Aug. 8, 1944. L. A. YERKES 2,355,130

SEPARATION OF MOLTEN MAGNESIUM FROM MOLTEN SALT BATHS

Filed Dec. 18, 1942

Fig. 1

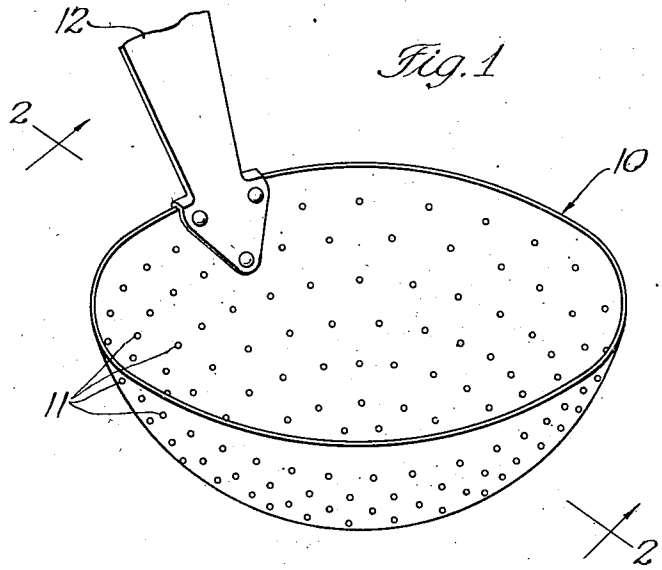
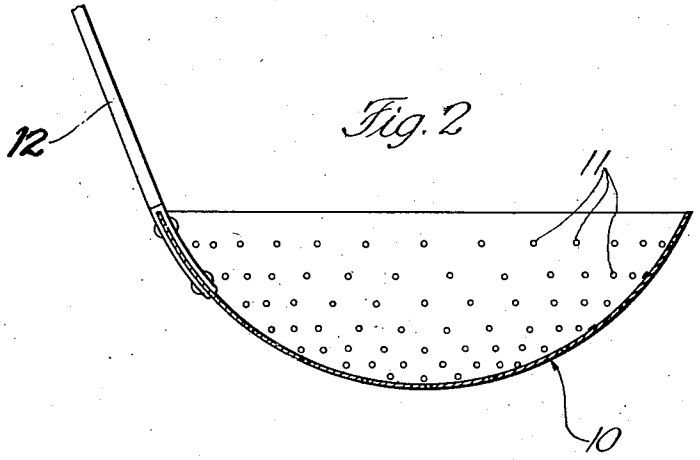
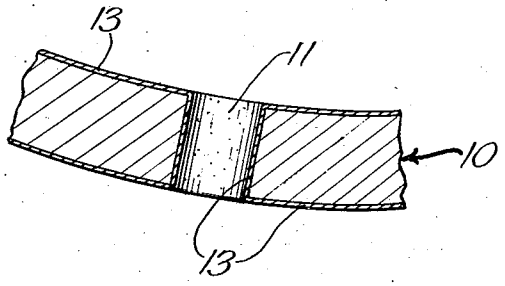


Fig. 2





INVENTOR.
Leland A. Yerkes
BY John J. McLaughlin
Attorneys

Patented Aug. 8, 1944

2,355,130

UNITED STATES PATENT OFFICE

2,355,130

SEPARATION OF MOLTEN MAGNESIUM FROM MOLTEN SALT BATHS

Leland A. Yerkes, Boulder City, Nev.

Application December 18, 1942, Serial No. 469,391

10 Claims. (Cl. 75—67)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

My invention relates to the separation of molten magnesium from molten salt baths and to apparatus for use therewith.

One usual method of producing magnesium metal commercially is to electrolyze it from a salt bath comprising essentially magnesium chloride. In a usual type of cell employed for the purpose, the magnesium compound is reduced at the cathode, producing metallic magnesium, and, the metallic magnesium being lighter than the bath from which it is electrolyzed, floats to the top of the cell near the cathodes thereof, usually in a cathode compartment provided in the cell. It is essential that this magnesium be removed for subsequent use as the metal and it should be free of substantially all traces of electrolyte. Various methods and equipment have been used for removing the magnesium metal but so far as I know neither the method nor equipment has been satisfactory in that the magnesium was either not suitably or rapidly removed or undesirably large proportions of the molten electrolyte were also removed.

I have discovered that if a ladle or ladle-like object be provided having a large number of relatively fine holes therethrough, and the surface be covered with an iron compound such as iron oxide, the molten magnesium can be dipped from the surface, all or substantially all of the molten magnesium being retained in the ladle and the molten electrolyte being quickly drained through the openings. Following this discovery, I have produced improved apparatus and provided an improved method as will be brought out in connection with the following description taken with the accompanying drawing wherein

Fig. 1 is a perspective view of apparatus constructed in accordance with my invention, a portion of the handle being broken away,

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1, and

Fig. 3 is an enlarged fragmentary section.

In accordance with my invention, I provide a dish shaped body 10 with a plurality of openings 11 running entirely therethrough and having a handle 12 suitably secured thereon. The dish shaped body 10 is formed of ferrous metal such as ordinary ingot iron or low carbon steel, although other ferrous metals may be used. The openings 11 are of relatively fine size but the size may vary, depending in part upon the thickness of the material comprising the dish shaped body of the ladle and partly because some latitude in cross sectional area is permitted from a functional standpoint. In general, I prefer to have the openings about .090" when material .25" to .125" thick is used although the openings may run between about .050" and .125" and satisfactory results obtained. The ladle may be cast and the holes formed therein by means of a $\frac{3}{32}$" drill. The openings 11 are shown round but they may have other shapes. While size and shape may vary, the ladle may be 12" to 18" in diameter and 12" deep when an open type of cell is used.

The formed ladle is treated to produce a continuous coating 13 of an iron compound on the surface thereof. The iron compound may be formed in various ways, such as by heating a mild steel ladle under controlled oxidizing conditions to form an oxide coating, immersing such a ladle in a boiling salt solution or a mixture of a boiling salt solution and a reducing agent if a black oxide coating is desired, treating the surface with oxidizing agents such as chlorine, heating the surface with a salt solution such as a solution of sodium chloride or sodium di-chromate, allowing the ladle to stand in the open air until oxidation occurs or in other ways to form an oxidized coating comprising an iron compound. It will be understood that the exact method of formation of the oxidized iron film is not critical to my invention, it only being necessary that an adherent film or layer of an iron compound be produced upon the entire surface.

The dish shaped body comprising the ladle, when prepared as described, is then employed to dip the molten magnesium metal from the surface of the electrolyte and the entrained molten salt comprising the electrolyte is allowed to drain by holding the ladle above the cell. This period of draining is only relatively short and, of course, the ladle may be handled manually or mechanically as determined by the type of mechanical installation comprising the electrolytic plant.

The iron compound coating causes the molten magnesium to be retained in the ladle, but allows the molten salt comprising the electrolyte to pass through. I explain this as being due to an interfacial surface tension phenomenon but do not wish to be limited to this explanation. It is my concept that magnesium metal will form a thin coating over a surface of metal, and the metal surface having been coated with magnesium in the region of the holes, the flow of magnesium through the holes is promoted rather than retarded. The iron oxide coating, according to my

concept, is not wetted by the magnesium metal, but is wetted or has some affinity for the molten electrolyte, with the result that the latter is fluid at the openings provided in the ladle and passes therethrough, while the molten magnesium tends to present a small surface, is less fluid at the openings and is retained in the ladle. For this reason, it is my concept that the ladle may be formed of any material so long as the surface thereof is an iron compound and the ladle has adequate strength. There is a definite advantage in having the material of the ladle formed of a ferrous metal, however, both from the standpoint of strength and from the standpoint of the simplicity of production of the oxidized surface.

It is clear that the invention may have somewhat broader aspects than indicated by the specific description. Molten salt baths are sometimes employed in connection with the purification of magnesium, for example, and the ladle of my invention will have advantage in connection therewith. The scope of the invention is defined by the claims.

What I claim as new and desire to protect by Letters Patent of the United States:

1. The method of separating molten magnesium from a molten salt bath, which comprises providing a dish shaped body of ferrous metal having a plurality of fine openings therethrough, treating the said ferrous metal to produce an oxide coating thereon, dipping the resulting coated dish shaped body into the molten magnesium in the salt bath, and allowing the same to remain above the said bath to drain the molten salt through the said fine openings, the molten magnesium remaining within the said dish shaped body.

2. A method of separating metallic magnesium from salts thereof which comprises passing a mixture of molten metallic magnesium with a molten salt thereof over a perforated support provided with an adherent coating of an iron compound unwettable by molten metallic magnesium, the perforations being sufficiently large to permit free passage of molten salt while being too small to overcome the surface tension of molten metallic magnesium, whereby metallic magnesium is retained on the perforated support while the molten salt passes through the perforations and is separated from the metallic magnesium.

3. A method of separating metallic magnesium from a molten salt bath which comprises passing a mixture of molten metallic magnesium and a molten salt over a perforated support provided with an adherent coating of an iron compound unwettable by molten metallic magnesium, the perforations being from about .050 inch to about .125 inch in diameter, whereby the molten salt passes through the perforated support while the molten metallic magnesium is retained thereby.

4. A method of separating metallic magnesium from a molten salt bath which comprises passing a mixture of molten metallic magnesium and a molten salt over a perforated support provided with an adherent coating of an iron compound unwettable by molten metallic magnesium, the perforations being about .090 inch in diameter, whereby the molten salt passes through the perforated support while the molten metallic magnesium is retained thereby.

5. A method of separating a mixture of metallic magnesium and salts thereof which comprises passing such a mixture over a perforated ferrous support provided with an iron oxide coating thereon, the perforations being sufficiently large to permit free passage of molten salt while being too small to overcome the surface tension of molten metallic magnesium, whereby metallic magnesium is retained on the ferrous support while the molten salt passes through the perforations and is separated from the metallic magnesium.

6. A method of separating metallic magnesium from a molten salt bath which comprises passing a mixture of molten metallic magnesium and a molten salt over a perforated ferrous support provided with an oxide coating thereon, the perforations being from about .050 inch to about .125 inch in diameter, whereby the molten salt passes through the perforated support while the molten metallic magnesium is retained thereby.

7. A method of separating metallic magnesium from a molten salt bath which comprises passing a mixture of molten metallic magnesium and a molten salt over a perforated ferrous support provided with an oxide coating thereon, the perforations being about .090 inch in diameter, whereby the molten salt passes through the perforated support while the molten metallic magnesium is retained thereby.

8. The method of separating molten magnesium from a molten salt bath which comprises providing a ferrous metal support having a plurality of fine openings therethrough, treating the ferrous metal to produce an oxide coating thereon, passing a molten magnesium metal-salt bath mixture over said coated support, and allowing the molten salt to drain through the said fine openings, whereby molten magnesium is recovered from said ferrous metal support free from molten salt.

9. The method of separating molten magnesium from a molten salt bath which comprises providing a dish-shaped body of ferrous metal having therein a plurality of fine openings of about .050 inch to about .125 inch in diameter, treating the said dish-shaped body with an oxidizing agent to produce an adherent oxidized coating thereon repellant to metallic magnesium, dipping the resulting coated dish-shaped body into the molten magnesium in the salt bath, and allowing the same to remain above the said bath to drain the molten salt through the said fine openings, the molten magnesium remaining within the said dish-shaped body.

10. The method of separating molten magnesium from a molten salt bath which comprises providing a dish-shaped body of ferrous metal having therein a plurality of fine openings of about .09 inch in diameter, treating the said dish-shaped body with an oxidizing agent to produce an adherent oxidized coating thereon repellant to metallic magnesium, dipping the resulting coated dish-shaped body into the molten magnesium in the salt bath, and allowing the same to remain above the said bath to drain the molten salt through the said fine openings, the molten magnesium remaining within the said dish-shaped body.

LELAND A. YERKES.