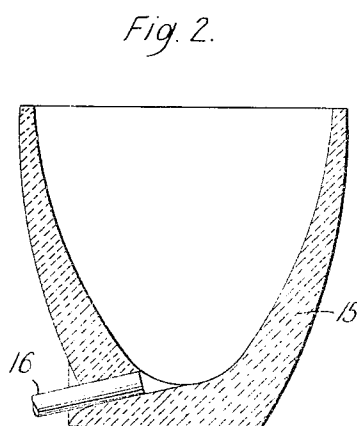
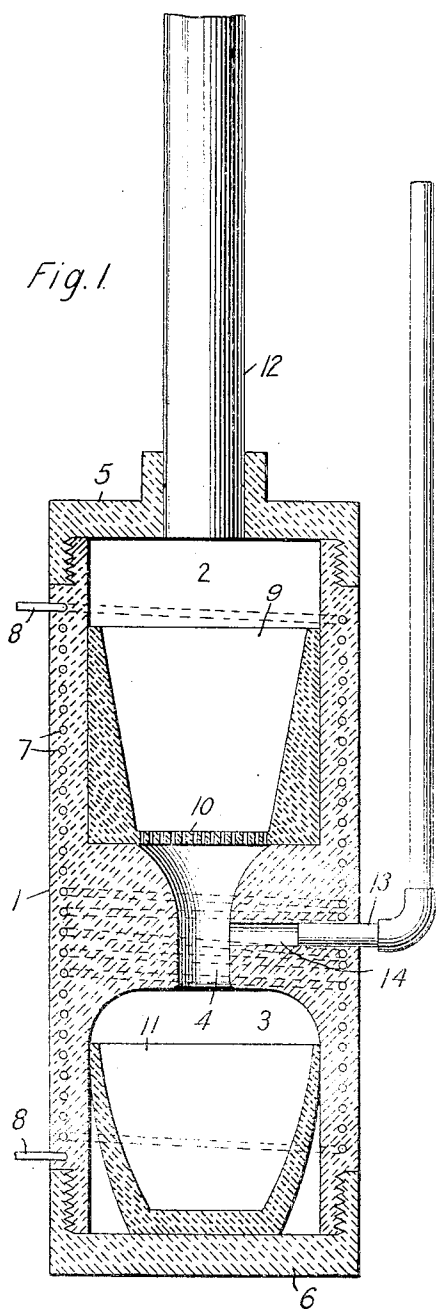


J. COULSON.  
METHOD OF RECLAIMING TURNINGS OF READILY OXIDIZABLE METALS.  
APPLICATION FILED SEPT. 22, 1915.

1,292,582.

Patented Jan. 28, 1919.



WITNESSES:

*Frederick Miller*  
*R. D. Brown*

INVENTOR

*John Coulson*

BY

*Wesley E. Carr*  
ATTORNEY

# UNITED STATES PATENT OFFICE.

JOHN COULSON, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

## METHOD OF RECLAIMING TURNINGS OF READILY-OXIDIZABLE METALS.

1,292,582.

Specification of Letters Patent.

Patented Jan. 28, 1919.

Application filed September 22, 1915. Serial No. 51,948.

*To all whom it may concern:*

Be it known that I, JOHN COULSON, a subject of the King of Great Britain, and a resident of Wilksburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Methods of Reclaiming Turnings of Readily-Oxidizable Metals, of which the following is a specification.

My invention relates to methods of reclaiming and melting into homogeneous metallic form the turnings and borings which result from machining operations upon readily oxidizable metals and alloys of the aluminum class, and it has special reference to methods of reclaiming borings and turnings of magnalium.

The object of my invention is to provide a simple and commercially practicable process of the above indicated character whereby turnings of aluminum, magnalium and other readily oxidizable metals and alloys may be melted into solid metallic form with a minimum amount of loss.

In the accompanying drawing, Figure 1 is a vertical sectional view illustrating one form of apparatus suitable for carrying out my invention, and Fig. 2 is a vertical sectional view of a crucible adapted for use in practicing a modified form of my invention.

My present invention finds special commercial utility in the treatment of borings and turnings of the alloy magnalium, and the steps of my process will therefore be described specifically with relation to this substance without, however, limiting my invention thereto. Magnalium, on account of its lightness, high tensile strength and other desirable physical characteristics is very largely used in the manufacture of castings and other machine parts, and the operations performed upon such castings result in the production of large amounts of more or less finely divided turnings, borings and other forms of scrap. This scrap metal cannot be melted down by ordinary methods on account of the very great rapidity with which the material is oxidized. It is found that magnalium oxidizes even more rapidly and violently than metallic aluminum itself. In melting magnalium scrap, it has therefore been customary, up to the present time, to make use of strong fluxes, such as the chlorids and fluorids of the alkali and al-

kaline earth metals, for the purpose of dissolving the oxid scale which covers the particles of metal and, by the production of gas, to mechanically agitate the molten metal and promote its diffusion. Cryolite, for example, is very commonly used as a flux under these circumstances.

The use of cryolite as a flux is objectionable on account of the vigor with which it attacks silicon or graphite crucibles. Crucibles of iron or other metal cannot be used on account of the dissolving action of molten magnalium, and it is therefore highly desirable to avoid the use of strong fluxes and, at the same time, to keep the melting losses as low as possible.

According to one modification of my present invention, I melt metallic turnings of the above mentioned kinds in the presence of an inert or reducing gas, which may conveniently be hydrogen. The gas should be applied to the metal in such manner as to pass through it during the heating process, which may be accomplished, for example, by means of the apparatus shown in Fig. 1 of the drawing. This apparatus consists of a circular casing 1 divided into upper and lower chambers 2 and 3 connected by a vertical passage 4. The ends of the casing 1 are inclosed by screw caps 5 and 6. Means are provided for heating the casing throughout its length, such means, as shown, comprising an electrical resistance coil 7 embedded in the walls of the casing and provided with terminals 8 to which electric energy may be supplied from any suitable source. Any other convenient heating means may of course be substituted for the electric heating coil 7 and the casing may be made of any suitable material.

A crucible 9 is received in the upper chamber 2 of the casing 1 and is provided with a perforated bottom 10 disposed directly above the vertical passage 4. A crucible 11 is disposed in the lower chamber 3 of the casing 1 for the purpose of receiving molten metal. A pipe 12 communicates with the chamber 2 through the cap 5 and another pipe 13 communicates with the vertical passage 4 through a horizontal opening 14.

In the operation of this form of device, the metallic turnings to be melted are placed in the crucible 9, the casing is tightly closed and hydrogen or other suitable inert or reducing gas is introduced under pressure

through the pipe 12. Since the gas outlet pipe 13 is of smaller diameter than the pipe 12, a considerable degree of pressure is maintained at all times in the crucible 11. The gas should be passed through the apparatus for several minutes in order to wash it thoroughly free from oxygen, and heat is then applied by energizing the coil 7 to raise the temperature within the treating vessel to about 900° C. I find it convenient to apply the gas from above and under such pressure that the globules of molten metal produced by the heat treatment are forced through the perforations in the plate on which the turnings rest, and I find that this method produces a very satisfactory recovery of magnalium.

It is very desirable that the metal particles be cleansed as thoroughly as possible before they are melted, and the cleansing treatment may conveniently be combined with the addition of small amounts of weak fluxing agents which are sometimes desirable. Since the metal is usually contaminated with oil or grease, a preliminary washing with benzin or other solvent is desirable, and the metal may then be boiled for a few minutes in a weak solution of a fluxing agent, which solution may be a 4% solution of sodium chlorid. This boiling treatment not only cleanses the metal to a considerable extent, but replaces the air entangled by the metal, while the small amount of sodium chlorid which adheres to the metal serves the purpose of a weak flux during the subsequent melting operation.

The cleansed metal, treated in the manner just described, may either be subjected to the foregoing heat treatment in the presence of gas or it may be melted in an open crucible according to the following method. An ordinary graphite or silicon crucible, such as is shown at 15 in Fig. 2 of the drawing, is heated to a temperature of about 900° C., and the metallic turnings, previously washed in benzin and boiled in a weak salt solution, are fed into the hot crucible while they are still damp. The introduction of the turnings is accompanied by mechanical stirring, and after each successive addition of the turnings, the contents of the crucible are thoroughly stirred or puddled until the mass becomes uniformly viscous.

In practising this modification of my invention, in which the turnings are puddled in successive small increments in an open crucible, the preliminary treatment with sodium chlorid or other fluxing solution may be omitted, in which case, a small pellet of solid magnalium should first be placed in the crucible and reduced to a molten state. The magnalium turnings are then fed slowly into the molten pool, which is agitated as before after each addition, and the molten metal is tapped off from time to time from the bot-

tom of the crucible by withdrawing a plug 16. The molten material already in the crucible smothers the turnings as fast as they are introduced and thus prevents oxidation to a very considerable extent.

In either of the methods described above, it is desired to let the molten charge stand in the hot crucible from ten to fifteen minutes after the last puddling operation, which gives the oxids which may be present time to rise to the surface where they float as a slag, while the clean metal may be poured from beneath. The dross remaining in the crucible after pouring contains some good metal which may be separated from the oxid by adding a small quantity of calcium chlorid and stirring vigorously.

During the puddling process described above, the heat may sometimes rise sufficiently to ignite the metal in the crucible. In such case, I find that the burning may be checked immediately by sprinkling into the crucible a small quantity of powdered cryolite. In order to avoid ignition of the charge during pouring, I prefer to tap off the molten metal from the bottom of the crucible.

The metal obtained by the foregoing methods always contains a small amount of metallic oxids which render the product inferior to the original magnalium or other metal from which the turnings were made. In order to improve the quality of the final product by removing such entangled oxids, I prefer to add to the contents of the crucible, in the course of the puddling process, a small amount of a de-oxidizing agent. Such de-oxidizing agent may be any one of a number of substances, but I prefer to employ, for this purpose, either metallic calcium or calcium-aluminum silicid, which need be added only in the proportion of  $\frac{1}{2}\%$  to  $1\frac{1}{2}\%$  of the charge of the crucible.

The several process steps which I have described may be combined in any convenient order or number as the requirements of special operations may make necessary or as the operator may desire. It is to be understood that my invention comprehends all such variations and that, in general, no limitations are to be imposed upon my invention except such as are indicated in the appended claims.

I claim as my invention:

1. The method of melting subdivided bodies of readily oxidizable metal that comprises boiling the subdivided metal in a solution of a fluxing agent, melting a solid mass of the same metal in a crucible, adding to the molten pool successive small increments of the subdivided metal, while still moistened with the said solution, and stirring the pool after each increment is added.

2. The method of melting subdivided bodies of readily oxidizable metal that com-

prises boiling the subdivided metal in a solution of sodium chlorid, melting a solid mass of the same metal in a crucible, adding to the molten pool successive small increments 5 of the subdivided metal, while still moistened with the said solution, and stirring the pool after each increment is added.

3. The method of melting subdivided 10 bodies of readily oxidizable metal that comprises combining successive increments of the metal while excluding air, separating the molten metal from the supernatant slag, heating the said slag with an alkaline earth

metal chlorid and removing the molten metal which separates from the slag.

4. The method of melting subdivided 15 bodies of readily oxidizable metal that comprises combining successive increments of the metal while excluding air and adding a small amount of a de-oxidizing agent containing calcium-aluminum silicid. 20

In testimony whereof, I have hereunto subscribed my name this 21st day of Sept., 1915.

JOHN COULSON.