367,985 I have claimed a process of producing compound or clad metal bodies comprising contacting a surface of one metal with a supermolten mass of an unlike metal and confining a portion of the metal from such supermolten mass, of substantial thickness in contact with such surface, and causing it to solidify thereon. In another application Sr. No. 367,986, filed April 13, 1907, I have claimed a process of producing compound or clad metal articles comprising contacting the surface of a metal unlike gold with a supermolten mass of a third metal and then casting molten gold or molten gold-comprising metal, against the surface so treated. In an application filed April 24, 1907, Sr. No. 369,995, I have claimed a process of forming compound or clad metal articles comprising contacting a body of metal unlike silver with a supermolten mass of a third metal and then contacting the surface so treated with a mass of molten silver and causing a layer thereof to solidify thereon. In an application filed April 24, 1907, Sr. No. 369,997 I have claimed a process of forming compound or clad metal objects comprising contacting the surface of a metal unlike metals of the light metal group (aluminum etc.), with a supermolten mass of a third metal and then contacting the surface so treated with a molten mass of a metal of the light metal group and causing a layer thereof to solidify thereon. In an application filed June 19, 1908, Sr. No. 439,284 I have claimed compound or clad metal articles comprising a coating of copper, silver, gold, aluminum and like metals, alloyed with ferrous metals, weld united to ferrous metals, and a process of making such articles. Therefore, I do not claim such inventions herein.

What I claim is:—

1. The process of producing compound bodies of unlike metals united together, which consists in contacting a surface of one such metal with a supermolten mass of an unlike metal and then contacting the coating formed by such supermolten metal with a molten mass of a third metal and causing a layer thereof to solidify thereon.

2. The process of producing compound bodies of unlike metals united together, which consists in contacting a surface of one such metal with a supermolten mass of an unlike metal, withdrawing such surface from the supermolten metal after the formation upon it of a weld-film, and then contacting the filmed surface with a molten mass of a third metal and causing a layer thereof to solidify thereon.

3. The process of producing compound bodies of unlike metals united together, which consists in contacting a surface of one such metal with a supermolten mass of an unlike metal, and thereby forming a coating on such surface, withdrawing the so-coated object from the supermolten metal under conditions precluding oxidation, and then contacting the coated surface with a molten mass of a third metal and causing a layer thereof to solidify thereon.

4. The process of producing compound bodies of unlike metals united together, which consists in contacting a surface of one such metal with a supermolten mass of an unlike metal, and thereby forming a coating on such surface, withdrawing the so-coated object from the supermolten metal and then contacting the coated surface with a molten mass of a third metal and segregating from such mass a substantial layer thereof in proximity to such coated surface and causing it to solidify thereon.

5. The process of producing compound bodies of unlike metals welded together, which consists in contacting a surface of one such metal with a supermolten mass of an unlike metal and thereby forming a coating on such surface and then contacting the coating so formed with a molten mass of a metal which, from its nature, may not be heated to so high a temperature, and causing a layer of such third metal to solidify thereon.

6. The process of producing compound bodies of unlike metals united together, which consists in contacting a surface of one such metal with a supermolten mass of an unlike metal and thereby forming a coating on such surface and then contacting the coating so formed with a molten mass of an alloy containing a readily-volatilizable metal and causing a layer of such third metal to solidify thereon.

7. The process of producing compound bodies of unlike metals united together, which consists in contacting a surface of one such metal with a supermolten mass of an unlike metal and thereby forming a coating on such surface and then contacting the coating so formed with a molten mass of an alloy containing zinc and causing a layer of such alloy to solidify thereon.

8. The process of producing compound bodies of unlike metals united together, which consists in contacting a surface of one such metal with a supermolten mass of an unlike metal and thereby forming a coating on such surface and then contacting the coating so formed with a molten mass of brass and causing a layer of such brass to solidify thereon.

9. The process of producing compound bodies of unlike metals united together, which consists in contacting a surface of steel with a supermolten mass of copper and thereby forming a coating on such surface and then contacting the coating so formed with a molten mass of a copper alloy and causing a layer of such alloy to solidify thereon.

10. The process of producing compound bodies of ferrous and non-ferrous metals welded together which consists in contacting the surface of a ferrous-metal object with a molten mass of a metal of the other such group having a melting point above 900 F., such second metal maintained at a temperature much above its melting point, and thereby forming a coating on such surface, and then contacting the coating so formed with a molten mass of another metal and causing a layer of such other metal to solidify thereon.

11. As a new article of manufacture, a ferrous base having a poreless dense coating of another metal inseparably united thereto by an intermediate layer of a third metal.

12. As an article of manufacture, a ferrous base having a poreless dense coating of an alloy inseparably united thereto by an intermediate layer of a third metal.

13. As an article of manufacture, a ferrous base having a poreless dense coating of a copper alloy inseparably united thereto by an intermediate layer of a third metal.

14. As an article of manufacture, a ferrous base having a poreless dense coating of a zinc alloy inseparably united thereto by an intermediate layer of a third metal.

15. As an article of manufacture, a ferrous base having a poreless dense coating of brass inseparably united thereto by an intermediate layer of copper.

16. As an article of manufacture, a ferrous base having welded thereto a coating of copper and having united to said copper coating a layer of another metal.

17. As a new article of manufacture, an extended metal article comprising a ferrous metal base and a continuous poreless, dense coating of a copper alloy, united thereto by a union resisting temperature changes, cutting tools, and mechanical stresses, said ferrous base and copper alloy coating having been extended together.

18. As a new article of manufacture, an extended metal article comprising a ferrous metal base and a continuous poreless, dense coating of brass, united thereto by a union resisting temperature changes, cutting tools, and mechanical stresses, said ferrous base and brass coating having been extended together.

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

JOHN F. MONNOT.

Witnesses:
J. F. KINDER,
H. M. MARBLE.