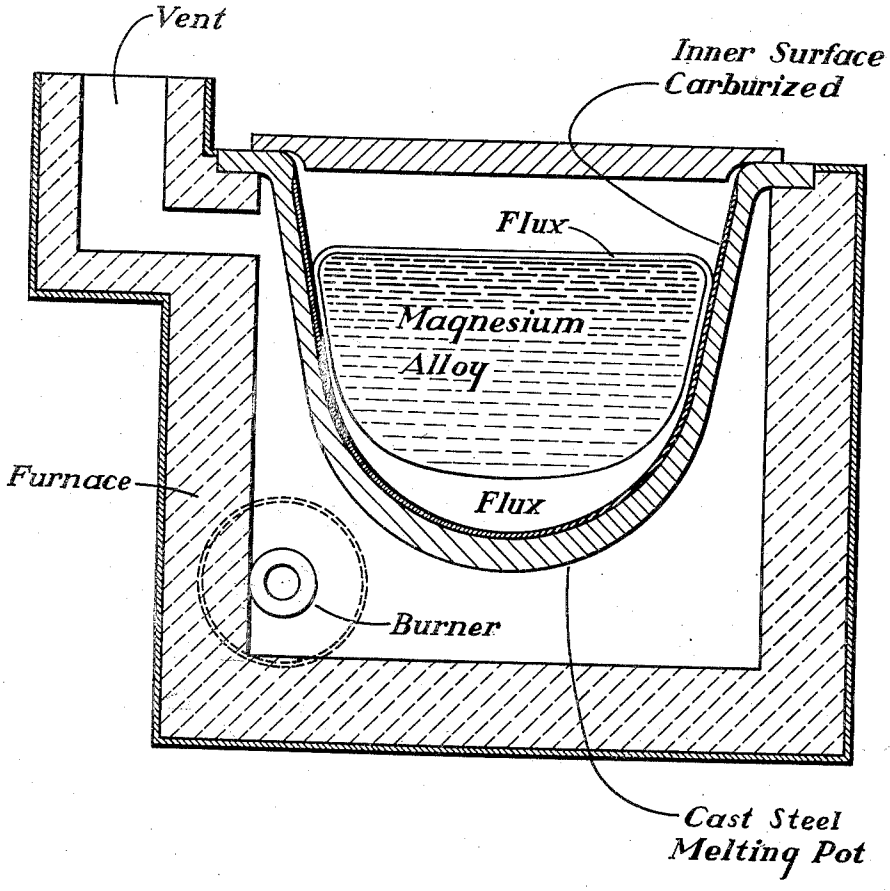
Nov. 11, 1941. F. C. BENNETT ET AL 2,262,220

MELTING MAGNESIUM-BASE ALLOY

Filed Aug. 30, 1940



INVENTORS
FOSTER C. BENNETT
BY RICHARD I. THRUNE
Griswold & Burdick
ATTORNEYS

Patented Nov. 11, 1941

2,262,220

UNITED STATES PATENT OFFICE

2,262,220

MELTING MAGNESIUM-BASE ALLOY

Foster C. Bennett and Richard I. Thrune, Midland, Mich., assignors to The Dow Chemical Company, Midland, Mich., a corporation of Michigan

Application August 30, 1940, Serial No. 354,788

6 Claims. (Cl. 75—67)

This invention relates to a method and apparatus for melting magnesium-base alloys.

In the melting of magnesium-base alloys, the art has been limited largely to the use of vessels formed of ordinary low-carbon low-alloy steel. Thus cast-iron containers are too porous to the metal and the fluxes used, while the more common special alloy and non-metallic vessels are frequently chemically reactive with the molten metal or else are too fragile or too expensive to be commercially feasible. However, steel containers are themselves subject to the disadvantage that during prolonged use they are attacked somewhat by the molten alloys, particularly those alloys containing a minor proportion of aluminum or manganese. This corrosion, while significant even in ordinary melting practice, is particularly serious in settling treatments and in those alloying processes in which aluminum or manganese is incorporated into a mass of molten magnesium. Such corrosive attack is unfortunate not only in that it results in the weakening and eventual failure of the vessels, but also in that it frequently leads to contamination of the alloy by traces of iron.

Efforts are commonly made to minimize these effects by surrounding the body of molten alloy with a film of protective flux which is intended to prevent the alloy from touching the walls of its container. However, these efforts have been largely unsuccessful, since during stirring, ladling, and pouring it is a virtual impossibility to maintain the flux film intact, and the alloy itself invariably is in direct contact with the vessel during an appreciable proportion of the time. As a result, the corrosive attack on steel containers by magnesium-base alloys has until now remained a serious practical problem.

The principal object of the present invention, then, is to overcome these existing difficulties by providing a method of treating steel vessels to render them more resistant to corrosion by magnesium-base alloys, especially those alloys containing a minor proportion of at least one of the metals aluminum and manganese.

According to the invention, this object is attained by carburizing the inner surfaces of the steel vessel prior to the introduction of the magnesium-base alloy. The carburized coating formed effectively retards corrosion of the vessel by the molten alloys without in any way sacrificing its mechanical strength. In addition, in contrast to previous treatments, the protective layer may be easily produced with the simplest of equipment and without the use of expensive reagents.

Carburization according to the invention may be applied to vessels formed of any of the steels, including alloy steels, commonly employed as containers for molten magnesium-base alloys. However, as a matter of economy, vessels of ordinary low-carbon low-alloy steel are usually selected, and, when carburized, attain a corrosion resistance entirely adequate for almost all purposes. In general, the treatment may advantageously be carried out on steel vessels used as containers for molten magnesium-base alloys in all the operations to which such alloys are subjected. As noted, the process is particularly useful in retarding the corrosion of the direct-fired cast-steel pots used in melting and settling operations, and in alloying processes involving magnesium-base alloys containing a minor proportion of at least one of the elements aluminum and manganese. These latter operations are carried out by heating a body of molten magnesium under a protective flux, and incorporating the aluminum or manganese therein. For all these purposes, the carburized pots are used in a manner entirely similar to that of the steel pots used heretofore.

In so far as it has been possible to determine, any of the carburizing treatments ordinarily applied to steel is operable in producing a surface resistant to attack by magnesium-base alloys. Thus gas and flame treatments, liquid and solid carburizations, cyanidation, and the like are all satisfactory, being carried out in accordance with known practice. In general, it is customary to carburize the entire inner surface of the steel vessel, although the process may if desired be limited to those portions of the vessel likely to come into contact with the molten alloy or alloying constituents. The treatment is carried out for a time sufficient to produce a carburized layer having substantial thickness and a significantly greater carbon content than the base metal. Instead of using direct carburization as described, the carburized layer may also be provided by casting in place or otherwise inserting a lining of carburized (i. e. high-carbon) steel or iron over the inner surfaces of the steel vessel.

In the case of cast-steel melting pots, the use of carbon pastes provides a particularly convenient method of effecting carburization. Thus, the inner surfaces of the pot are first coated with a layer of paste consisting essentially of finely-divided carbon or graphite and a heat-hardening binder therefor, such as a heavy liquid tar. (Such

pastes are described in detail in application Serial No. 312,550, filed January 5, 1940, by Richard I. Thrune.) After coating, the pot is baked at a high temperature, e. g. 600° C. to 800° C. to set the binder and form a continuous adherent carbon lining. The lined pot is then heated for a time sufficient to produce substantial carburization of the inner steel surface thereof by the carbon from the lining, usually for several hundred hours at a temperature of 650°–1100° C. This heating may be accomplished simply by using the lined pot in regular service for melting magnesium-base alloys. In this manner, it is possible, in the case of an ordinary cast-steel melting pot having a carbon content of roughly 0.1 per cent, to produce a carburized layer having a thickness as much as 0.25 to 1.0 inch or more and a carbon content of 0.7 to 1.2 per cent, or even higher, if desired. When sufficient carburization has been effected, the lining is removed from the pot, after which the pot is ready for use according to the invention.

The accompanying self-explanatory diagrammatic drawing will further serve to illustrate the invention.

It is to be understood that the foregoing description is illustrative rather than strictly limitative, and that the invention is co-extensive in scope with the following claims.

We claim:

1. In a process wherein a magnesium-base alloy is maintained in the molten state in a steel vessel, the improvement which consists in retarding corrosion of the vessel by the molten alloy and reducing contamination of the alloy by heating the alloy in such steel vessel, the inner surfaces of which exposed to contact with the molten alloy have previously been provided with a carburized iron layer.

2. In a process wherein a magnesium-base alloy containing a minor proportion of at least one of the metals aluminum and manganese is melted in a cast-steel pot, the improvement which consists in retarding corrosion of the pot by the molten alloy and reducing contamination of the alloy by melting the alloy in such cast-steel pot, the inner surfaces of which have been previously carburized.

3. In a process for forming a magnesium-base alloy wherein at least one of the alloying metals aluminum and maganese is incorporated into a mass of molten magnesium maintained in a low-carbon low-alloy cast steel pot, the improvement which consists in heating the molten magnesium under a protective flux and incorporating the alloying metal therein in such cast-steel pot, the inner surfaces of which have previously been carburized.

4. In a furnace for melting magnesium-base alloys containing a minor proportion of at least one of the metals aluminum and manganese, an improved melting pot consisting of a low-carbon low-alloy cast-steel pot the inner surfaces of which have been carburized to render the same more resistant to corrosive attack by the molten alloys.

5. In a process wherein a magnesium-base alloy is maintained in the molten state in a steel vessel, the improvement which consists in retarding corrosion of the vessel by the molten alloy and reducing contamination of the alloy by carburizing the inner surfaces of the vessel to be exposed to the molten alloy prior to bringing the alloy into contact with such surfaces.

6. In a process wherein a magnesium-base alloy containing a minor proportion of at least one of the metals aluminum and manganese is melted in a cast-steel pot, the improvement which consists in retarding corrosion of the vessel by the molten alloy and reducing contamination of the alloy by carburizing the inner surfaces of the pot prior to melting the alloy therein, said carburizing operation comprising coating the inner surfaces of the pot with a paste consisting essentially of finely-divided carbon and a heat-hardening binder therefor, baking to set the binder, then heating the resulting carbon-lined pot for a time sufficient to produce substantial carburization of the inner steel surface thereof, and thereafter removing the lining.

FOSTER C. BENNETT.
RICHARD I. THRUNE.