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APPARATUS FOR CHLORODIZING ALUMINUM-BASE ALLOYS

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Fig. 1

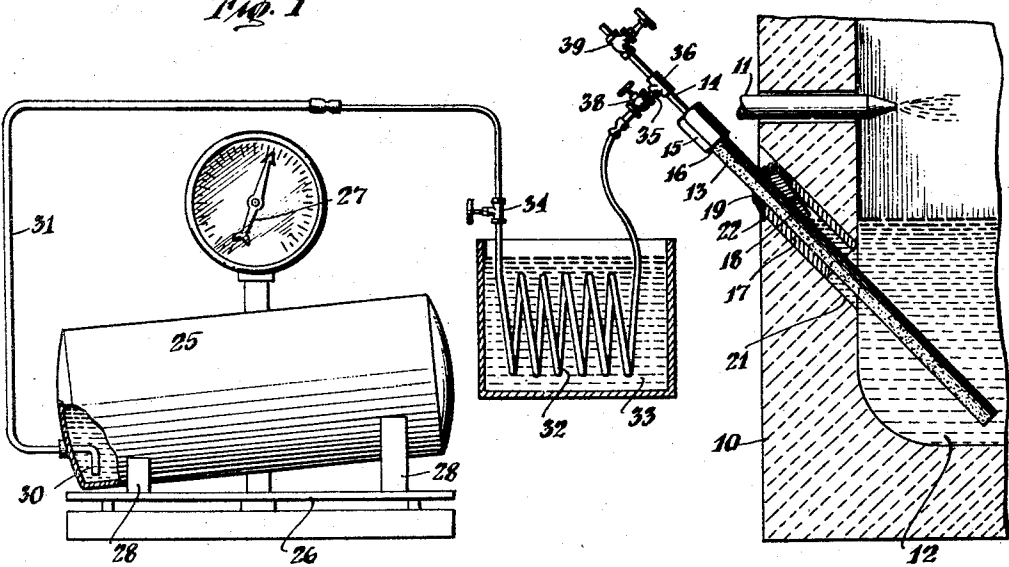
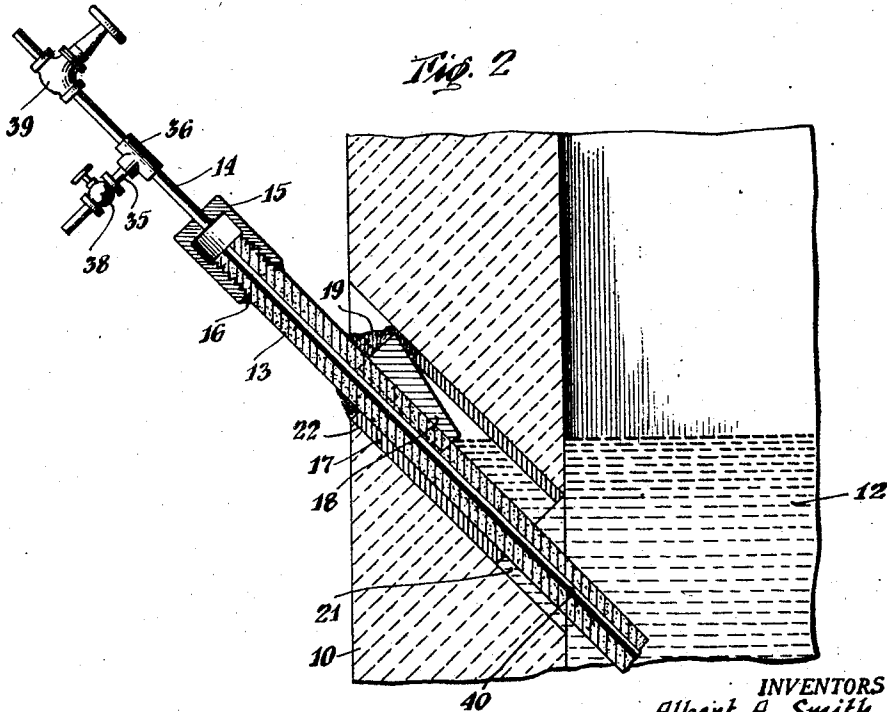


Fig. 2



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APPARATUS FOR CHLORIDIZING ALUMINUM-BASE ALLOYS

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1 Claim. (Cl. 266—34)

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This invention relates to the refining of aluminum and, more particularly, to the chloridization of aluminum-base alloys to effect the removal of magnesium.

It has been proposed in the past to bubble halogen gas through a molten bath of aluminum in order to remove dissolved gases and suspended solid impurities, such as dirt, oxides, nitrides, carbides, etc., therefrom; further, it has been proposed to conduct the de-gassing of aluminum and aluminum-base alloys by chlorine in an atmosphere of dry air.

More recently, it was suggested that magnesium might be selectively removed from aluminum alloys by treating such alloys with chlorine. However, repeated attempts to carry the suggestion into commercial practise met with failure both as regards effecting proper chloridization and in obtaining a satisfactory casting of the refined metal.

The present invention provides certain improvements in an apparatus which establishes the selective chloridization of magnesium from aluminum-base alloys as a truly commercial operation.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claim appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawing, forming a part thereof, in which

Fig. 1 is a view in elevation, partly in section, of apparatus embodied by the invention and suitable for practicing the process thereof; and

Fig. 2 is an enlarged view of a portion of the apparatus shown in Fig. 1 showing, in section, the tube for introducing the chlorine gas into the melt and the mounting of the tube in the furnace wall.

Like reference characters denote like parts in the two figures of the drawing.

In the drawing, 10 indicates a furnace of the reverberatory type which may be equipped with the conventional forehearth as is well known in the commercial treatment of aluminum scrap materials. A burner 11 is provided for firing the furnace and 12 indicates the bath or melt of aluminum-base material from which magnesium is to be removed. A refractory tube member, generally designated by 13, projects through a wall of the furnace at an angle of approximately 45° and into the body of the melt 12. As shown

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in Fig. 1, the tube 13 is of such length that its discharge end extends to a position adjacent the furnace hearth.

The tube 13 is made of a suitable refractory material, for example, silicon carbide, quartz, graphite or the like, that is resistant to the corrosive action of gaseous chlorine. It has been found that a very satisfactory tube can be provided by drilling a .5 to .75-inch diameter hole centrally and longitudinally of a 3.25-inch dense graphite electrode of desired length. The upper and outer end of the graphite tube 13 is connected to a pipe section 14 by means of a reducer pipe coupling 15 threaded on the end of the graphite tube. To assure a gas-tight point the threads are filled with a mastic composed of powdered graphite and light machine oil and, after screwing the coupling on tightly, the joint is packed with graphite mastic as indicated at 16, Fig. 2.

To preclude vibration or whipping action of the tube 13 during use, it is firmly mounted by providing a silicon carbide sleeve 17 extending diagonally through the furnace wall from inner wall opening 21 to outer wall opening 22. It will be observed that the inner wall opening 21 is well below the surface of the melt 12 thereby precluding accelerated oxidation of the tube 13 by direct action of the furnace flame from burner 11, while the outer wall opening 22 is well above the metal line thereby permitting ready removal, repair or replacement of tube 13 during operation of the furnace.

The tube 13 is positioned in sleeve 17 by means of a wedge 18 made of similar refractory material and inserted between the tube 13 and the upper inner wall of sleeve 17 as shown in the drawing. Fire clay 19 may be applied to close any remaining openings between the exterior of the tube 13 and the interior of the sleeve 17. While one tube has been found satisfactory for a reverberatory furnace treating 15 to 25-ton aluminum-base melts of the composition for the treatment of which the present invention is particularly applicable, i. e., melts analyzing up to 2% magnesium, the furnace may be provided with a plurality of tubes 13 if deemed desirable or necessary.

As illustrated in Fig. 1, a steel cylinder 25 containing liquid chlorine is supported on a suitable scale means 26 equipped with a weight indicating dial hand 27. A cradle structure 28 is provided on the scale means 26 for retaining the liquid chlorine tank 25 on its side with one end slightly raised. Pipe means 30, 31 lead from the liquid chlorine tank 25, through needle valve 34

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to a vaporizer comprising copper coil 32 immersed in heated water bath 33, and thence through globe valve 38, nipple section 35 and T-pipe fitting 36 to pipe 14 and refractory tube 13. A gate valve 39, normally closed, is provided on the extended portion of pipe 14 above T-fitting 36 to permit insertion of a rod through pipe line 14 into the bore 40 of tube 13 to clean or clear the latter as required.

The following will serve to illustrate how the invention may be practiced. A melt is established in the reverberatory furnace 10 by charging with aluminum-bearing scrap materials containing magnesium, and the melt brought to a proper temperature. This temperature is $750^{\circ}\text{C} \pm 100^{\circ}\text{C}$. and preferably in the lower half of that range, depending somewhat upon the constituents of the particular melt. While slightly higher temperatures can be tolerated, they should not exceed an upper maximum of 850°C – 900°C . This is an important consideration as it has been found that temperatures above this maximum range invariably invite not only improper chloridization but imperfections in the cast metal as well.

Having established the melt at the proper temperature, valve 39 is opened wide and needle valve 34 slowly opened to admit liquid chlorine from cylinder 25 into the coil section 32 where the chlorine is vaporized and from whence the gaseous chlorine passes through valve 38, pipe 14 and downwardly through tube 13 into the melt 12 at a point immediately above the hearth of the furnace. By introducing the gaseous chlorine in this manner, it has been found that sufficient agitation and circulation of the metal results to selectively chloridize the magnesium to magnesium chloride which floats on the melt and renders it unnecessary to provide for mechanical agitation. The weight of chlorine introduced into the melt can be readily obtained by observing the relative change in position of the dial hand 27.

Liquid chlorine supply cylinder 25 is preferably located in a relatively cool place, that is, a location where it will not be subjected to temperatures appreciably above room temperature. On the other hand, the vaporizing unit is preferably located in an environment of higher temperature, e. g., adjacent the outer wall of the furnace, as an aid in providing warmth to the water bath 33 for insuring complete vaporization of the chlorine passing into the tube 13. As a simple control measure for plant operation, it has been found effective to open the needle valve 34 sufficiently to provide a flow of chlorine through coil 32 at such rate that no frost forms between the needle valve and the vaporizing unit but that frost does develop on the pipe coupling 15. Operating in this manner, the controlled flow of chlorine is such that no liquid chlorine enters the melt; additionally, the coupling 15, pipe 14, etc., may be made of cast iron as such operation renders them immune to accelerated corrosive attack by the

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chlorine gas. Conducting the chloridization in this manner with a tube 13 having a .5-inch diameter bore, no difficulty has been encountered in introducing chlorine into melts at a rate of from 100 to 200 pounds per hour up to several times that figure except for an increased tendency toward aluminum chloride formation at the higher rates.

The advantages attending the use of the invention will be readily apparent from the following actual commercial runs. In the first instance, a melt of 23 tons of aluminum-base scrap materials was established at about 730°C . in a reverberatory furnace as hereinbefore described. The melt analyzed originally 0.75% magnesium and was treated with 1880 pounds chlorine over a two-hour period. The cast product was sound and contained only 0.02% magnesium. In a similar run, a 24.6 ton melt analyzing 1.1% magnesium was brought to a temperature of about 705°C . and treated with 2610 pounds chlorine during a four-hour period. Sound metal ingots were cast analyzing only 0.01% magnesium.

The present application is a continuation-in-part of applicants' prior application Serial No. 469,544, filed December 19, 1942, now abandoned.

What is claimed is:

Apparatus for refining metal such as an aluminum-magnesium mixture to remove magnesium from the aluminum in the form of magnesium chloride which comprises a furnace for maintaining a molten bath of said metal, means for internally heating said furnace to melt said metal, a tank for liquid chlorine, a temperature controlled chlorine vaporizer, a conduit connecting said tank and vaporizer to carry liquid chlorine from said tank, a valve in said conduit ahead of said vaporizer to control the rate of flow of chlorine into said vaporizer, a duct through a wall of said furnace, the opening of the duct on the outside of said wall being above and the opening of the duct on the inside of said wall being below the surface of the metal in said furnace, a graphite tube extending through said duct and having its portion within the furnace below the surface of said metal to carry gaseous chlorine into said molten metal, removable sealing means to hold said tube firmly in said duct, and a conduit connecting said vaporizer with said tube to carry gaseous chlorine from said vaporizer to said tube.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,174,926	Messner	Oct. 3, 1939