Aug. 22, 1944. C. D. COXE 2,356,222

APPARATUS FOR MAKING METALLIC SHAPES

Original Filed May 11, 1940

Fig. 2

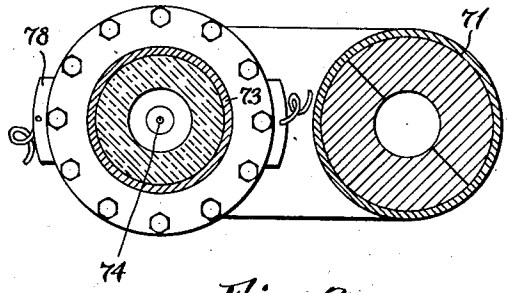



Fig. 3

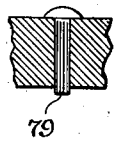



Fig. 1

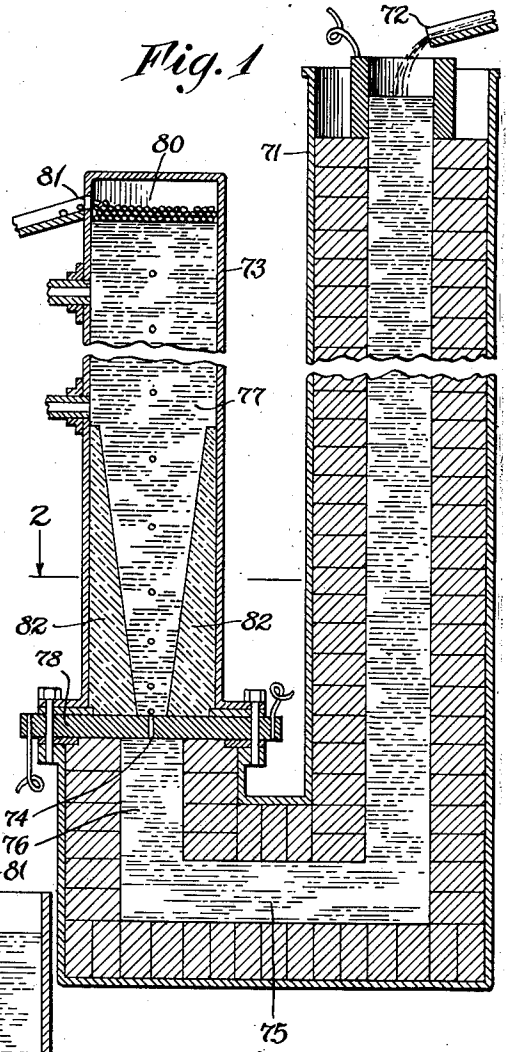
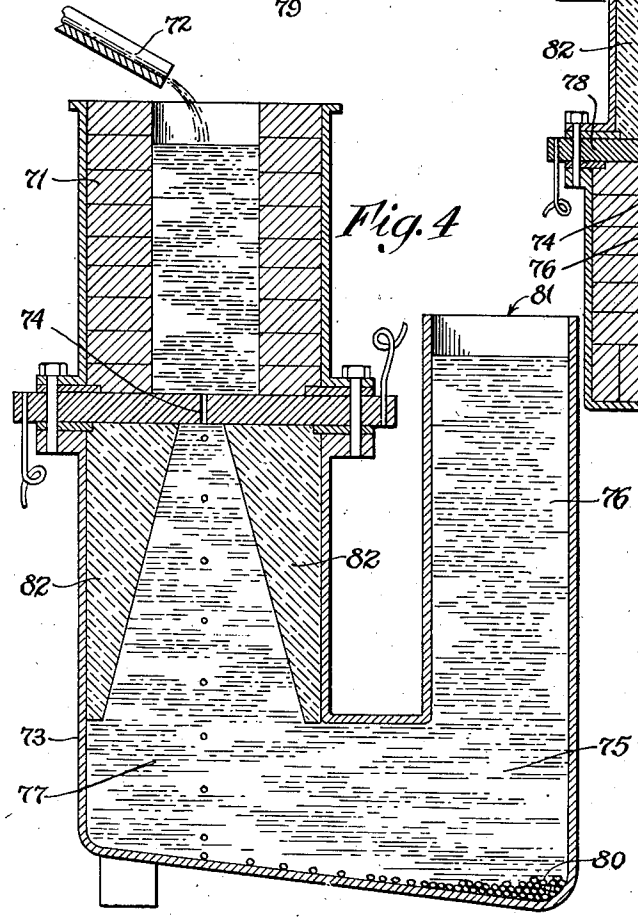



Fig. 4




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## APPARATUS FOR MAKING METALLIC SHAPES

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Original application May 11, 1940, Serial No. 334,537. Divided and this application June 10, 1942, Serial No. 446,453

5 Claims. (Cl. 83—91)

This invention relates to apparatus for the making of metallic shapes directly from a molten metal and is particularly adapted for the production of spherical objects such as balls or shot.

The present application is directed particularly to the production of spherical objects and is a division of application Serial Number 334,537, filed May 11, 1940, patented October 13, 1942, Patent No. 2,298,348. The making of round or spherical objects heretofore has required expensive machinery or the use of high towers for the dropping of the metal in its molten form. When the metal is dropped in the conventional shot tower it will assume a spherical form before it reaches the bottom of the tower. In the invention disclosed herein a molten metal bath is provided having a lower melting point than the freezing point of the metal to be shaped. The metal of the molten bath and the metal to be shaped must be immiscible or substantially immiscible, both in the liquid and the solid state. Preferably the two metals should have a different specific gravity so that they may be properly and easily separated from each other. By immiscible, it is not meant that the metals absolutely are not immiscible but that the immiscibility is such that they may be readily separated. The metal being shaped should also have sufficient hot tenacity to hold itself together as it is being formed into spherical articles.

The other objects of the invention will appear from the detailed description and drawing following, which give several forms of the invention and are merely for the purpose of illustration.

In the drawing:

Fig. 1 is a cross-sectional side elevation of an apparatus for making individual metal shapes, such as round balls or shot.

Fig. 2 is a sectional view taken at the line 2—2 of Fig. 1.

Fig. 3 is a diagrammatic sectional view of one form of nozzle and closure therefor, shown in Fig. 1.

Fig. 4 is a cross-sectional side elevation of a different form of an apparatus for making individual metal shapes, such as round balls or shot.

In general, the metal of the molten bath is one having a lower melting point and a higher boiling point than the freezing point of the metal which is to be shaped, and the specific gravity of the molten bath may be greater or less than the specific gravity of the metal to be shaped, depending upon the mode in which the invention is carried out, as will become apparent in the description of the invention which follows.

In the formation of spherical objects such as shot, a molten bath having a greater specific gravity than the metal to be shaped may be used and the molten metal to be shaped introduced at the bottom of the bath. When this is done a nozzle may be so arranged that the molten metal to be shaped will flow upwardly through the bath in particles or globules which will become spherical due to the surface tension of the metal and will freeze at the interface of the two metals so that by the time it reaches the top of the molten bath the metal object will have obtained its spherical form.

It is also evident that this process may be reversed and the specific gravity of the molten bath be less than that of the metal to be shaped and the molten metal allowed to drop into the molten bath and the spherical shapes removed from the bottom of the bath. The temperature of the bath and metal must be so regulated as to allow the proper shaping of the globules as they pass through the bath.

As an example of two metals that may be used, lead having a melting point of 621° F., a boiling point higher than 2800° F., and a specific gravity of 11.34 may be used as the molten bath; and aluminum having a melting point of about 1220° F. and a specific gravity of 2.7 may be used as the metal to be shaped. In this case, if aluminum shot or spherical objects are to be made, the metal may be introduced at the bottom of the molten lead bath and the aluminum will travel upwardly through the bath, attaining a spherical form by the time they reach the top of the bath. It is evident, of caurse, that the depth of the bath must be made such and the temperatures kept at such a point that the balls will attain their spherical form by the time they reach the surface.

Steel or iron having a melting point of about 1535° C. may be used in place of aluminum. As other examples, silver may be used as the molten bath for the shaping of chromium and nickel, silver having a lower melting point than chromium and nickel, and having a higher specific gravity. Bismuth or cadmium may also be used as the molten bath for the formation of aluminum shapes.

If, for example, aluminum be maintained at a temperature of about 690° C. and most of the lead kept at a temperature of about 400° C., the aluminum will freeze at the interface of the two metals.

By the invention described herein, metal objects may be formed such as spherical or similar objects by the apparatus shown in Figs. 1 and 2. The form shown in Figs. 1 and 2 is one wherein the molten bath has a higher specific gravity and lower melting point than the metal to be shaped. In Fig. 4 the molten bath has a lower specific gravity than the metal to be shaped.

The form shown in Figs. 1 and 2 first will be described in detail. The metal bath to be used in the forming of the objects is located within container 73 wherein there is a molten metal bath having a higher specific gravity and lower melting point than the metal to be shaped. A nozzle may be provided at 74 through which the metal passing down the tower 71 through passages 75 and 76 may be introduced at the bottom of the molten bath 77. It is to be understood that there may be more than one nozzle and that the nozzle may take various forms, sizes and shapes, in dependence upon the object that is to be produced. The molten metal is introduced directly into the bath. In the specific form shown there is a graphite plate 78, which may be heated by suitable electric means. This will serve to keep the nozzle clear and prevent freezing of metal at this point. To start the device, a rivet 79 or similar article may be put in the hole, and when a sufficient head of metal has been placed in the tower 71, the rivet 79 will be forced from the hole and will allow the passage of the metal upwardly through the molten bath 77. It is evident that many other means may be employed to control this opening, and that this is merely an example. The metal objects will cool at the top of the bath 77, such as at 80, and may be removed through the opening 81 in any suitable manner.

In Fig. 4 there is shown suitable apparatus for the formation of spherical objects when the specific gravity of the molten bath is reversed from that shown in Figs. 1 and 2 and is less than the objects being formed. The reference numerals applied to Fig. 4 are similar to that of Fig. 1 and designate corresponding parts. The metal to be shaped is poured into the tower 71 and will flow through the orifice 74 directly into the bath 77, and the formed articles will collect at point 80 and will be removed from the bath through 81. The graphite plate 78 is similar to that shown in Fig. 1. The molten bath in both instances may have suitable insulating means 82 to keep the bath at a suitable temperature to allow the desired spherical shape to be attained.

By the invention disclosed herein, a molten bath having a melting point lower than that of the metal to be shaped and immiscible therewith may be employed in the shaping of spherical metal objects directly from molten metal, thus eliminating much of the waste and large facilities used in previous methods. As this is the first time that a satisfactory method and apparatus has been developed for such a purpose, the invention is not limited to the details disclosed herein, but is to be construed as broadly covering all equivalent devices and processes falling within the scope of the appended claims.

What is claimed is:

1. In an apparatus for forming spherically shaped objects directly from molten metal, said molten metal having a melting point greater than 200° C. and an atomic volume less than 19, the combination comprising: a container for a bath of a second molten metal, said second molten metal being substantially immiscible with and having a substantially lower melting point and higher specific gravity than the first mentioned molten metal; means to introduce the molten metal to be shaped into the molten metal bath under a pressure such as to permit formation of globules so that the first mentioned metal will pass upwardly through the bath and, during such passage, will freeze at the interface of the metals and become spherical in shape.

2. In an apparatus for forming spherically shaped objects directly from molten metal, said molten metal having a melting point greater than 200° C. and an atomic volume less than 19, the combination comprising: a container for a bath of a second molten metal, said second molten metal being substantially immiscible with and having a substantially lower melting point and substantially lower specific gravity than the first mentioned molten metal; orifice means to introduce the molten metal to be shaped into the molten metal bath so that the first mentioned metal will pass downwardly through the bath and, during such passage, will freeze at the interface of the metals and become spherical in shape.

3. In an apparatus for forming spherically shaped objects directly from molten metal, said molten metal having a melting point greater than 200° C. and an atomic volume less than 19, the combination comprising: a container for a bath of a second molten metal, said second molten metal being substantially immiscible with and having a substantially lower melting point and a substantially different specific gravity than the first mentioned molten metal; nozzle means through which the molten metal to be shaped is introduced into the bath under a pressure such as to permit formation of globules so that said metal will pass through the bath and, during such passage will freeze at the interface of the metals and become spherical in shape.

4. In an apparatus for forming spherically shaped objects directly from molten metal, the combination comprising: a container for a bath of a second molten metal, said second molten metal being substantially immiscible with and having a substantially lower melting point than the first mentioned molten metal; apertured means through which the molten metal to be shaped may be introduced into the molten metal bath; temperature controlling means for said apertured means, said metal to be shaped passing through the bath and, during such passage, freezing at the interface of the metals and becoming spherical in shape.

5. In an apparatus for forming separate shaped bodies directly from molten metal, said molten metal having a melting point greater than 200° C. and an atomic volume less than 19, the combination comprising: a container for a bath of a second molten metal, said second molten metal being substantially immiscible with and having a substantially lower melting point and a substantially different specific gravity than the metal to be shaped; an orifice to introduce the molten metal to be shaped into the molten metal bath under such a pressure as to permit formation of the separate bodies so that the metal will pass through the bath; and means to remove the shaped bodies from said bath.

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