Oct. 7, 1941. J. H. BRENNAN 2,257,878

PRODUCTION OF METAL SHOT

Filed April 11, 1939

Fig. 3.



Fig. 2.

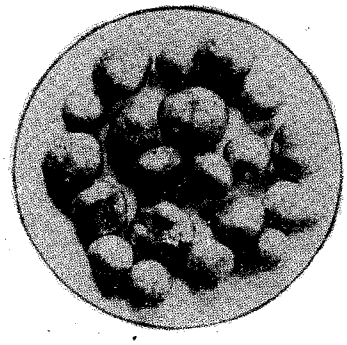


Fig. 1.



Fig. 4.

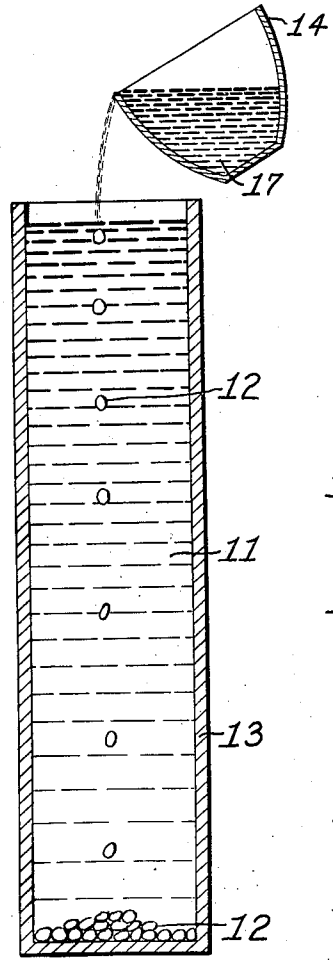
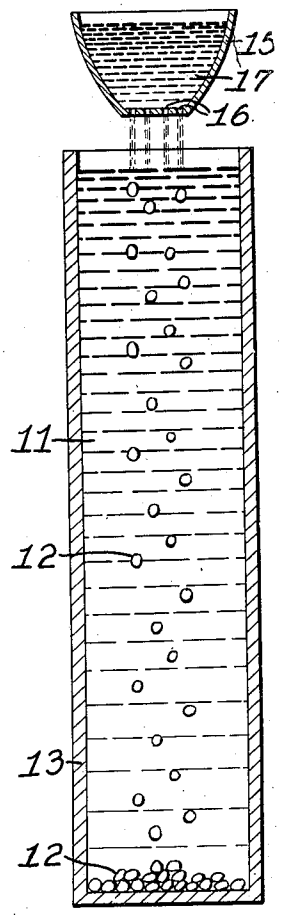


Fig. 5.



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PRODUCTION OF METAL SHOT

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Application April 11, 1939, Serial No. 267,249

3 Claims. (Cl. 83—91)

The invention relates to the production of metal shot and particularly to a method of producing shot from iron groups (iron, cobalt, nickel) metal alloys containing a large proportion of chromium, which latter element enhances the hardness and corrosion resistance of such alloys. Herein and in the appended claims the term "shot" includes not only small spheres, but also small spheroids, discs, buttons, and small pieces in other shapes having a generally rounded contour predominantly free from sharp projections.

Although many metals and alloys may be formed cheaply and simply into small, solid spheroids by pouring the molten metal in a uniform and continuous stream into water or other similar cooling medium, attempts to manufacture satisfactory shot from alloys containing a large proportion of chromium, by this and analogous methods have heretofore been unsuccessful. The particles so produced, instead of being in the form of solid spheroids of the alloy, are sometimes hollow and nearly always have needle-sharp spines or spikes projecting from the surface. These spines are a source of danger to those handling the material.

A principal object of this invention is to provide a simple and efficient method of producing solid and otherwise satisfactory shot from alloys containing a large proportion of chromium. The manner in which this and other objects are attained by the invention will be apparent from the following description and drawing.

In accordance with the present invention, shot which are solid, regular in shape, and predominantly free from spines and spikes are manufactured in a simple manner from alloys containing not only a substantial proportion of chromium but also a small proportion of aluminum, the aluminum being present in a proportion sufficient to impart good "shotting" characteristics to the alloy but insufficient to affect detrimentally other desirable properties of the alloy. The aluminum is suitably present in a proportion between 0.02% and 0.80%, preferably between 0.10% and 0.25%, of the alloy.

The invention is advantageous in the production of solid and otherwise satisfactory shot from alloys containing chromium in excess of 5%, with or without one or more metals of the group consisting of tungsten, molybdenum, and vanadium in a proportion up to about 40%, carbon in a proportion up to about 3.5%; remainder metal of the iron group consisting of iron, cobalt, nickel and mixtures thereof. It is of particular benefit in producing shot from alloys of the "Stellite" type comprising 15% to 40% chromium; tungsten, molybdenum or mixtures thereof in a proportion between 4% and 40%; carbon in a proportion up to about 3.5%; with or without vanadium in a proportion up to about 10%; remainder cobalt which may be partially replaced by iron or nickel or both.

Fig. 1 illustrates typical shapes which are produced when attempts are made to shot an alloy containing a large proportion of chromium by ordinary methods.

Fig. 2 illustrates the satisfactory shot produced from an alloy of similar chromium content when aluminum is present within the limits of the invention.

Fig. 3 illustrates the effect of too much aluminum on the shapes of shot of alloy otherwise similar in composition to that shown in Figs. 1 and 2.

Fig. 4 is a sectional view of an apparatus suitable for producing shot from a molten alloy.

Fig. 5 is a sectional view of a modified form of the apparatus shown in Fig. 4.

A simple and inexpensive procedure which I prefer for "shotting" the alloy and which I have found to produce shot of excellent characteristics is to pour the molten chromium alloy containing aluminum within the limits specified above, in a thin, uniform stream into water or other suitable quenching liquid. In a specific instance, about 0.12% aluminum was added to a molten chromium-tungsten-cobalt alloy containing about 30% chromium, 6% tungsten, remainder mostly cobalt. The aluminum was added at or near the end of the heat to minimize the loss of aluminum by oxidation. As illustrated in Fig. 4, the molten alloy 17 was then poured in a uniform stream from a crucible 14 into a container 13 containing water 11, from a height about one inch above the surface of the water 11, sufficient depth and volume of water 11 being employed to form the molten alloy 17 into shot 12 and to chill the shot 12 thoroughly before they reached the bottom of the container 13. In "shotting" the alloy in this manner, the temperature of the molten alloy 17 and the distance through which it falls before striking the water 11 are important factors in determining the shape of the product or shot 12, and usually must be determined empirically.

In an alternative procedure, illustrated in Fig. 5, the molten alloy 17 containing aluminum within the limits specified above may be poured through a refractory container 15 having a plurality of openings 16 in the bottom thereof. The

molten alloy 17 is caused to flow by gravity through the openings 16, thereby forming several uniform streams of said alloy which, upon subsequent introduction into the water 11, are formed into shot 12.

Shot produced in either of the foregoing ways, when aluminum is present in the alloy within the limits of this invention, are similar to those illustrated in Fig. 2. Such shot are solid, regular in shape, and are free from sharp spines or spikes such as those which characterize the shot produced from a chromium alloy containing no aluminum (illustrated by Fig. 1) or from a chromium alloy containing a larger proportion of aluminum than that within the invention (illustrated by Fig. 3).

The addition of aluminum to chromium alloys in accordance with the invention is particularly advantageous in manufacturing shot from wear resistant cobalt-chromium-tungsten alloys of the "Stellite" type. However, the invention is also applicable to the manufacture of shot from other alloys containing a large proportion of chromium.

The invention is not limited to the particular methods herein disclosed for "shotting" the molten alloy. The molten alloy may be poured through a single opening or plurality of openings and may be rapidly cooled in any suitable medium. It seems probable that the aluminum exerts a beneficial effect on the surface tension characteristics of the alloy so that, regardless of the method of pouring and chilling employed, the alloy tends to form regular well-shaped pellets or spheroids.

I claim:

1. In the method of producing shot by dropping into a cooling fluid a stream of molten alloy of iron group (the group consisting of iron, cobalt, and nickel) metal with 5% to 40% chromium which promotes the formation of undesirable, sharp spines on the shot, the improvement which comprises adding to the said molten alloy to be dropped between 0.02% and 0.8% aluminum which counteracts the spine-promoting effect of the chromium.

2. In the method of producing shot by dropping into a cooling fluid a stream of molten alloy of iron group (the group consisting of iron, cobalt, and nickel) metal with at least one metal of the group consisting of tungsten and molybdenum in an aggregate percentage between 4% and 40%, and with between 15% and 40% chromium which promotes the formation of undesirable, sharp spines on the shot, the improvement which comprises adding to the said molten alloy to be dropped between 0.1% and 0.25% aluminum which prevents the formation of said spines.

3. Smooth, spine-free dropped shot composed of an alloy consisting substantially of iron group (the group consisting of iron, cobalt, and nickel) metal, at least one metal of the group consisting of tungsten and molybdenum in an aggregate percentage between 4% and 40%; between 15% and 40% chromium which imparts sharp spines to dropped shot; and between 0.1% and 0.8% aluminum which counteracts the effect of chromium in imparting said sharp spines.

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