J. F. MONNOT.

COMPOUND METAL BODY AND PROCESS OF PRODUCING SAME.

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929,778. Patented Aug. 3, 1909.

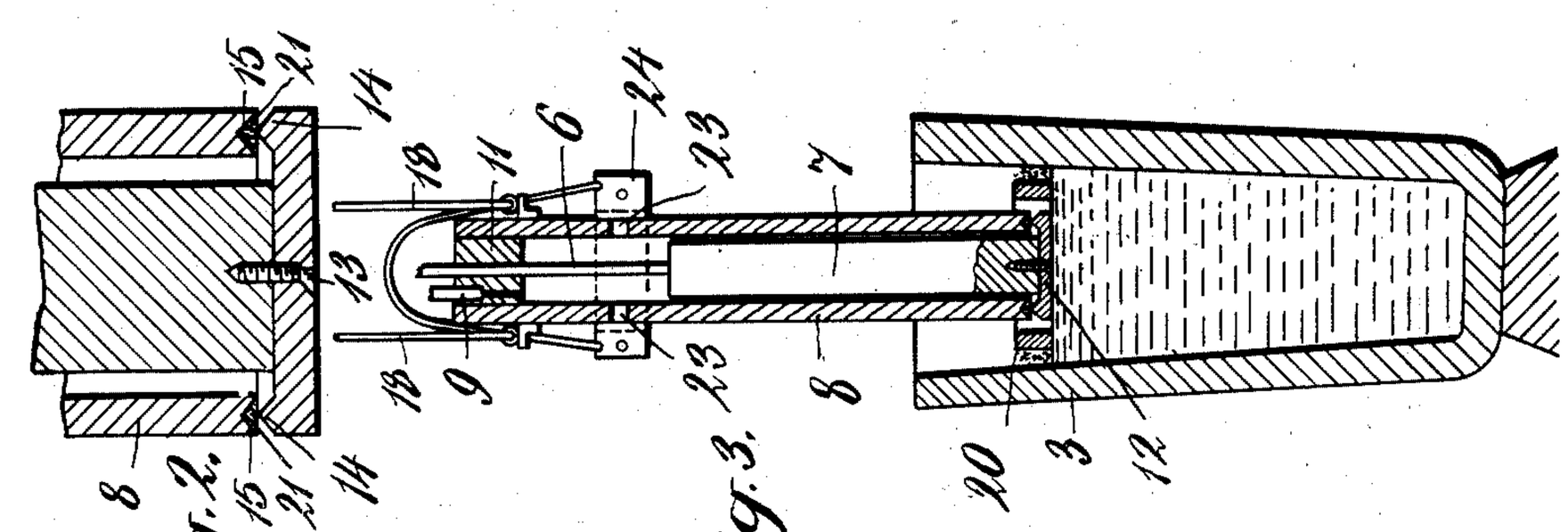

Fig. 2.

Fig. 3.

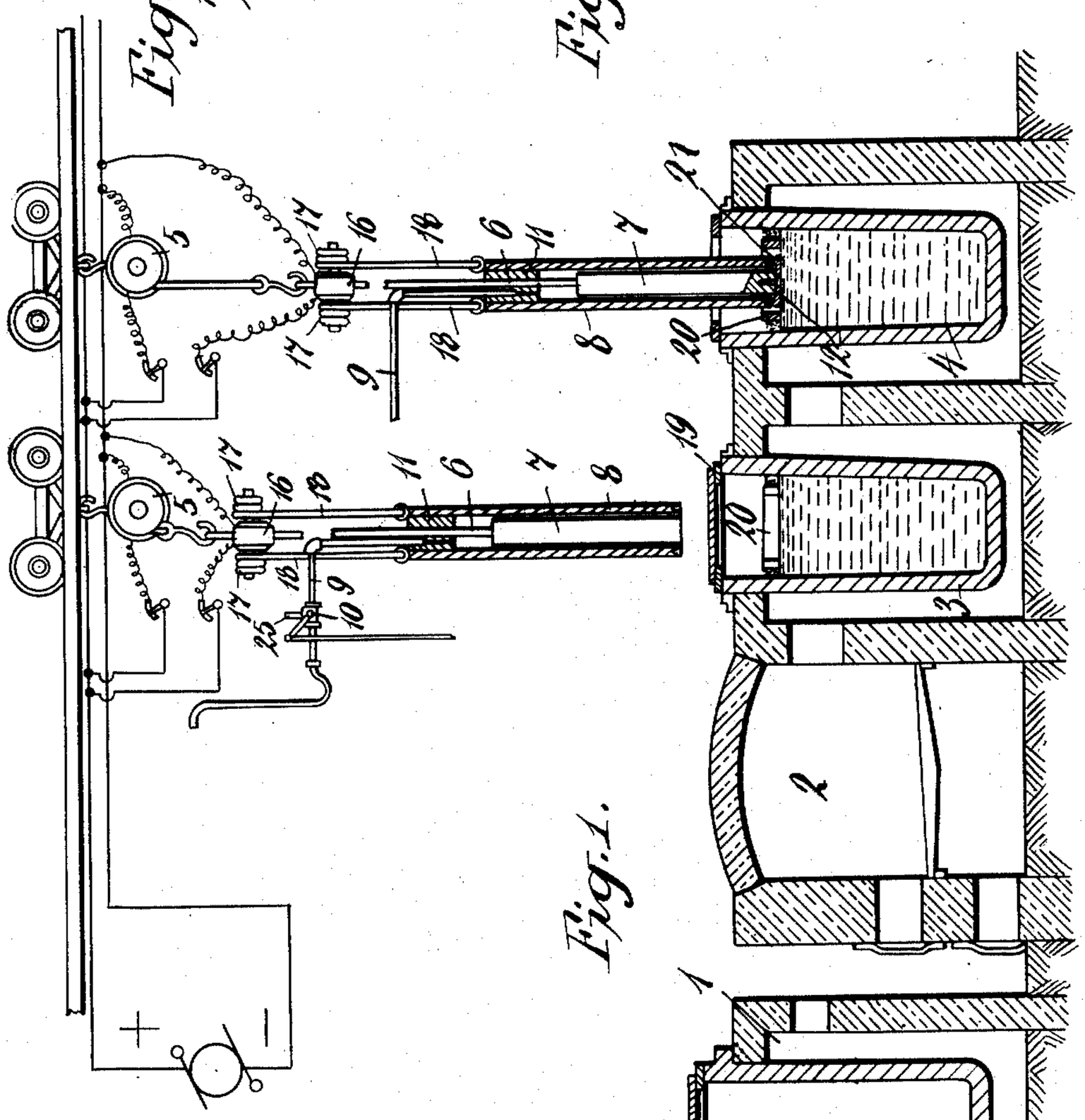

Fig. 1.

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COMPOUND METAL BODY AND PROCESS OF PRODUCING SAME.

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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 metal articles composed of layers of aluminum or other like metal of the light-metal group, (such as magnesium, beryllium or glucinum, or alloys such as magnalium, which because of high content of one or more of the metals of such group, partake in general of the nature of such metals) united to unlike metals, and particularly to ferrous metals such as iron or steel (including the various compound steels), and also in a process of producing such compound metal bodies.

My invention further consists in aluminum or a metal or alloy of the light-metal group united to an unlike metal, such, for example, as iron or steel, by an intermediate layer of a third metal, such, for example, as copper, and in the process of producing such compound metal bodies.

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

It is well known that aluminium and metals and alloys of the light-metal group do not readily unite with iron or steel and certain other metals. I am not aware for example, that they unite readily with nickel or cobalt. In my said prior applications I have set forth a discovery made by me, which is that metals which ordinarily lack affinity for each other and do not readily unite, may be united by heating one of them to a temperature far above its melting temperature to a condition which I have termed, for want of a better term, the "supermolten condition", and then contacting such supermolten metal with the surface of the unlike metal to which the same is to be joined, and permitting a layer or coating of such supermolten metal to solidify on such surface. Such a coating, being set from the fluid state, is poreless and it is found to cohere to the metal base with a union equivalent to a weld-union, such union resisting temperature changes, as in heating and quenching, mechanical stresses and discovery by cutting tools, such as a cold chisel, and permitting almost indefinte co-extension of the joined metals, as by rolling, drawing and the like, without severance of said joined metals. I have set forth in my said applications that the full coating may be made from the supermolten bath, or that a mere film coating may be formed in such supermolten bath by dipping the object to be coated therein for a very short time, such as a few seconds, and withdrawing such object from such supermolten bath under conditions precluding oxidation of the intensely hot film coating formed in such bath, and then a further coating applied to such film coated surface by contacting such surface with a molten body of metal at substantially ordinary casting temperature and confining a layer of suitable thickness of such latter body of supermolten metal in contact with such film surface and causing it to solidify thereagainst; after which ordinarily the coated ingots so produced are worked by rolling, pressing, hammering or other suitable mechanical treatment. I have further set forth in my said prior applications that the intermediate coating is not necessarily the same metal as the outer coating, but may be a different metal having the property of uniting in the supermolten condition with the surface to be coated and having also the property of combining with the metal of the desired outer coating at or near the ordinary casting temperature thereof.

Aluminum is capable of being heated to a supermolten temperature at which it will combine directly with iron or steel; but for various practical reasons depending upon the properties of aluminum and particularly the ease with which it oxidizes (and

metals in the supermolten condition are much more reactive than in the ordinary molten condition, and this is as true of aluminum as of copper or silver) it is desirable and preferable, particularly when coating iron or steel with aluminum, not to heat the aluminum to the supermolten condition, but to first film coat with another metal which withstands better the supermolten temperature (copper for instance), and then to form a coating of aluminum on the copper surface formed by the action of supermolten copper, molten aluminum uniting readily with the copper of the copper-filmed surface. Such a coating of aluminum, being formed from a solidified fluid, is also poreless and has the other general properties of a cast metal, or, after extension, of a cast and extended metal.

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 aluminum 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 intermediate coating metal in 3 being in supermolten condition, 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, containing molten aluminum or metal

or alloy of the light-metal group 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) of which is inseparably united to the core or base (steel for example) and the outer layer (aluminum 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 ingot so produced may then be worked either immediately or after reheating or submission to a soaking heating, in the ordinary manner.

In a companion application, Serial No. 368,770, filed April 17, 1907, I have claimed broadly the process of uniting two unlike metals by means of an intermediate third metal inseparably united to the other two metals, and the product so produced; hence I do not claim such broad invention herein, but only claim said invention as embodied in coating with aluminum or metals or alloys of the aluminum group.

What I claim is:—

1. The process of producing compound bodies comprising a metal of the light-metal group and an unlike metal inseparably united, which consists in contacting a body of one such metal with a supermolten mass of a third metal and then contacting the coating so formed by such supermolten metal with a molten mass of the other metal and causing a layer thereof to solidify thereon.

2. The process of producing compound bodies comprising a metal of the light-metal group and an unlike metal inseparably united, which consists in contacting a body of such unlike metal with a supermolten mass of a third metal and then contacting the coating formed by such supermolten metal with a mass of said metal of the light-metal group, and causing a layer thereof to solidify thereon.

3. The process of producing compound bodies comprising aluminum and a non-aluminous metal inseparably united, which consists in contacting a body of one such metal with a supermolten mass of a third metal and then contacting the coating formed by such supermolten mass with a mass of molten aluminum and causing a layer thereof to solidify thereon.

4. The process of producing compound bodies comprising a metal of the light-metal group and a ferrous metal inseparably united, which consists in contacting a body of such ferrous metal with a supermolten mass of metal belonging neither to the ferrous nor light-metal groups and then contacting the coating formed by such supermolten metal with a molten mass of such light-metal group metal and causing a layer thereof to solidify thereon.

5. The process of producing compound bodies comprising a metal of the light-metal group and a ferrous metal inseparably united, which consists in contacting a body of such ferrous metal with a supermolten mass of copper and then contacting the coating formed by such supermolten metal with a molten mass of such light-metal group metal and causing a layer thereof to solidify thereon.

6. The process of producing compound bodies comprising aluminum and a ferrous metal inseparably united, which consists in contacting a body of such ferrous metal with a supermolten mass of copper and then contacting the coating formed by such supermolten metal with a molten mass of aluminum and causing a layer thereof to solidify thereon.

7. As a new article of manufacture, a compound metal body comprising a ferrous metal base and a poreless layer of a metal, said metal having the properties of metal set from a liquid state comprising one of the group of light metals united thereto by an intermediate layer of a metal of high melting point, said intermediate layer also having the properties of metal set from a liquid state.

8. As a new article of manufacture, a compound metal body comprising a ferrous metal base and a poreless layer of a metal comprising aluminum united thereto by an intermediate layer of a metal of high melting point, both of said layers having the properties of metal set from a liquid state.

9. As a new article of manufacture, a compound metal body comprising a ferrous metal base and a poreless layer of a metal comprising aluminum united thereto by an intermediate layer of copper, both said layers having the properties of metal set from a liquid state.

10. As a new article of manufacture, a compound metal body comprising a ferrous metal base and a poreless layer of aluminum

united thereto by an intermediate layer of copper, both said layers having the properties of metal set from a liquid state.

11. As a new article of manufacture, a compound metal body comprising a layer of metal comprising one of the light-metal group and an unlike metal, each inseparably weld-united to an intermediate layer of metal unlike both, both said layers having the properties of metal set from a fluid state.

12. As a new article of manufacture, a compound metal body comprising a layer of aluminum and an unlike metal, each inseparably weld-united to an intermediate layer of a third metal, both said layers having the properties of metal set from a fluid state.

13. As a new article of manufacture, a compound metal body comprising a layer of aluminum and a ferrous metal, each inseparably weld-united to an intermediate layer of copper, both said layers having the properties of metal set from a fluid state.

14. As a new article of manufacture, a compound metal body comprising a ferrous metal base and a poreless layer of aluminum united thereto by a union resisting temperature changes, cutting tools and mechanical stresses.

15. As a new article of manufacture, a ferrous metal having inseparably united thereto a poreless dense aluminum coating set thereon from the liquid state.

16. As a new article of manufacture, a compound metal body comprising a ferrous metal base and a poreless dense layer of a metal comprising aluminum united thereto by a union resisting temperature changes, cutting tools and mechanical stresses.

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

JOHN F. MONNOT.

Witnesses:

BYRON E. ELDRED,

JAS. K. CLARK.