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TIN-ZIRCONIUM ALLOY AND PROCESS OF MAKING THE SAME.

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To all whom it may concern:

Be it known that I, HUGH S. COOPER, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Tin-Zirconium Alloys and Processes of Making the Same, of which the following is a specification.

This invention comprises alloys of tin and zirconium, and processes of making the same. It includes also novel and useful mixtures of finely divided tin and zirconium in alloying proportions, and bodies of pyrophoric tin-zirconium alloy shaped to adapt them for use in igniters.

Tin and zirconium form alloys having very high melting points, probably above the melting point of pure zirconium. The alloys are pyrophoric to a high degree, especially when they contain more than about 40% zirconium, and are therefore adapted for use in igniters such as those which have heretofore employed cerium alloys.

Because of the very high melting points of tin zirconium alloys, and the avidity with which they unite with oxygen, it is desirable to avoid the necessity of remelting them. I have found that the alloy may be produced in suitable shapes, without remelting, by the following method:

Zirconium metal in the form of powder or laminæ, prepared for example by reducing anhydrous zirconium tetrachloride with metallic sodium, is carefully dried, for example by heating at 60°–80° C. for several days. In this finely divided form, the metal is very easily oxidized and tends to ignite spontaneously: to prevent this, it is preferable to evacuate the drying oven.

The thoroughly dry powder is then pressed into dies under heavy pressure. For example, a rod about ten inches long and one-fourth inch square may be subjected to a pressure of 50 to 60 tons applied in a transverse direction. The bodies formed by the method described are comparatively hard and strong.

The rods or the like are next heated in a bath of molten tin. This may be done by packing them in powdered tin in narrow vertical alundum tubes, or by placing them, surrounded by fragments of tin, in horizontal boats, and then heating in vacuo until the tin melts and alloys with the zirconium. If the tin is present in proper amount, it will be almost completely absorbed, and I have found that the pyrophoric properties are most strongly developed when tin is present in the alloy to the extent of 20% to 40%.

As the temperature is increased, there is a considerable evolution of heat between 700° and 1000° C., indicating a chemical reaction and alloyage of the metals. The heating is continued to a temperature of 1500° C. or above to permit the reaction to complete itself, and the furnace is then cooled and the shapes removed.

As an alternative, dry tin powder may be mixed with the thoroughly dry finely-divided zirconium in the proper proportions, and the mixture pressed into shapes as before. These shapes are then heated in vacuo to 1500° C. or above without surrounding them with tin. The evolution of heat takes place between 700° and 1000° C., as in the preceding example.

By the method described, the alloy can be formed into rods, blocks, discs, or any other shape required by a particular type of igniter without remelting the alloy, and without cutting it. It is only necessary to produce coherent bodies of zirconium of the size and shape desired, with or without the necessary tin, and then to cause the zirconium to combine with tin in a non-oxidizing atmosphere.

I claim:

1. An alloy composed of zirconium and tin, each element being present in a substantial amount.

2. A pyrophoric alloy containing zirconium and tin.

3. A pyrophoric alloy containing zirconium and 20% to 40% of tin.

4. An alloy composed of tin and more than 40% of zirconium.

5. Process of forming a zirconium-tin alloy which comprises heating zirconium in contact with tin at a temperature above 700° C.

6. Process according to claim 5 in which the zirconium and tin in finely divided state are mixed and pressed into compact form before heating.

7. Process of producing a zirconium-tin alloy in bodies of predetermined form,

which comprises pressing a material containing dry finely divided zirconium and tin into the form desired, and then heating the bodies at a temperature above 700° C., in absence of substantial quantities of oxygen.

8. A composition suitable for making pyrophoric alloys containing dry tin powder and dry zirconium powder in alloying proportions.

9. In a pyrophoric igniting device, a sparking element formed of a tin-zirconium alloy.

In testimony whereof, I affix my signature.

HUGH S. COOPER.