F. E. CANDA.

APPARATUS FOR AND PROCESS OF MIXING METALS.

APPLICATION FILED DEC. 29, 1906.

995,421. Patented June 13, 1911.

Fig. 3.

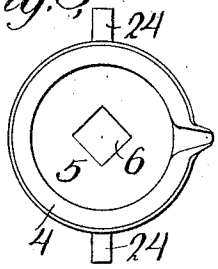

Fig. 1.

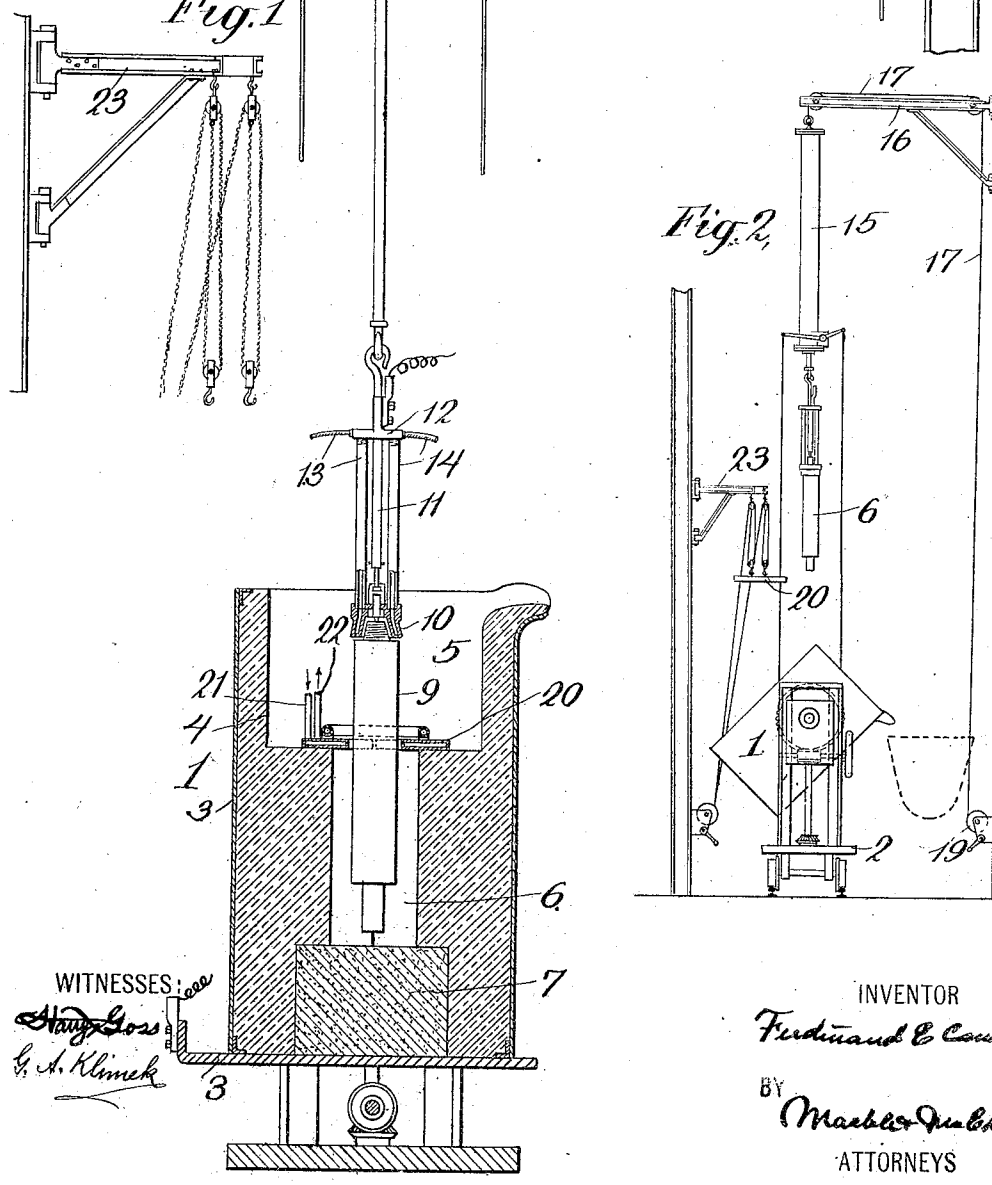

Fig. 2.

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APPARATUS FOR AND PROCESS OF MIXING METALS.

995,421. Specification of Letters Patent. Patented June 13, 1911.

Application filed December 29, 1906. Serial No. 350,030.

To all whom it may concern:

Be it known that I, FERDINAND E. CANDA, a citizen of the United States, residing in New York, in the county of New York and State of New York, have invented an Apparatus for and Process of Mixing Metals, which are new and useful, and of which the following is a specification.

My invention relates to apparatus for and a process of making exact mixtures of metals, particularly mixtures comprising one or more metals of high melting point.

My invention is particularly intended for application in the making of various compound steels or alloy steels, from metallic materials, such as titanium, chromium, tungsten, tantalum, etc. which because of their high melting point, or violent tendency to combine with air, furnace gases, or other contaminating medium, cannot be added to or mixed thoroughly with steel by ordinary methods with ease and certainty of results.

My invention comprises apparatus for carrying out the process of my Patent No. 813,278, dated Feb. 20, 1906, for making titanium steel, also improvements in said process. According to the process of that patent, titanium-bearing material, such as ferro-titanium, and the steel to which the titanium is to be added, are melted separately, the titanium being melted preferably in an electric furnace, and then the two molten masses are united. In practice, considerable difficulty is found in pouring molten ferro-titanium containing a high percentage of titanium, owing to the tendency of the molten mass to solidify before the pouring is complete, and for other reasons, such as contamination of the metal by atmospheric gases. In pouring, a comparatively large surface of metal is exposed to the air and with such sensitive materials as titanium this leads to formation of oxids, nitrids, etc.

The present apparatus and process provide means for and a method of uniting and mixing thoroughly the titanium or other material of high melting point and the steel, before the titanium or like material is poured. The resulting mixture having a much lower melting point and being less sensitive to air than the titanium or titanium-alloy first melted, no difficulty is experienced thereafter in pouring the mixture. The apparatus and process herein described are, however, of great utility in the production of high-grade steels and the like where absolute precision in the proportions of the ingredients is essential. Under the method of manipulation adopted the necessity of pouring the molten high-melting metal is precluded, it being melted in a suitable container and mixed with the steel or other metal which it is to alloy, without exposure to air.

According to my invention I employ an electric furnace the crucible of which is at the bottom of a pouring ladle, forming a pit at the bottom of such ladle. The bottom of the crucible commonly forms one electrode of the furnace, the other being introduced from above through the top of the ladle; and means are provided for raising and lowering the latter electrode as desired, and also for covering over the crucible so as to confine the heat and prevent or minimize entrance of air or other gases. When the refractory mixture in the said crucible has been melted and heated to give the necessary heat-margin, the cover and upper electrode are lifted out, and molten steel to be mixed with the melted refractory material is poured into the ladle and caused to mix with the molten mass in the crucible-pit thereof; the agitation due to the pouring in of the large mass of steel in this manner and also currents due to difference of specific gravity of the metals, if any, resulting in a very thorough mixture of the two molten masses.

My invention consists in the novel combined furnace and metal receptacle; in the novel method of mixing a refractory material with a less refractory material; and generally in the features particularly pointed out in the claims.

The objects of my invention are to facilitate the uniting of metals of high melting points with other metals; to facilitate the production of precise mixtures of metals; and to make the apparatus simple, easily understood, and easily handled and operated.

In the accompanying drawings, I show one form of apparatus constructed for carrying out the process and method of operation above described.

In said drawings Figure 1 shows a vertical section of a combined furnace crucible and ladle such as above described, together with an electrode for such furnace and means for raising and lowering the same and the cover for the crucible; Fig. 2 shows a more complete side view of the same parts,

on a smaller scale; and Fig. 3 shows a top view of the combined ladle and crucible.

In said drawings, 1 designates a ladle mounted upon a car 2 and provided with means for raising and lowering it and for tilting it, as is customary.

3 designates the metal casing of the ladle, 4 the refractory lining thereof, 5 the main chamber of the ladle, 6 a crucible or pit extending downward therefrom, and 7 a carbon block forming the bottom of said pit or crucible and also forming one of the electrodes of the electric furnace. As shown the crucible pit has a much thicker wall of refractory material than the body of the ladle; and this thick wall assists in retaining heat and prevents freezing of the molten titanium. The pit being at the bottom of the metal, and being covered until just before casting of the steel, access of air to the molten titanium is substantially precluded. The said block 7 rests upon a metal plate 8 forming the bottom of the ladle and also one of the electric terminals of the apparatus.

9 is the other electrode of the furnace. It is, customarily, a large carbon rod, secured at its upper end to a water-jacketed head 10 suspended by rod 11 from a crosshead 12 forming the other electric terminal of the furnace. Water pipes 13 and 14 supply water to and carry it away from the jacket of head 10. Suitable means are provided for raising and lowering the electrode 9. It is desirable to be able to raise and lower it rapidly, and for this purpose I have indicated a power hoist 15 of the well-known pneumatic type. It is also desirable to be able to raise and lower said electrode 9 through smaller distances, but with absolute precision and steadiness, during the operation of the furnace, in order to regulate the action of the current, prevent the cutting of the sides of the crucible, etc.; and for this purpose a hand-operated hoist has been found to be most convenient. Therefore I have shown the pneumatic hoist 15 suspended from a crane 16 by means of a cable 17 passing to the drum of a hand-operated windlass 19. The operator, standing with his hand on the crank of this windlass and his eye on the volt-meter indicating the current passing through the furnace, can move the electrode 9 up and down with absolute precision as may be required to keep the operation of the furnace steady.

20 indicates a two-part water-jacketed cover for the crucible 6; 21 and 22 pipes for supplying cooling water thereto and carrying such water therefrom; and 23 suitable hoisting means for lifting said cover out of the furnace.

Preferably, the section of the crucible 6 is square or some other section having sharp angles, as shown in Fig. 3, the trunnions 24 upon which the ladle tilts being so placed (preferably on the diagonal of crucible 6, as shown in Fig. 3) that when the ladle is tilted the lower-most corner of the crucible forms a natural spout insuring the complete emptying of the contents of the crucible into the larger chamber 5.

I do not limit myself to pouring from the ladle by tilting, as shown, but may employ any convenient or well-known method of or means for discharging the contents of the ladle. However, the tilting method is convenient.

In the operation of the apparatus, and in carrying out the process, a charge of the material to be melted in the crucible pit 6 is placed therein, the electrode 9 is introduced, the cover 20 adjusted in position, the electric current is turned on, and the apparatus operated as an electric furnace until the charge is melted. The pit or crucible being of comparatively small volume will contain but little air and this is soon displaced by the gases given off in heating up, so that the titanium is practically shielded from contamination. Cover 20 aids materially in this preclusion of contamination. When this has been done, and when all is in readiness for introducing the further body of molten metal to be mixed with the charge so melted, the electrode 9 is raised, the cover 20 lifted out, and the molten metal to be added is poured into the main chamber 5 of the ladle. In so entering the ladle much of the stream will of necessity be directed toward the molten mass in crucible 6, causing violent agitation which is exceedingly effective in producing thorough mixture of the two masses of molten metal. As soon as the proper quantity of molten metal has been added in this manner, and sufficient time has elapsed for thorough mixture, the removal of slag, etc., the mass is poured.

It will be observed that with this apparatus, and by this process, it is easy to melt in the crucible 6 a definite weight of the refractory material, and to do this without oxidation to any material extent. It is of course easy to add a definite weight of molten steel or other metal when pouring into the main chamber 5; and it being insured, by the very method of mixing the two metals, that the entire charge placed in the crucible 6 is melted and mixed with the further charge poured into the ladle, it is easy to determine just what should be the weight of each charge to give the desired result.

What I claim is:—

1. Apparatus for mixing metals, comprising a receptacle for molten metal having a floor and having projecting downward from said floor a crucible pit provided with an electrode of an electric heating device.

2. Apparatus for mixing metals, comprising a receptacle for molten metal having a

floor, and having, projecting downward from said floor, a pit forming a melting crucible, and means for passing an electric current through said pit.

3. Apparatus for mixing metals, comprising a receptacle for molten metal provided with means whereby it may be tilted to discharge its contents, said receptacle comprising a main chamber for receiving molten metal, having a floor, and a pit extending downward from said floor, and means for passing an electric current through said pit.

4. Apparatus for mixing metals, comprising a ladle provided with means for tilting it for pouring and having a main chamber and, at a lower level and communicating therewith, an electric furnace.

5. Apparatus for mixing metals comprising a tilting ladle having a main chamber for receiving molten metal and, extending down from said main chamber, a crucible chamber of approximately angular section, one of the angles approximately in the plane in which the ladle tilts.

6. Apparatus for mixing metals comprising a ladle adapted to receive molten metal and having a main chamber and, in its bottom a melting crucible of smaller diameter, means for raising and lowering an electrode from and into said crucible, and a cover for said crucible.

7. The process of producing mixtures of metals, which consists in melting within a suitable receptacle, and by the action of an electric current, one of the metals, and then pouring into such receptacle an already-melted mass of a metal to be mixed with said first metal.

8. The process of producing mixtures of metals, which consists in melting within a suitable receptacle by the action of an electric current, and with substantial exclusion of contaminating media, one of the metals, and then pouring into such receptacle an already-melted mass of a metal to be mixed with such first metal.

9. The process of producing mixtures of metals, one of which is of high melting point, which consists in melting within a suitable receptacle, by the action of an electric current, the said metal of high melting point, and then pouring into such receptacle an already-melted mass of a metal of lower melting point.

10. The process of producing mixtures of metals, one of which is of high melting point, which consists in melting within an electric furnace having capacity to receive the entire mixture, the material of high melting point, and then pouring into said furnace already-melted metal of lower melting point and by the resulting agitation mixing the two bodies of molten metal.

11. Apparatus for mixing metals, comprising a refractory walled receptacle containing a substantially closed space of comparatively small dimensions, and, in communication with such space, another space of comparatively much greater dimensions, and electric means for applying heat to the contents of said relatively small space.

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

FERDINAND E. CANDA.

Witnesses:
ALPHONSE KLOH,
H. M. MARBLE.