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METHOD OF MAKING LIGHT METAL ALLOYS.

No Drawing.

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To all whom it may concern:

Be it known that we, WILLIAM R. VEAZEY and EDWARD C. BURDICK, both citizens of the United States, and residents of Cleveland, county of Cuyahoga, and State of Ohio, and of Midland, county of Midland, and State of Michigan, respectively, have jointly invented a new and useful Improvement in Methods of Making Light Metal Alloys, of which the following is a specification, the principle of the invention being herein explained and the best mode in which we have contemplated applying that principle, so as to distinguish it from other inventions.

Aside from the difficulties inherent in the handling of molten magnesium, such difficulties being well set forth in U. S. Patent No. 906,820 to Racowicz, dated December 15, 1908, special difficulties are encountered when it is sought to alloy with the magnesium one or more additional metals in relatively small amount. Particularly when it is attempted to add to such magnesium as an alloying ingredient either copper or any other metal which has a specific gravity higher than and a melting point much above that of magnesium, the direct addition of the alloying metal in solid form to molten magnesium, as described for example in German Patent No. 122312 to Aluminium- und- Magnesium Fabrik, dated December 16, 1900, results in the former sinking promptly to the bottom of the mass of magnesium, or where the latter is floated, as described in the patent just cited, in a bath of suitable flux material, then such heavier metal will drop entirely through the molten magnesium and into the flux below the latter. If it is sought to overcome this difficulty by heating the magnesium high enough for the copper to alloy quickly, there is considerable danger of burning the magnesium, and even where the copper, or other metal, is cut up into very fine pieces to facilitate the alloying operation at a lower temperature, considerable time is consumed in the alloying process.

One object of the present invention, accordingly, is to provide a simple and expeditious method for adding alloying metals to a larger mass of magnesium, whereby the thorough inter-mixture of the ingredients is insured and particularly the retention of

all of the alloying ingredient. A further object is to avoid the necessity of employing temperatures so high as to endanger the magnesium taking fire.

To the accomplishment of the foregoing and related ends the invention, then, consists of the steps hereinafter fully described and particularly pointed out in the claims, the following description setting forth but one of the various ways in which the principle of the invention may be carried out.

In making an alloy of the character described by the present improved method or process, a measured quantity of pure magnesium metal is first melted in a suitable pot along with the proper amount of a flux that, while heavier than such metal, will have proper surface tension to promptly and effectively coat the metal. As an example of such a flux, approximately equal parts of anhydrous magnesium chloride and sodium chloride may be employed, and if the specific gravity of such flux proves inadequate to float the metal after it has been alloyed, a small amount of barium chloride may be added.

A small amount of the molten magnesium metal is then taken up in a ladle, the film of flux covering the surface of the latter in the pot being brushed aside for this purpose and all or a part of the alloying metal, depending upon the total percentage of the latter to be added to the batch, is placed in such ladle and melted with the magnesium therein, whereby an alloy relatively rich in such added metal is produced. The contents of the ladle are then gradually added to the main body of molten magnesium with the result that the added ingredient will diffuse throughout the mass and not drop through into the body of flux on which the latter floats and so be lost.

As soon as the introduction of the preliminary alloy thus made in the ladle has been effected, the whole mass is well puddled and the operation may then be regarded as complete and the molten alloy cast either into ingots or directly into the form of mechanical parts, such as pistons or the like, for which it is intended to be used.

Alloys in which magnesium is the predominant constituent, i. e., alloys containing 80 per cent or more of this metal, may be readily made in accordance with the fore-

going procedure where, for example, aluminum, tin, zinc, copper or cadmium is the added ingredient. Where two or more such added ingredients are desired in the alloy, a binary combination of the magnesium with one such ingredient may first be produced in the fashion described above and the relatively small amount of each additional metal may then be separately introduced in the same fashion as was the added ingredient that goes to make such binary alloy; or, on the other hand, two or more of such additional ingredients may be at once admixed with the relatively small amount of the molten magnesium taken up in a ladle as before and so form a preliminary alloy relatively high in such added ingredients, which alloy is subsequently added to the main body of the molten magnesium metal, resulting in the production of the desired alloy in which such magnesium is the predominant ingredient.

Where an alloy of the class described is desired in which, in addition to aluminum, copper or other metal of similar relatively high melting point is to be included as an ingredient, we have found it advantageous to first alloy such copper with the aluminum so as to give an alloy containing approximately equal parts of each metal. The melting point of such resulting alloy will be below that of magnesium, and when it is added to a little magnesium in the ladle, the ternary combination is effected without difficulty. The resultant ternary alloy is then intermixed with the main body of the magnesium and where the amount of aluminum required in making such preliminary aluminum-copper alloy is less than the total amount of aluminum to be added, the remaining quantity of this metal is then separately introduced into the main body of metal in the pot, preferably being first melted along with a little magnesium in a ladle, as before described. In the same way, where an alloy of more complex formula is to be made, and still other ingredients as, for example, zinc and cadmium, are to be added, these will be introduced in the same fashion, being admixed with a relatively small amount of molten magnesium apart from the main body thereof, either singly or together, and then added to such main body.

It will thus be seen that our improved method is adaptable for the making of light metal alloys in which magnesium is the predominant ingredient, irrespective of whether one or more additional ingredients are employed. In other words, a simple binary alloy of magnesium with either aluminum, tin, zinc, cadmium, or the like, may be thus made, or ternary and higher, more complex alloys. By means of our improved method we, furthermore, are successful in eliminating all of the practical difficulties heretofore

encountered in handling magnesium alloys, and the resultant alloy in the molten condition in which it exists in the pot after the alloying process proper has been completed, may be directly employed in the casting either of ingots or mechanical parts by simply ladling such molten metal into suitable molds.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the method herein disclosed, provided the step or steps stated by any of the following claims or the equivalent of such stated step or steps be employed.

We therefore particularly point out and distinctly claim as our invention:—

1. In a method of making a light metal alloy in which magnesium largely predominates, the steps which consist in first interfusing the desired amount of the alloying metal with a relatively small quantity of magnesium, and then adding the resulting alloy to the remaining quantity of magnesium in molten state.

2. In a method of making a light metal alloy in which magnesium largely predominates, the steps which consist in melting a measured quantity of magnesium, floating same in a bath of flux, interfusing the proper amount of the alloying metal with a relatively small quantity of such molten magnesium, and then adding the resulting alloy to the remainder of such magnesium.

3. In a method of making a light metal alloy in which magnesium largely predominates, the steps which consist in melting a measured quantity of magnesium floating same in a bath of flux consisting of a mixture of magnesium chloride and an alkali metal chloride, interfusing the proper amount of the alloying metal with a relatively small quantity of such molten magnesium, and then adding the resulting alloy to the remainder of such magnesium.

4. In a method of making a light metal alloy in which magnesium largely predominates, the steps which consist in melting a measured quantity of magnesium, floating same in a bath of flux consisting of a mixture of magnesium and sodium chlorides in approximately equal proportions, interfusing the proper amount of the alloying metal with a relatively small quantity of such molten magnesium, and then adding the resulting alloy to the remainder of such magnesium.

5. In a method of making a light metal alloy in which magnesium largely predominates, such alloy also including aluminum and another metal, the steps which consist in first making an alloy of the aluminum and such other metal, interfusing such aluminum alloy with a relatively small quantity of magnesium, and then adding the result-

ing alloy to the remaining quantity of magnesium in molten state.

6. In a method of making a light metal alloy in which magnesium largely predominates, such alloy also including aluminum and copper, the steps which consist in first making an alloy of the aluminum and copper, interfusing such aluminum-copper alloy with a relatively small quantity of magnesium, and then adding the resulting alloy to the remaining quantity of magnesium in molten state.

7. In a method of making a light metal alloy in which magnesium largely predominates, such alloy also including aluminum and copper, the steps which consist in first making an alloy of the aluminum and copper in approximately equal proportions, interfusing such aluminum-copper alloy with a relatively small quantity of magnesium, then adding the resulting alloy to the remaining quantity of magnesium in molten state, and similarly interfusing with a relatively small amount of magnesium and adding to the main body of the latter any additional aluminum required by the formula.

8. In a method of making a light metal alloy in which magnesium largely predominates, such alloy also including aluminum and copper, the steps which consist in first making an alloy of the aluminum and copper in approximately equal proportions, interfusing such aluminum-copper alloy with a relatively small quantity of magnesium, then adding the resulting alloy to the remaining quantity of magnesium in molten state, and similarly interfusing with a relatively small amount of magnesium and adding to the main body of the latter any additional constituent required by the formula having a melting point not greatly exceeding that of magnesium.

9. In a method of making a light metal alloy in which magnesium largely predominates, such alloy also including aluminum and copper, the steps which consist in first making an alloy of the aluminum and copper in approximately equal proportions, interfusing such aluminum-copper alloy with a relatively small quantity of magnesium, then adding the resulting alloy to the remaining quantity of magnesium in molten state, and similarly interfusing with a relatively small amount of magnesium and adding to the main body of the latter any additional alu-

minum and other metal required by the formula having a melting point not greatly exceeding that of magnesium.

10. In a method of making a light metal alloy in which magnesium largely predominates, the steps which consist in melting a measured quantity of magnesium, floating same in a bath of flux capable of forming a protective coating over the surface of such magnesium, adding the alloying metal to a portion of such magnesium apart from the main body of the latter, and then returning such portion with alloying metal interfused therewith to such main body.

11. In a method of making a light metal alloy in which magnesium largely predominates, the steps which consist in melting a measured quantity of magnesium, floating same in a bath of flux capable of forming a protective coating over the surface of such magnesium, adding the alloying metal in molten state to a portion of such magnesium apart from the main body of the latter, and then returning such portion with alloying metal interfused therewith to such main body.

12. In a method of making a light metal alloy in which magnesium largely predominates, the steps which consist in melting a measured quantity of magnesium, floating same in a bath of flux consisting of a mixture of magnesium chloride and an alkali metal chloride, adding the alloying metal to a portion of such magnesium apart from the main body of the latter, and then returning such portion with alloying metal interfused therewith to such main body.

13. In a method of making a light metal alloy in which magnesium largely predominates, the steps which consist in melting a measured quantity of magnesium, floating same in a bath of flux consisting of a mixture of magnesium chloride and an alkali metal chloride, adding the alloying metal in molten state to a portion of such magnesium apart from the main body of the latter, and then returning such portion with alloying metal interfused therewith to such main body.

Signed by me this 21st day of November, 1921.

WILLIAM R. VEAZEY.

Signed by me this 23 day of November, 1921.

EDWARD C. BURDICK.