Patented May 12, 1936 2,040,078

UNITED STATES PATENT OFFICE

2,040,078

LEAD ALLOY

Robert H. Canfield and Herman F. Kaiser,
Washington, D. C.

No Drawing. Application November 8, 1933,
Serial No. 697,144

2 Claims. (Cl. 75—166)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

This invention relates to an alloy of lead and strontium. It has among its several objects to produce a composition of the type mentioned that will have desirable features of mechanical strength and hardness and resistance to disintegration when subjected to the action of an electric current while immersed in electrolyte.

Our invention is especially adapted for use in making grids for the plates of storage batteries although its usefulness is by no means limited thereto. Usually the grids of both the positive and negative plates of storage batteries are made of lead to which 5% to 10% of antimony has been added to impart the requisite strength and hardness. While the effect of the antimony is satisfactory in the respects mentioned, it has a number of disadvantages.

One such disadvantage is that the composition specified does not freeze into a homogeneous mass but first segregates crystals of lead which, if undisturbed, fall to the bottom of the melt. Finally, when the proportion of antimony in the still fluid portion of the metal rises to 13%, due to depletion of the lead by crystallization, the remainder of the melt freezes at constant temperature into an eutectic mixture of lead crystals and antimony crystals. It is apparent that under these conditions the finally solidified body has different compositions in different parts thereof. Further, due to the presence of free antimony, local action is set up between the lead and the antimony and this gradually destroys the grids. An additional undesirable feature is that the antimony of the positive grid is carried, during the process of charging, into the active material (spongy lead) of the negative electrodes where it produces local action and sulphation of the plate.

We have found that the alkaline earth metal strontium, in certain proportions, produces a desirable degree of hardness in lead and does not have the disadvantages connected with the use of antimony. It forms an insoluble sulphate and therefore is not present in appreciable amounts in the electrolyte and can not give rise to local action.

Useful hardening of the lead can not be obtained by means of this metal when it is present in the low percentages in which it forms solid solutions in the lead, but it forms precipitation-hardening alloys with lead. By this is meant that the hardness is obtained through a special heat treatment the theory of which follows:

This metal has a much higher solid solubility in lead at a high temperature, near the melting point, than its does at room temperature. When an alloy having a composition of about the percentages in which solid solutions are formed is slowly cooled to room temperature the original complete solidification is followed by the precipitation of minute crystals of an intermetallic compound of lead and the alloying metal within the body of solidified metal. The crystals so produced do not add significantly to the hardness of the lead. If, however, the same alloy is quenched suddenly from the high temperature, the atoms of the alloying metal are trapped in solid solution but still are not very effective in imparting hardness. If, following this quenching, the lead is allowed to age for several days either at room temperature, or perhaps better at a somewhat elevated temperature below the melting point, extremely minute and evenly distributed crystals of the compound are formed which, due to their small size and even distribution, impart a marked degree of strength to the alloy. For instance, 0.08% of strontium, added to pure lead gives an alloy which after quenching from 300° C. and aging for three weeks at 100° C. has a Brinell hardness of from 7 to 9 which is a desirable hardness for storage battery grids. We have found further that alloy so prepared and treated is not attacked by oxygen to an appreciably greater degree than the antimony alloys.

An alloy of lead containing 0.5% strontium and 0.2% tellurium is very resistant to intergranular corrosion, the presence of the tellurium at the grain boundaries rendering these regions more stable. The Brinell hardness of this alloy is 7.9 both before and after steam corrosion. In addition, the presence of tellurium lowers the solubility of gases in the melted alloy so that a casting is more free from blow holes due to bubbles of escaping gas than is a casting made with the alkaline earth metal and lead alone.

Alloys of lead with 0.04% to 0.20% strontium may be hardened by quenching from a temperature not far below the freezing point followed by aging at temperatures ranging from room temperature to somewhat below the melting point and are sufficiently resistant to corrosion to be suitable for storage battery grids and while the alloy is largely eutectic if as much as 0.5% strontium is used, it is still well adapted for that use. When tellurium is used the percentage of strontium may vary between 0.2% and 0.6% and the tellurium between 0.1% and 0.5%.

By the term "balance consisting substantially

of lead" is meant that elements other than lead in the portion so designated do not substantially exceed 1 per cent of the total alloy.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes, without the payment of any royalties thereon.

We claim:

1. An alloy comprising 0.04% to 0.6% strontium and the balance consisting substantially of lead, said alloy being characterized by even distribution of minute crystals of the alloy, a desirable degree of hardness, stability at the grain boundaries, low solubility of gases when in the molten condition and high resistance to intergranular corrosion and attack by oxygen.

2. An alloy comprising 0.04% to 0.6% strontium, 0.1% to 0.5% tellurium and the rest lead.

ROBERT H. CANFIELD.
HERMAN F. KAISER.